PROCEEDINGS

5. CONFERENCE AND EXHIBITION ON TELEVISION TECHNIQUES

Vol. I.

12—14 JUNE, 1990
BUDAPEST
HUNGARY

5.CONFERENCE AND EXHIBITION
on TELEVISION TECHNIQUES

organized by

the Scientific Society for Telecommunication,
the Budapest Regional Society of the MTESZ

supported by

the State Office for Technical Development /OMFB/
Ministry of Industrie

12-14. June, 199o
BUDAPEST
Hungary

Original texts have not been revised
Quality of printing is determined by photos,
diagrams,etc. given at our disposat

Chairman of the Organizing Committee:

Dr.Pál FERENCZY

Secretary:

Ferenc S.TÓTH

Members:

Dr.László FALUS
Ferenc FISTER
Géza KOROMPAY
Elek NEMCSICS
Dr.Gábor PRÓNAY
Sándor STEFLER
Gerő SZÁSZ
Dr.Károly G.TÓTH
János VARSÁNYI
László VOZÁK
János VÖLGYI

Administrative Committee:

Mrs.Ilona BULCSU
Miss Katalin MITÓK

Adress of Administrative Committee:

Scientific Society for Telecommunication
H-1372 Budapest, P.O.Box: 451

Cable Address:

5th CONFERENCE AND EXHIBITION ON
TELEVISION TECHNIQUES--Budapest

Telex: 22 5792 MTESZ-H, Budapest
Telefax: (36-1) 156 1215
Telephone: (36-1) 153 1027

TABLE OF CONTENTS

/Part One/

Pages

5. TV KONFERENCIA, BUDAPEST.

1990. június 12...14.

Az előadások szerzői, címei és rövid kivonatai magyar nyelven.

I. Szekció: TV stúdió-technika és rendszertechnika

1. J.P. CHAMBERS (GB): *Teletexten alapuló TV-műsor kijelölő szolgáltatás.*

A francia EPEOS rendszert, amely teletext felhasználásával biztosította a TV műsorok címkézését, 1975-ben ismertették. Az elgondolás lehetővé teszi a néző számára, hogy előre több műsort kiválasszon felügyelet nélküli rögzítésre és későbbi visszajátszásra. Az angol rendszerű teletextben való felhasználás céljára már 1980-ban definiáltak egy ilyen címkéző rendszert, de 1989 augusztusáig copyright akadályozta az angliai nyilvános szolgáltatás bevezetését. Az előadás ismerteti a Műsorszóró Szolgáltatás Adatcsomagnak (Broadcast Service Data Packet) az ilyen célra történő jelenlegi kísérleti felhasználását. Bemutatja, hogy mennyire leegyszerűsíthető teletext felhasználásával a műsorok kiválasztása. A hatásfok, megbízhatóság, rugalmasság és ennek és más EBU által rögzített rendszereknek a jövőbeni felhasználása ugyancsak szóba kerül az előadáson.

2. T. KIDA (JAPAN): *Helyzetkép az IEC szabványosítási munkáiról a TV és műholdas vevőkészülékek területén.*

A néző számára a vett TV vagy a DBS kép minősége attól függ, milyen jól működnek a vevő egyes fokozatai. Az IEC/SC12A/WG7 munkacsoportja egy egész sorozat nemzetközi szabványt dolgozott ki TV vevőberendezések műszaki jellemzőinek a meghatározására és a mérési módszerek leírására. Világszerte ezeket a szabványokat használják a vevőkészülék gyártók, a vizsgáló intézetek és a nemzeti minősítő hatóságok ezáltal biztosítják, hogy a vevő-berendezések a legjobbat nyújtják hangban és képben egyaránt. Az előadás összefoglalót ad a 12A/WG7 munkacsoportban végzett eddigi munkáról, a jelenleg folyó és a jövőben kidolgozásra váró témákról, azok hátteréről és az irányzatokról.

3. R. LONGMAN (GB): *Az angol televízió műszaki áttekintése: múlt, jelen és jövő.*

Az előadás összefoglalja azokat a főbb műszaki fejlődési lépcsőket, amelyek elvezettek 1936-ban a brit TV szolgáltatás beindításához. A továbbiakban leírja a későbbi technológiai fejlődés főbb állomásait, beleértve a színes adásoknak a 60-as években történt bevezetését. Végül kitekintést nyújt a TV műsorszórás műszaki jövőjére és megvizsgálja milyen hatással lesz a jelenlegi és a jövő technológiája a televíziózásnak az elkövetkező évtizedben várható fejlődésére.

4. R. BIMBALOV (BG): *IMB/XT kártya és software képmagnó műsorok feliratozására, felhasználva az új teletext integrált áramkört.*

A kifejlesztett feliratozó rendszer viszonylag olcsó és mindazoknak a rendelkezésére áll, akik ilyen irányú tevékenységet folytatnak. A rendszer fő részét az előadásban ismertett áramköri kártya képezi. A kártya bedugaszolható egy IMB PC/XT típusú személyi számítógépbe. A képfeliratok előállítására az SAA5243 típusú (EURO CCT) karakter generátor szolgál. Ez lehetővé teszi a több nyelven való feliratozást a megfelelő ékezetes betűk hibátlan kiiratásával. Mind a be-, mind a kimenet lehet akár összetett video jel (fehér felirat fekete háttér előtt), akár RGB jel (színes képaláírás). A nyomtatott áramköri lap vezérlésére kifejlesztésre került a kapcsolódó software, amely a következő funkciókat biztosítja: karakter készlet és képfelirat elrendezés megválasztása, felirat szerkesztése és felirat időzítése.

5. B. TICHIT (F): *Új irányzatok CCD stúdió kamerák területén.*

Az elmúlt néhány évben drámai módon javultak a félvezető alapú képérzékelők (CCD) műszaki paraméterei. A kezdeti technológiák, mint például a kép-átvivő (Frame Transfer, FT), és a sor-átvivő (Interline Transfer, IT) számos adatán sokat javítottak; az újabb technológiák pedig, mint például a kép-sor-átvivők (Frame Interline Transfer, FIT) már rendelkezésre állnak és ezáltal új felhasználások egész sora kerül előtérbe. Ma már újra kell tervezni a stúdió kamerákban alkalmazott jelfeldolgozást, hogy figyelembe lehessen venni ezeket az új CCD paramétereket; néhány jellemző, mint például a dinamika tartomány, vagy felbontás ma már sokkal jobb, mint amit a legkitűnőbb képfelvevő csövek tudnak...

II. Szekció: Video- és hangjelek átvitele

1. C. BALCHIN (GB): *NICAM 728 - a 90-es évek digitális TV hangja.*

Az utóbbi időben megnőtt az érdeklődés a sztereo és a kétnyelvű TV hang iránt. A Philips cég kifejlesztett egy teljes NICAM 728 vevő-megoldást akár TV, akár képmagnó számára, amely a CD-hez hasonló hangminőséget biztosít. Egy kettős D/A konverter (TDA1543) szolgáltatja a HIFI hangkimeneteket, amelyeket két különlegesen tervezett IC, a NIDEM (TDA8732) és a TDSD (SAA7280) vezérel.

2. TEMESI Á. (H): *A NICAM 728 rendszer és az első kísérletek Magyarországon.*

A TV műsorszórás fejlődése megköveteli a kiváló minőségű sztereo kísérő hang átvitelét. A földi műsorszórásban kezdetben e célra analóg eljárást alkalmaztak. Miután a kívánt minőséget így nem lehetett biztositani, szükségessé vált a digitális átvitel kifejlesztése. Több nyugat- és észak-európai TV társaság használja a NICAM 728 digitális hangátviteli rendszert a B/G, illetve I szabványnak megfelelő paraméterekkel. Az előadás áttekinti a 1989 szeptemberében lefolytatott magyar adás-kisérleteket, és összefoglalja azok eredményeit.

3. PÁLINSZKI A. (H): *TV jelek digitális átvitele (34 Mbit/s).*

Az előadás bemutat két kódolási eljárást színes tv jelek és kísérő hangműsorok átvitelére 34 Mbit/s adat sebességgel. Ismertetésre kerülnek az alkalmazott bit-redukciós eljárások és a felhasznált adaptív rendszerek.

4. H.E. HAASE (D): *Video- és hangjelek kiváló minőségű átvitele.*

Az a növekvő érdeklődés, ami a TV és hangműsorokhoz való korlátlan hozzáférést kíséri, valamint a közeljövőben várható új TV szabványnak a bevezetése megköveteli azt, hogy a stúdiótól valamennyi előfizetőig az egész átvitel igen jó minőségű legyen. Attól függően más és más az átviteli úttal szemben támasztott minőségi követelmény, hogy mekkora a távolság a stúdió és az egyes előfizetők között. Ez az előadás megmagyarázza azokat a szigorú követelményeket, amelyek az igen jó minőségű átvitelhez szükségesek. Ugyancsak hangsúlyozásra kerülnek azok az előnyök, amelyek digitális TV és hangátvitellel megvalósított optikai hálózatok felhasználásából fakadnak. Bemutatásra kerül egy egyetlen TV műsort átvivő gyakorlati rendszer, amely a legmagasabb minőségi igényeket is kielégíti, továbbá egy hasonló igényű sokcsatornás rendszerre történő javaslat is.

5. **HAJDER T. (H):** *Video-, hang- és adat-átvitel a "C" mikrohullámú frekvencia sávban.*

Olyan átviteli rendszer kerül ismertetésre, ahol a modulált jelet közvetlenül a kisugárzott vivőfrekvencián hozzák létre. A frekvencia modulált vivőt varaktorral hangolt oszcillátor hozza létre. Az oszcillátor frekvencia stabilitásáról mikrohullámú diszkriminátor gondoskodik, amely dielektromos tárcsa rezonátorral készült. Röviden bemutatásra kerül a vevő is, különös tekintettel a dielektromos tárcsával hangolt oszcillátor fokozatra. Végül sor kerül egy újonan kifejlesztett microstrip antenna és egy egyszerű paraboloid antenna ismertetésére.

6. **J.M. BARRIERE (F):** *Félvezetős UHF adók - a multi-technológiás eljárás egy része.*

A TV műsorszórás világa megpróbálja ötvözni a leghaladottabb technológiát a leggazdaságosabb megoldással. Úgy tűnik, a THOMSON-LGT -nek van e tekintetben mondani valója. Az utóbbi 20 év alatt részt vettünk tetródás és klisztronos adók fejlesztésében csakúgy, mint félvezetős adókéban, legutóbb a Klystrode† projekt keretében, közösen a COMARK amerikai leányvállalatunkkal. Az itt szerzett tudás sokat segíthet a műsorszóró cégek számára nyujtható megoldásokban. Az egyik ilyen multi-technológiás eljárás eredménye az, hogy ma bemutathatjuk az új THOMSON-LGT 5kW/10kW félvezetős adónkat, amely bizonyos fajta üzem esetén (24 óra/egyetlen adó) optimális megoldást nyújt mind üzemeltetésben, mind vásárlási árban, összehasonlítva a klasszikus, két adóval történő, teljes tartalékkal számoló megoldásokkal. Kihangsúlyoztuk azt a tényt, hogy nagyobb teljesítmények esetén más technológiák jobban adaptálhatók gazdasági célkitűzésekhez, mint a félvezető technológiák, feltéve, ha az egyedüli szilícium eszköz hatásfoka 30% körüli értéken marad átlagos képszint esetén.

7. **D.A. LAPRES (F):** *Többcsatornás, többpontú szétosztó rendszer.*

Az előadás ismerteti a többcsatornás, többpontú műsor - szétosztó rendszereket (Multi-point Multi-channel Distribution Systems, "MMDS"), taglalja kifejlődésük történetét, kifejti az előnyeiket ahhoz, hogy adott követelmények szerint hogyan kell kiválsztani a legmegfelelőbbet és egy konkrét és azonnali alkalmazást javasol, különös tekintettel az európai sajátosságokra.

8. BERCELI T. (H): *Optikai átvitel TV szétosztó rendszerekben.*

Állandóan növekvő igény mutatkozik TV szétosztó hálózatokban arra, hogy növeljék az egyidejűleg szétosztott TV műsorok számát. Erre a célra a jelenlegi hálózatok, amelyek szimmetrikus vonalakból és koaxiális kábelekből állnak, nem alkalmasak. Ezzel szemben igen nagy átviteli sávot tudnak biztositani az optikai fénykábelek. Ugyanakkor a félvezető lézerek igen nagy frekvenciával is modulálhatók és ezeket jó hatásfokkal tudják demodulálni a fotó-detektorok is. Így az optikai fénykábel akár 60-80 TV csatornát is át tud vinni. Az előadás a probléma rendszer és eszköz kérdéseivel foglalkozik. Bemutatásra és összehasonlításra kerülnek a különböző rendszer konstrukciók. Ismertetjük a félvezető lézerekkel és a fotó-detektorokkal szemben támasztott áramköri követelményeket. Megfontolásra kerülnek a torzítási és a zaj problémák is.

III. Szekció: Televízió adástechnika

1. BARTHA A. (H): *TV adóállomások telepítési kérdései.*

Az előadás megkísérli megvilágítani TV adók létesítésének probléma körét, elsősorban azon tapasztalatok alapján, amelyek a TV ismétlőállomás projektek kapcsán adódtak. Megvizsgálja az ellátási problémák lehetséges megoldási módjait. Áttekintést ad a magyarországi TV hálózat fejlődésének történetéről, a műszaki eszközök változásairól, és az elért eredményekről. Javaslatot tesz alternativ megoldásokra, figyelembe véve a különleges helyi feltételeket, különös tekintettel a sok helyütt már folyamatban lévő kábeltelevízió kezdeményezésekre. A demokrácia megerősödése a hely kiválasztását ugyancsak bonyolultabbá teszi. A kereskedelmi TV műsorszórás terjedése komoly kihívást jelent a korábbi monopol helyzethez képest és új gondolkodási módot kíván meg. Végül kitér az előadás a fejlődés várható tendenciáira.

2. TORMÁSI GY. (H): *Korszerű, nagyteljesítményű UHF TV adók műszaki-gazdasági vizsgálata.*

A legújabb fejlesztések eredménye alapján ma a félvezetős TV adók éppúgy rendelkezésre állnak, mint a jól ismert klisztronos és csöves típusú adók. Az előadás a félvezetős adók műszaki jellemzőivel foglalkozik. Tárgyalásra kerülnek a rendszer-technikai, megbízhatósági és teljesítmény felvételi kérdések, továbbá összehasonlításra kerülnek a félvezetős, a csöves és a klisztronos adók. Az adók jellemzőit megvizsgáljuk gazdasági szempontokból is. A beruházási költségeken túlmenően a fenntartási költségek jelentősebb szerepet játszanak.

3. RÓZSA I. (H): *Hatásfok növelésének lehetősége az UHF TV adók klisztronos teljesítmény végerősítőiben.*

Az előadás megvizsgálja klisztronok optimális hatásfokra való beállítását a sugár-paraméterek függvényében, multiplex tartalék rendszerben, NORMÁL HANG üzemmódban és bemutat egy számítási eljárást, amellyel a gyakorlatban meghatározható a munkapont. Ugyancsak ismerteti a konstans perveanciával történő munkapont változtatást, amely még jobb hatásfokot eredményez, továbbá bemutatja a meglévő TV adók sugár tápegysége rekonstrukciójának a gyakorlati lehetőségeit.

4. JÁSZ G. (H): *A budapesti mikrohullámú műsorszétosztó rendszer.*

A budapesti Központi Műsorvevő és Szétosztó Rendszer a műholdas televízió műsorszórás kezdeti idejében jött létre a Magyar Posta kezdeményezésére abból a célból, hogy a budapesti nagy szállodákat ellássák műholdas műsorokkal. Időközben a rendszer által biztosított műsorválaszték bővült és a csillag-pontos szétosztó rendszert felváltotta egy egész területet ellátó átviteli mód. Az előadás ismerteti a szétosztó rendszer rendszer-technikáját, a felületi besugárzás antenna rendszerét és az eddig nyert vételi tapasztalatokat.

IV. Szekció: Kábeltelevízió

1. S.I. BÍRÓ (USA): *12 év tapasztalata az amerikai CATV típusú kis földi állomások tervezésében és telepítésében.*

Az amerikai kábeltelevíziós iparágat szolgáló kis földi állomások tervezésének és létesítésének újdonságairól való beszámoló kötetekre rúgna, nemhogy beleférne egy alig húsz perces előadást lefedő néhány oldalnyi gépelt szövegbe. A hiradástechnika történetében példa nélkül áll az a fejlődés, ami a műholdas vevőantennák, kis zajú erősítők, koaxiális kábelek, passzív eszközök, vevők, titkosító/megfejtő berendezések, jelfeldolgozók és ellenőrző berendezések terén létrejött 1975 óta. Az előadás három területet válszt ki a fenti témák közül: több-nyalábos antennák, a műszaki adatok ellenőrzése és interferencia kiküszöbölése. A szerző ezeken a területeken meglehetősen bő tapasztalatokat szerzett.

2. F.J. SCHULZ (CH): *A zürichi nagy CATV rendszer és Svájc legújabb CATV rendszere Baselben.*

A Nagy-Zürich területén létesített kábeltelevízió rendszernek 330 ezer előfizetője van, ezeket mind egyetlen fejállomás látja el egy bonyolult kisfrekvenciás törzskábel rendszeren át. Több, mint 50 láncba kapcsolt erősítőt használ a rendszer. Az előadás részletesen ismerteti a sok-vételi lehetőséggel rendelkező fejálllomás kiépítését, beleértve a csatorna feldolgozó rendszereket is. Basel városa Franciaország, Németország és Svájc közös érintkezési pontján helyezkedik el, mindig kiváló vételi lehetőségekkel birt, így ott kábeltelevízió rendszernek a kiépítése nem volt sürgős. A műholdas vétel által biztosított számos új csatorna megjelenésével, továbbá a hatóságoknak attól a kívánságától vezérelve, hogy egy modern, egész városra kiterjedő rendszert hozzanak létre, elkezdődött Svájc legújabb kábeltelevíziós rendszerének a kiépítése. A koncepció szerint fénykábellel oldják meg a törzs-kábel kialakítását, amire számos ponton VHF szétosztó rendszer kapcsolódik. Az előadás részletesen ismerteti az OVID 4 jelű optikai átviteli rendszert.

3. R. BINES (Israel): *Kábeltelevízió hálózatok. - izraeli megoldás a műsorszórás modernizálására.*

Az évszázad utolsó évtizedének hajnala az izraeli műsorszórásban egy új korszak kezdetét jelzi. A következő egy-két hónapban befejeződnek azok a kábeltelevízió hálózatokra kiírt versenytárgyalások, amelyek célja egész Israel kábellel történő lefedése és kihirdetik az utolsó, még függőben lévő négy körzet elnyerőjének a nevét abból a 31-ből, akik résztvettek e pályázaton. Ehhez a fő projekthez csatlakozik most a Kettes Csatorna, amelyről a parlament döntött 1990 januárjában. Amíg az első projekt esetén a verseny tárgyalások már a végéhez közelednek, a második esetében csak most kezdődnek, és előreláthatólag egy és fél év kell ahhoz, hogy befejeződjenek. Az előadás áttekintést igyekszik adni e kábeltelevízió vállalkozások részleteiről, e szakma jelenlegi szintjéről, annak múltjáról, jelenéről és jövőjéről, a különböző nyertes cégek által megvalósítandó megoldásokról, a Hírközlési Minisztérium és a Kábeltelevízió Tanács tevékenységeiről. Ugyancsak szó esik irányelvekről és azokról az első lépésekről, amelyeket a hiradástechnika ezen területén a Magyar Posta és az izraeli Hírközlési Minisztérium közösen tervez.

4. S. D'AGOSTINO (B): *Kábeltelevízió ellenőrző rendszer.*

A CATV hálózati rendszerek rövid áttekintése után az előadás ismerteti az ellenőrző rendszert. Kitér a követelmények, a felépítés, a megvalósítás és az alkalmazások kérdés- csoportjaira is.

5. SCHÉDER T. (H): *Kábeltelevízió rendszerek kis falvakban.*

A kábeltelevízió rendszerekkel szembeni érdeklődést jelentősen növelte a műholdas TV műsorszórás megjelenése. A kis települések eddig hátrányban voltak a nagyobb városokkal szemben. Az előadás egy már létező rendszert példának véve illusztrálja a kábeltelevízió rendszerek lehetséges kiépítéseit, valamint azok különlges műszaki megoldásait. Külön hangsúlyt kap a rendszer tervezés, amely ilyen esetben eltér a megszokottól. Szó esik az elektromos teljesitmény ellátás nem mindennapi módjáról, továbbá annak a biztonságra való kihatásáról. Végül vizsgálat tárgyát képezi az, hogy a rendszer mennyire alkalmas VHF, ill. UHF sávokban történő alkalmazására.

6. M. HEGENDÖRFER (D): *Műhold vétel - fogyasztói nézőpontból.*

Az előadás ismerteti az egyéni és a közösségi műholdas vétel problémáit, különös tekintettel a fogyasztó érdekeire. Részletesen vizsgálja mind a kültéri, mind a beltéri egységgel szemben támasztott felhasználói elvárásokat és a készülékek kezelési egyszerűségét, illetve bonyolultságát.

7. **STEFLER S. (H):** *A szélessávú ISDN és a kábeltelevízió.*

Mialatt egyre gyakrabban lehet hallani többszolgáltatású kábeltelevízió rendszerekről, azok egyre gyakoribb megvalósításairól, a professzionális híradástechnikai cégek és hálózatot kiépítő társaságok igen szorgalmasan dolgoznak az integrált szolgáltatású digitális hálózatokon (ISDN). Jóllehet ezek elsősorban beszéd és telematikai információk átvitelére szolgálnak, az ISDN szélessávú változata (ú.n. B-ISDN) ugyancsak fejlesztés alatt áll. Ennek a rendszernek a hálózati filozófája és néhány terminológiai kérdése képezi az előadás tárgyát, beleértve azokat az utalásokat, amelyek a B-ISDN és a CATV egymáshoz képesti viszonyára vonatkoznak.

8. **SOLTI M. (H):** *Adatátvitel kábeltelevízió hálózatokon.*

Kábeltelevízió rendszerekben önként kínálkozik olyan többcsatornás kis- és közepes-sebességű adatátvitelnek a lehetősége, amely egy viszonylag keskeny frekvencia sávot használ (néhány MHz-et), és amely úgy csatlakozik a sokcsatornás video átvitelhez, hogy azt semmi módon nem zavarja. Az előadás áttekinti az átvitel kiépítését, valamint a kiinduló paramétereket (szint és frekvencia adatokat), amelyek a hálózat tervezéséhez szükségesek, továbbá analizálja az interferencia és egyéb zavar problémákat, és végül ajánlásokat ad az adatátvitel megbízhatóságának a javítására.

9. **SOLTI M. (H):** *Kábeltelevíziós minitrunk erősítők.*

Magyarországon a kábeltelevízió rendszerek törzs hálózata csak kvázi ideális: két szomszédos trunk erősítő között legalább 3, vagy 4 leágazás van (iránycsatoló). Ezért a tetőesés és szint értékek elméletileg eltérnek az ideális hálózat tervezési értékektől és a 450 MHz-es rendszerek pontosabb kiegyenlítést kívánnak meg. Az előadás megvizsgálja az olyan törzsvonali konstrukciónak az előnyeit, amelyben 3-5 kézileg beállítható minitrunk erősítő helyezkedik el két szomszédos, viszonylag nagy üzemi erősítésű PLTC törzsvonali erősítő között. A minitrunk erősítők használatából nyerhető előnyök hálózat tervezési példák kapcsán kerülnek illusztrálásra.

10. **R. KOCHAN (D):** *Interaktív szolgáltatásokat biztosító kábeltelevízió rendszerek koncepciós kérdései.*

Egészen napjainkig a kábel TV hálózatokat csak TV és FM programok szétosztására használták. Abból a célból, hogy tetszetősebbé tegyék a rendszert az előfizetők számára, valamint azért, hogy a kábel-TV-társaságok is nagyobb jövedelemhez jussanak, egyre több és több új műsor kerül szétosztásra. A műsor és csatorna kapacitás azonban korlátos a kábel TV (450 MHz) hálózatokban. A további jövedelem növelés céljából a kábel-TV-társaságoknak meg van a lehetőségük új interaktív, érték növelő szolgáltatások bevezetésére. Az előadás ennek a probléma körnek szentel megkülönböztetett figyelmet és ismerteti az e téren kialakult nemzetközi helyzetet.

11. G. KREUTZ (B): *Kábeltelevízió és CATV-kábelek Belgiumban az elmúlt 20 évre visszatekintve.*

1961-ben Belgiumban épült fel az európai földrészen az első nagyközösségi kábeltelevízió rendszer. Az igazi CATV áttörés 1968-ban kezdődött, aminek eredményeképpen Belgium lett a világon a legjobban "bekábelezett" ország. Sok különböző kábel konstrukció került alkalmazásra. Ez az előadás ismerteti a legfontosabb kábel jellemzőket és azok viselkedését hosszútávú gyakorlati tapasztalatok alapján. Végezetül a CATV-csatlakozókkal kapcsolatos néhány megfontolással zárul az előadás.

12. H. GOUNY (F): *VHF-UHF kábeltelevízió hálózatok.*

A video-kommunikáció terén mutatkozó irányzatok a hagyományos VHF hálózatokat elavulttá tették; a megnövelt sávszélességek használata irányában kialakult tendenciák új kábel hálózati architektúrákhoz vezettek. Az előadás mérlegeli ezeknek az új architektúráknak az előnyeit és hátrányait.

V. Szekció: Televízió vételtechnika

1. FERENCZY P. (H): *Új stratégia az ECCT teletext dekóder IC vezérlésére.*

Európában kezd elterjedt gyakorlattá válni a teletext adatszórásban az ú.n. kiegészítő packetek alkalmazása, különösen azokban az országokban, ahol a nemzeti karakterkészlet sokfajta ékezetes betűt használ. Az első generációs teletext dekóderekkel való összeférő üzem megtartása céljából külön figyelmet kell szentelni az új dekóderek vezérlő software-ének kialakításakor arra, hogy a megjelenített teletext oldal mentes legyen a villogó ékezetektől. Ez ugyanis elkerülhetetlen, ha az X26 packet feldolgozása hagyományos módon történik. Az előadás ismerteti azt az új program stratégiát, amely nem csak ezt a problémát oldja meg maradéktalanul, de egy sor további kényelmi szolgáltatást is nyújt a teletext magazint olvasó TV nézőknek.

2. M. ROBERTS (GB): *Új fejlemények a teletext világszabványban (WST).*

Az előadás bemutat egy új teletext dekóder családot és kifejti azok várható piaci hatását is. Rámutat a WST-et és a vevőkészülék gyártókat érintő problémákra is. Ugyancsak körvonalazza az előadás a WST technológia új piaci területeit.

3. TAKÁCS L. (H): *A VIDEOTON digitális TV készülék családja.*

Az innovációs tervek keretében a VIDEOTON, az ITT digitális TV rendszerére építve, megvalósította a digitális TV vevő fejlesztés és gyártás műszaki és technológiai feltételeit. A cél olyan TV vevő konstrukció kialakítása volt, amely figyelembe veszi a piaci érdekeltséget és a VIDEOTON ambícióit. Az alsó kategóriájú készülékek céljára egyetlen digitális TV vevő kerül kifejlesztésre. A közép és felső kategóriájú vevők céljára olyan konstrukció születik, amelynek egyik változata alkalmas S-VHS jelek fogadására és feldolgozására is. Bár a készülék több modulból épül fel, a különböző modulok ugyanahhoz az anya-laphoz tudnak csatlakozni. A továbbfejlesztés lehetőségét így az új modulokkal lehet biztosítani.

4. VITVERA L. (H): *Az ORION színes TV fejlesztési koncepciója.*

Az ORION mérnökeinek az a meggyőződése, hogy a magyarországi színes TV gyártás első szakasza befejeződött. Kezdetben mind a technológiát, mind a teljes konstrukciót a SEL cégtől vették meg. A piaci követelményeknek megfelelően a konstrukciót lépésről lépésre megváltoztatták, de a 10 éves alap-készülék megköti a fejlesztők kezét. Az az általános irányelv, hogy azonos alapra épüljenek a készülékek, mind máig sikeres volt. Nem szabad ugyanis elfeledkezni arról, hogy a hazai igény, az évi kb 320 ezer TV vevő nem elég nagy darabszám ahhoz, hogy egyidejűleg túl sok típust tudjanak gyártásban tartani. Az előadás ismerteti a konstrukcióval kapcsolatos kialakult álláspontot és néhány érdekesebb áramköri részletet is bemutat.

5. HALMAI T. (H): *A D2-MAC dekóderek fejlesztése az ORION-ban.*

Napjainkban nagy az igény az egyre tökéletesebb TV műsorszórásra. Ez az oka annak, hogy a D2-MAC/packet szabványt kifejlesztették az EUREKA program keretében. Bár ezt a kódolási eljárást már két DBS műhold is alkalmazza, a szükséges dekóderek még nem kaphatók kiskereskedői forgalomban. Ez az oka annak, hogy a D2-MAC dekóderek fejlesztő munkái elkezdődtek az ORION-ban. Ezidőszerint két önállóan működő típusú dekóder fejlesztése már befejeződött. Mindkettő az ITT DIGIT 2000 integrált áramköri készlet eleméből van kialakítva. Az előadás bemutatja e két dekóder főbb áramköri megoldásait, továbbá ismertetésre kerülnek a mikroprocesszor vezérlő programjának fontosabb részletei, amely utóbbi ugyancsak az ORION-ban készült. A program különlegessége a "szolgáltatás azonosítás csatorna" adat-feldolgozása.

6. J. BLINEAU (F): *Második generációs, feltételes hozzáférésű TV rendszerek.*

Az elmúlt néhány évben számos országban drasztikusan megnőtt a TV műsorok száma és sokrétűsége és ez a növekedés tovább folytatódik. E műsorok legtöbbjét műhold segítségével igen nagy területekre sugározzák és több kábel rendszereken át is folyik ezek terítése. Ez az új helyzet a néző-tábor hatásos ellenőrzésének kérdését is felveti, hiszen a szolgáltatást nyújtóknak meg kell kapniok az előfizetési díjakat, illetve biztosítani kell a copyright és licensz kérdések tiszteletben tartását. A kezdeti feltételes hozzáférést biztosító rendszerek sokat szenvedtek a kalóz vételek miatt, főleg e titkosító rendszerek egyszerűsége miatt. Ma már egy új generációs megoldás van kialakulóban, amely két, egymást kiegészítő technika jelenlétén alapszik: az egyik a sor-forgatáson alapuló jelkeverés, amit a fogyasztói elektronikába bevonuló digitális jelfeldolgozó áramkörök tesznek megvalósíthatóvá, míg a másik a nagyteljesítményű biztonsági processzorok, amelyek titkos funkciókat tartalmaznak és segítségükkel minden fogyasztó egyedileg címezhető. Az előadás az új koncepció ismertetését tartalmazza, amit mind PAL/SECAM, mind MAC/packet rendszerekben történt megvalósítás leírása követ.

7. D. SCHULZ (D): *Üzenet az égből: a moduláris kiépítésű TVRO gyártmány választék, különböző európai műsorok vételére.*

Bár a műholdas TV műsorok nézőinek igen eltérő kívánságai lehetnek, de mindig van egy olyan, csak vételi célt szolgáló TV vevő-összeállítás (TVRO), amely megfelel az elvárásoknak. Abból a célból, hogy lefedésre kerüljön minden várható felhasználási variáció, olyan gyártmányokra van szükség, amelyek kombinációi olcsó, ugyanakkor a kor technológiai szintjének megfelelő TVRO kiépítését teszik lehetővé. A FUBA cég által gyártott moduláris TVRO rendszer minden egysége úgy lett kialakítva, hogy az egyedi alkatelemek mind mechanikai, mind elektromos csatlakoztatása megoldott, ezáltal azok bármilyen kombinációban probléma nélkül illeszthetők egymáshoz. Olyan részek pedig, amelyek illeszkednek - a szó igazi értelmében modulárisak.

8. A. NEELEN (NL): *Integrált áramkörök műholdas TV vétel céljára.*

Az előadás azokat az új integrált áramköröket mutatja be, amelyeket műholdas TV jelek vételére lehet felhasználni, függetlenül a műsorszórásra felhasznált szabványtól.

9. J.C. GUILLON (F): *Több-formátumú, több-szolgáltatású, 16:9 képméretarányú TV vevő.*

Az előadás bemutat egy új TV vevőt, amely alkalmas HDTV forrásból származó jel megjelenítésére. Ezt az új, 16:9 képméretarányú képcső, egy 31,5 kHz sorfrekvenciájú eltérítő rendszer és egy 31,5 kHz peri-TV csatlakozó teszi lehetővé. E néhány HDTV-vel kapcsolatos tulajdonságon túlmenően a vevő alkalmas a hagyományos TV műsorképek minőségének a megjavítására is, mivel tartalmaz sorfrekvencia konvertert, adaptív PAL fésűszűrőt és dinamikus kontúr élesítőt (DCC). A hagyományos 4:3 képméretarányú képet úgy jeleníti meg, hogy módosítja a képek vízszintes és függőleges méreteit. A vevő természetesen fel van szerelve a mai csúcs vevők minden ismert kiegészítésével (műholdas vétel hangolóegysége, D-MAC/ D2-MAC dekóder, kép-a-képben

/PIP/, teletext, több peri-TV csatlakozó, ...).

10. Y.A.DOLGIKH - J.V.KOVSHEV - V.M.PODGEATSKII - O.R.KHROLOVA - A.S.TSAPRILOV (SU):

Folyadék fényszűrők vetítős TV vevőkhöz.

Vizsgálat tárgyát képezte az az optimalizálási folyamat, amelynek célja azon folyadék fényszűrők összetételének kialakítása, amelyek a vetítős TV-ben használt katódsugárcsövek vörös, zöld és kék foszfor rétegéről kibocsájtott fényt szűrik. A fizikai hőtan, a korróziós paraméterek és a szerves oldók oldási készsége került összehasonlításra és ugyancsak megvizsgálták a festőanyagok spektrális lumineszcens paramétereit. A mért hő- és fotostabilitás anyagaiból, valamint a tényleges festőanyagokkal készített katódsugárcső kísérletekből levonható végeredmény három különböző típusú fényszűrő összetételt eredményezett.

11. Y.A.DOLGIKH - A.A.KAZAKOV - V.M.PODGEADSKII - A.S.TSAPRILOV (SU):

Önálló folyadék hűtő rendszerrel rendelkező, nagy fényerejű, nagy stabilitású, vetítős katódsugár csövek.

Kifejlesztésre kerültek önálló folyadék hűtő rendszerrel bíró vörös, zöld és kék lumineszcenciájú, vetítős rendszerű katódsugár csövek. A különböző színű lumineszcens csövek számára három fajta folyadék hűtő került kifejlesztésre a hűtés céljára. Fgy elasztikus membrán került felhasználásra a hőtágulás kiegyenlítésére. A fény szűrő-hűtőknek kicsiny a viszkozitásuk és ugyanakkor nagy az üzemi hőmérséklet tartományuk. A fényszűrők alkalmazása lehetővé teszi katódsugárcsöves képernyők színkoordinátáinak a javítását.

12. MARCZIN GY.- MÉSZÁROS S. (H):

Óriás méretű megjelenítő képernyő a Bécs-Budapest világkiállításon.

A szerzők javaslata szerint egy színes TV kompatibilis gigantikus méretű képernyő lesz felállítva az 1995-ben esedékes Bécs-Budapest világkiállítás alkalmából. Az előadás bemutatja a képernyő konstrukcióját és azokat a katódsugár csöveket, és vezérlési módjukat, amelyek RGB színes sávokat használva alap fényforrásként szolgálnak.

VI. Szekció: Új irényzatok a televízió technikában

1. Á. TÓTH (USA): *Nagyfelbontású televízió - gondolatok az északamerikai bevezetéséről.*

Az előadás igyekszik feltárni azokat a hajtó erőket, amelyek a HDTV amerikai bevezetését szorgalmazzák és vizsgálja a lehetséges bevezetési elképzeléseket. Leírja a teljes HDTV rendszer épitő elemeit. Kihangsúlyozza az NTSC-vel való összeférés fontosságát és egyetlen közös HDTV alapsávi jel-paraméter értékrend szükségességét valamennyi műsor terítő rendszerben. Az előadás ismerteti a HDTV fogyasztói TV vevőrendszer jellemzőit az NTSC-hez viszonyítva. Kifejti, hogy ezek az új vevők fel lesznek szerelve integrált szolgáltatások nyújtására, és több-bemeneti lehetőség biztosításával alkalmasak különböző átviteli médiák, továbbá egy sor műsorszóró és távközlő szolgáltatás fogadására. Végül az előadás röviden taglalja a televízió hoszútávú lehetséges fejlődési irányait.

2. M. ARTIGALAS (F): *EDTV-től a HDTV-ig.*

Gazdasági okoknál fogva az EDTV (Megnövelt Felbontású TV) a 16:9 képméretarányával és azzal a minőségi szintjével, amely ezt a szolgáltatást a jelenlegi és a jövő nagy felbontású TV rendszere közé sorolja, már úton van a megvalósulás felé. Az EDTV nem fogja helyettesíteni a HDTV-t, de megenged egy olyan átmenetet, amely összefér mind a műsorgyártók, mind a műsorszórók pénzügyi problémájával. Ma a hagyományos TV műsorgyártásnak különböző szintjei léteznek. Nagyon valószínű, hogy hasonló lesz a helyzet a jövőben a HDTV-vel is. Hasonló képpen különböző szabványú műsorokat fognak sugározni a megfelelő vételre kialakított fogyasztói TV vevők részére EDTV szabvány szerint 90-95 -ben, HDTV szabvány szerint 95-ben. A műsorgyártási és műsorszórási területek ilyen fajta összeférő és fokozatosan kifejlődő megközelítése tűnik a legígéretesebbnek a HDTV felé vezető úton azáltal, hogy hatalmas fogyasztói piacot teremt mind a műsorgyártók, mind a műsorsugárzók számára.

3. T. SOMOGYI - L. VAN EYCCKEN - A. OOSTERLINCK (B):

HDTV jelek digitális kódolása szétosztó hálózatokon való átvitel céljából.

Az előadás első része rövid áttekintést ad a HDTV-ről, annak fokozatos fejlődéséről egészen napjainkig. Ismerteti azt a két, az analóg műholdas műsorszóró láncon való átvitelre kialakult fő rendszert, a MUSE és a HD-MAC eljárást, amelyet Japánban, illetve Európában szándékoznak bevezetni. Az előadás második része a HDTV jelek digitális kódolásával foglalkozik: bemutatásra kerül a Leuven Egyetemen fejlesztés alatt álló hierarchikus kódolási terv. Megtartva a folyamatos letapogatás előnyeit, a kódolási eljárás lehetőséget biztosít alacsonyabb minőségi szintű képjelekhez való hozzáféréshez is, amely utóbbiak továbbíthatók kisebb adatsebességek mellett is.

4. B. TICHIT (F): *A 4:2:2 digitális szabvány - a fejlődés kulcsa a nagy felbontás felé vezető úton.*

Az előadás először ismerteti a TV szabványok kialakulását

- az összetettől az összetevőkig,
- az analógtól a digitális összetevőkig,
- a párhuzamostól a soros digitális összetevőkig.

A soros digitális összetevők szabvány előnyeit taglalja, bemutatva a flexibilitásban, egyszerűségben és minőségi jellemzőkben mutatkozó javulásokat. Ezen túlmenően a 4:2:2 szabvány további előnyökkel is jár: új lehetőségeket nyit meg, felajánlva az EDTV használatát is 16:9 képméret aránnyal. Az előadás bemutatja a TV gyártási szabvány kifejlődését, továbbá, hogy a 4:2:2 digitális szabvány használata hogyan oldja meg az összeférés kérdését a jelen szabvány és a jövő EDTV és HDTV szabványai között.

5. B.J. LECHNER (USA): *Továbbfejlesztett TV rendszerek az USA-ban. - Helyzetkép.*

Nagy igyekezettel folyik a munka az USA-ban abból a célból, hogy kiválasszák azt a szabványt, amely a földi TV műsorszórásban lehetővé teszi egy Haladó TV Rendszernek a bevezetését. Az előadás összefoglalja azokat a tevékenységeket, amelyek e téren folynak a Szövetségi Hírközlési Bizottság (FCC), a Haladó TV Rendszerek Tanácsadó Bizottsága (ACATS) és a Haladó TV Vizsgáló Állomás (ATTC) keretein belül. Az előadás kitér a szabvány választásnak és kábeltelevíziónak az egymásra hatására is. Meghatározza a rendszerek kategóriáit és a javasolt 21 rendszerből 9-et kategorizál. Részletesen ismerteti azt a négy rendszert, amelyet vizsgálatra alkalmasnak tartanak. Áttekinti a rendszerek vizsgálatának beosztását és egy szabványnak a kiválasztási elveit. Végül szó esik más szervezetek tevékenységéről, amelyek műsorok gyártására és cseréjére, továbbá TV vevők interface egységeire vonatkozó szabványokat dolgoznak ki.

6. V. ABAKUMOV (SU): *TV rendszerek ás eljárások tudományos és ipari alkalmazásokra.*

A modern TV rendszerekre jellemző az igen jó képminőség, jó szín visszaadási készség, nagy érzékenység és felbontás. Ezek a tulajdonságok teszik lehetővé a TV technika képfelbontási eljárásának a használatát olyan új területeken, mint automatikus kép-analízis, alakzat felismerés, távoli tárgyak méreteinek mérése, kép színmérési analízis, stb. Ilyen rendszereknél nagy megbízhatóság és pontosság érhető el a TV jelfeldolgozó áramkörök optimalizálásánál, TV képfelvevő csövek kimenő jelének illesztett szűrőinél és TV képfelvevő csövek optimális munkapontjának a helyes megválasztásánál.

7. U. SIEBEN (G): *D2-, D-, HD-MAC, rövid műszaki áttekintés.*

A műholdas TV műsorszórás népszerűsége egyre nő, különösen, hogy az aránylag olcsó MAC vevők már megjelentek a piacon. Ennek az előadásnak az a célja, hogy főként műszaki szempontok alapján a MAC rendszerek jelenlegi helyzetéről áttekintést adjon. Ismerteti a MAC rendszerekben alkalmazható titkosítási eljárások koncepcióját és röviden bemutatja a HDTV vevőket.

8. U. SIEBEN (G): *Szubmikron integrált fogyasztói rendszerek.*

A fogyasztói elektronika mai rendszerei nagymértékben épülnek a fejlett integrált áramkörökre. A digitális TV vevők például olyan integrált áramkörökkel készülnek, amelyekben egy-egy chipen 300 ezernél több tranzisztor is működik és az alapsávban másodpercenként elvégzett műveletek száma több milliárdra rúg. 1990-től a fogyasztói elektronikában is rendelkezésre fog állni a szubmikronos technológia. Az új IC-kben több, mint 1 millió tranzisztor kerül integrálásra, ami jelentősen megnöveli a nagyteljesítményű jelfeldolgozó architektúrák lehetőségét és "lágyabb" megoldásokat kínál még az igen nagy sebességű jelfeldolgozó áramkörök céljaira is. Az ilyen IC-k "új-útas" koncepcióját foglalja össze az előadás, a digitális TV jelfeldolgozás területéről vett példákkal illusztrálva az egyes megoldásokat.

VII. Szekció: Mérőműszerek és mérési eljárások

1. B. MATTHEWS (GB): *Jel-zaj viszony mérése.*

Mi a "jel-zaj viszony" és milyen mérési technika használható? Az előadás röviden ismerteti a mérési eljárást. A jel-zaj viszony meghatározása a CATV rendszerek egyik kulcs kérdése.

2. SÓLYOM CS. (H): *A szelektív hozzáférés lehetőségei interaktív kábeles műsorszétosztó hálózatokon.*

Az előadás összefoglalja a szelektív műsorszóró rendszerek különböző megvalósítási lehetőségeit. Szó esik röviden a szokásos analóg keverési módszerekről, majd áttekintést nyújt a különböző digitális titkosítási eljárások lehetőségeiről.

3. P. DUBERY (GB): *Méréstechnika HDTV rendszerek számára.*

A nagyfelbontású televízió (HDTV) a fejlődésének a kezdeti szakaszában van. Az aránylag korlátozott számú létező berendezésre való tekintettel mind a műsorgyártás, mind a méréstechnika szerte a világon csupán néhány műsor- és készülékgyártóra korlátozódik. A leggyakrabban felmerülő probléma a műsorgyártásra készülők körében az, hogy elegendő mennyiségű, de azonos szabványú (!) berendezést (kamerák, képmagnók, képkeverők, stb.) tudjon beszerezni. A mérési eljárások fejlesztésének tehát lépést kell tartani az egyre halmozódó HDTV tapasztalatokkal.

4. KOVÁCS I. (H): *C-, D- és D2-MAC/packet jelgenerátor.*

Az előadás bemutatja annak a továbbfejlesztett MAC/packet jelgenerátornak a konstrukcióját, amelyet a Budapesti Műszaki Egyetem egyik fejlesztő csoportja készített. A berendezés alkalmas C-, D-, vagy D2-MAC/packet jelek előállítására. A készülék célja az, hogy mérőjel forrást biztosítson azon többrendszerű MAC dekóderek vizsgálatához, amelyek az Európában beindított közvetlen műholdas műsorsugárzás (DBS) vételére készülnek. Segítségével lehetővé válik a dekóderek valamennyi szolgáltatásának, illetve műszaki adatának az ellenőrzése.

5. A. MITARU (USA): *Video mérések digitális megközelítése.*

Az előadásban ismertetésre kerül a Tektronix cég VM700A tipusú új, számitógép alapú mérőműszere. Működésében ötvözi egy hullámalak monitor, egy vektorszkóp és egy önműködő mérőberendezés kombinációját. A mért adatok újszerű grafikus ábrázolását nyujtja, teljes zajmérési összeállítást biztosit, továbbá spektrum kirajzolására is alkalmas. A műszer képes bonyolult felhasználói programok végrehajtására és különböző nyomtatási lehetőséget is biztosit. A készülék konstrukciója 32 bites mikroprocesszor technológián alapszik és van benne egy 10 bites 20 Mminta/s analóg-digitál konverter is. Valamennyi mérés és hullámalak görbe mintavett adatokkal történő digitális jelfeldolgozó eljárásokon alapszik. Az információ egy nagy felbontású, folyamatos letapogatást használó grafikus képernyőn jelenik meg. Ernyő-érintős technológia alkalmazásával a műszer kezelése kimondottan újszerű és felhasználó-barát.

6. SOMODI J. (H): *TV ábrák előállítása digitális úton.*

Hosszú előkészületi munka után a CCIR kiadta azokat a dokumentumokat, amelyek ajánlásokat tartalmaznak a TV technikában alkalmazandó digitális eljárásokra és a csatlakoztatandó digitális berendezések interface-eire. Az előadás célja bemutatni azokat az eljárásokat, amelyekkel a különböző analóg mérőjelek és vizsgáló ábrák digitális úton is létre hozhatók továbbá, hogy ezen a téren hogyan használhatók fel a CCIR ajánlások.

7. D. SCHREIBREITHNER (A): *Digitális video jelgenerátorok.*

Abból a tényből kiindulva, hogy a jelenleg használt földi és műholdas tv műsorszóró rendszerek országonként és szervezetek szerint is általában különböző szabványok szerint működnek, a vizsgálatokhoz, ellenőrzésekhez szükséges mérő-vizsgáló jelek száma meghaladja az 50-et is. Ez viszont igen nagy problémát okoz, mivel nagyon nehéz olyan mérőberendezést találni, amely képes lenne ezen nagyszámú vizsgálójel előállítására. Az előadás röviden összefoglalja annak az MG6301A/B/C digitális video jelgenerátornak a tervezési, konstrukciós és áramköri részleteit, amely új fejlesztés eredményeképpen megoldja az említett problémát.

8. JUHÁSZ S. (H): *TV vevőkészülékek nagyfrekvenciás egységének a mérése számítógéppel vezérelt mérőműszerekkel.*

Az előadás ismerteti a TV vevők hangolóegységeinek a mérését, amely aránylag olcsó számítógéppel és mérőeszközökkel megoldható. Az ismertetés a mérési eljárásnak csupán a legfontosabb részeire korlátozódik, nevezetesen a mérési összeállításra és a felhasznált műszerekre.

A DOMESTIC TELEVISION PROGRAMME DELIVERY SERVICE BASED ON TELETEXT

J P Chambers

British Broadcasting Corporation Engineering Research Department
Kingswood Warren, TADWORTH, Surrey, United Kingdom, KT20 6NP

The French EPEOS system for carrying television programme labels by teletext was described in 1975. The idea allows the viewer to preselect several programme items in advance for unattended recording and later replay. A labelling system in UK teletext was defined in 1980 but until August 1989 copyright prevented the use of such a public service in the UK. This paper describes how the Broadcast Service Data Packet is now being used experimentally for such a service. It indicates how the selection of programmes may be simplified by using teletext. The efficiency, reliability, flexibility and future applications of this and other EBU specified systems are discussed.

BACKGROUND

At the SMPTE Technical Conference in New York in 1976 [1] Bernard Marti of the French CCETT discussed the EPEOS system of programme delivery. He pointed out that in Europe the television network is underemployed and that many programmes are missed by a potential part of their audience because of time constraints. The EPEOS system transmits an identification label with every programme, using what we now call teletext, together with codes for the remote control of a tape recorder. The user with a key-pad could store up to 15 labels and the corresponding programmes would be recorded when broadcast. The service was intended for the general public, for educational programmes and for automatic delivery of special programmes for particular segments of the public, such as businessmen and doctors. An earlier paper [2] described prototype hardware and associated decoder software.

When the UK teletext specification [3] was written certain binary code combinations were reserved for future use. Some were allocated for uses associated with a particular teletext page, some with a particular magazine,and some were independent of the page and magazine structure. Details of this allocation are given in [4] which specifies the codes used in the Datacast (TM) commercial data broadcasting service. In 1980 a television service data line was proposed [5] to carry television programme and network identification labels, and other information. This was later more fully specified as the Broadcast Service Data Packet (BSDP) format 1, and has been broadcast by BBC teletext since early 1982 and by other British broadcasters since 1986.

Although the BSDP included 32 bits for programme labelling this feature was not used in the UK, these 32 bits generally remained unchanged. This was because under British law the domestic recording of most television programmes, even for 'time shifting', was a breach of the broadcaster's Copyright. It was thought that providing programme labels could have been seen as giving permission for such recording. The law changed in August 1989, giving the public the general right to record broadcast programmes for personal use. It is because of this change that the BBC is now interested in developing a programme delivery service using the BSDP, taking advantage of advances over the intervening years.

In the German Federal Republic (FRG) the VPS system [6] was developed. This uses biphase coding at 2.5 Mbit/s on television line 16, a very rugged data carrier originally established for broadcaster's internal use. The VPS system is characterised by its use of a first-announced scheduled local time of broadcast as the programme label, which leads to operational restrictions. The line-16 VPS service was launched in 1985 but it is thought that this will be discontinued as soon as possible when it has been replaced by a teletext-based service. In 1983, countries bordering FRG asked the UK to define a method of carrying the VPS data bits using teletext as a carrier, and this became the format 2 BSDP.

A Video Programming by Teletext (VPT) service was also defined in FRG, whereby the programme label information for VPS could be included in a teletext programme listing page and loaded automatically under user control. The information was concealed within the normal page layout but, following objections from teletext editors, an alternative method using packet 26 'ghost rows' was defined.

With the exception of EPEOS, all the systems mentioned above are included in the May 1989 EBU 'PDC' Specification [7]. This also includes a list of service requirements including

- programmes not broadcast at the scheduled time, or unscheduled programmes, should be recorded properly,
- the presentation constraints on existing services (e.g. teletext and television) should be minimized,
- the service should be user-friendly and allow both manual and automatic preselections,
- the service should be reliable. In case of recording-control function failure, normal timer control should operate,
- the service should operate consistently regardless of time-zone boundaries and changes to and from daylight-saving time,
- the rate of transmission of recording controls must permit error control, and frequency scanning by the receiver,
- programmes with and without conditional access are supported,
- the required data capacity should be minimized,
- the announced date and time can be changed one or more times by the broadcaster without adverse effect on the service.

BROADCAST SERVICE DATA PACKET (FORMAT 1)

This section details the content of the BSDP, which has been broadcast since 1982. It is part of the UK teletext specification and appears in annex 2 of the EBU specification [7]. A programme delivery service can be supported by broadcasting only this BSDP, as it contains sufficient information uniquely to identify a particular television network and programme. In this case the user must enter the programme label by a method such as by keypad from a printed or on-screen listing, or by barcode reader. It is not necessary to enter the network label (NI) as a decoder can 'learn' from the BSDPs, or be 'told' separately by the user, the NIs associated with each tuner position. The programming instruction may be associated with a 'time window' during which the programme is expected to be broadcast. The structure of the BSDP is shown in Fig. 1.

The BSDP is broadcast at a rate of once per second. More specifically, it is ideally broadcast at the seconds changes of Coordinated Universal Time (UTC). In the case of satellite services its earliest landfall in the target area should be at UTC seconds change. This is to allow a decoder to search through several channels, where necessary, at a regular rate of one channel per second allowing time for retuning.

The BSDP contains the magazine, page and subcode number of an initial teletext page selected by the teletext editor and intended to be received and displayed automatically following switch-on or channel change to introduce the teletext service on that network.

A 16-bit network identification (NI) code follows. These codes are assigned arbitrarily, without any specific meanings to the bits, but in such a way that all pairs of codes likely to be received at a common point differ from each other in at least three of their 16 bits. This allows single-bit errors to be ignored during comparison. A single television channel may be associated with different NI codes at different times if the programmes come from different sources. A particular programme may be broadcast from different parts of a network each with different NI codes at the same time. So, in general, more than one NI code may be associated with each tuner position. Also, more than one NI code may be associated with a particular broadcast of a programme. It is expected that there will be sufficient NI codes available for all allocations to be unique. A code may be reserved for use where the broadcaster is unable to use an allocated code.

An eight-bit local time offset code follows, allowing the broadcaster to be associated with a particular time zone different from UTC. This local offset means that the user can adopt a particular broadcaster's local time for use in the decoder when converting UTC schedule listings for display.

The next three bytes contain the Modified Julian Date(MJD). This is a five decimal digit day count increasing at midnight UTC. As a reference point, the date of first broadcast of the BSDP, 1982 January 31, happened to be MJD 45000. Only the last three decimal digits of MJD are used for programme delivery, as this covers a period of almost three years. The full five digits are given in the BSDP to allow unambiguous calendar conversion.

The next three bytes contain the hours, minutes and seconds of UTC. This information (and MJD) is given one second early.

UTC and MJD are used for programme delivery purposes to avoid discontinuities caused by changes to and from daylight-saving time, and to allow schedules from different time zones to be placed in absolute chronological order. Note that, using this convention, at any particular second all the BSDPs throughout the world carry the same MJD and UTC data. So a decoder can use any source to provide or maintain an internal clock/calendar. The use of MJD simplifies the calculation of day differences between events and supports all known calendar conventions.

The next 32 bits contain two consecutive 16-bit short programme labels known as SPL1 and SPL2. In general, no importance attaches to whether a particular 16-bit label appears as SPL1 or SPL2 or both. Reserved SPL codes with 'no meaning' are provided. A decoder searching for a particular programme will look for one or more particular NI codes in combination with a particular SPL as either SPL1 or SPL2 or both. The SPLs in use nearby in time on a particular network will generally differ from each other in at least three of their 16 bits, to provide protection against single-bit errors. The use of two SPLs allows, for example, one to cover an entire sports programme while the other relates to ski-jumping, or one to cover a series of programmes while the other covers a particular episode. It also allows particular codes to be reserved for functions such as 'the programme whose SPL accompanies this code has been cancelled'. The one or two SPLs of each programme are broadcast regularly every second throughout the programme. Codes may be reserved to indicate interruption or termination of a programme. It is intended that a decoder should only start a recording after three consecutive 'wanted' events and stop after three consecutive 'unwanted' events. This provides strong protection against errors and it allows other options in the future. For example, the label sequence ...AAABAABBABBBB... could provide advance warning of a programme start or stop while maintaining compatibility with the above decoder. An alternative service depending on a deterministic sequence of labels to identify a programme, rather than a fixed label, would not disturb such a decoder.

The remainder of the BSDP carries a 20-character status message about the television programme for display on switch-on or channel change.

THE PRESELECTION FUNCTION

A combination of one or more NI with one SPL is sufficient to define a required television programme within a time span of interest, and to allow it to be recognised by the contents of its BSDP. In principle, a decoder with a list of wanted NI/SPL combinations could be permanently searching the BSDPs of all relevant channels in sequence waiting for one of the wanted programmes to be broadcast. Clearly this operation can be simplified if the time windows during which the programmes are expected are also stored in the decoder. In any case decisions will be required within the decoder when two or more wanted programmes are being broadcast at the same time, and the user may be invited to assign different priorities to the different programmes. There are many other aspects of a video recorder for a programme delivery service which present challenges for the manufacturer, such as the control of the amount of videotape available and the positioning of each recording on the tape. The operation of creating the list of programme details for future action is known as the preselection function.

Some of the ways in which the preselection function can operate are indicated in Fig. 2. The simplest is similar to most current VCRs where the tuner position and start and stop time and date are entered manually by a keypad. The extra information required for the programme delivery service, the SPL, is entered as a five-digit decimal number. It is assumed that the NI code(s) associated with each tuner position are already stored.

Some manufacturers have provided a method whereby numerical details (such as times) from teletext programme listings pages can be copied into storage, to eliminate copying errors. This technique, sometimes known as 'pseudo VPT', could be extended to copy five-digit SPLs from a teletext page. This approach puts pressure on the broadcasters to compile their listings pages to suit the needs of the various manufacturers and it is therefore unpopular with the broadcasters as it implies a constraint on page layout for an indefinite period in the future.

The use of a barcode to collect numerical information for programme preselection is established in some countries. This could readily be extended to include the SPL. As the barcode is not itself directly readable it might be appropriate to adopt the MJD + UTC convention for date and time so that the printed codes become independent of local time.

Perhaps the most interesting methods of preselection involve the use of teletext as the information carrier. But, even with the current situation in the UK, an unreasonable number of teletext pages and large editorial effort would be needed to maintain a comprehensive service and this becomes worse as more channels become available. A more efficient way of using the limited teletext capacity is needed.

PRESELECTION USING TELETEXT

The 'ghost row' VPT technique could be used quite efficiently to provide the programme selection information needed to accompany an item in a teletext listings page. Generally the NIs (if different from that in the BSDP) and MJD are sent first, perhaps with a reference time (REF) to set the start of a 24-hour period. For each entry one or two menu cursor positions (MCP) are given as a pair of coordinates. One defines a point to highlight an item on the page, two define a rectangular window containing the human-readable programme details for storage. When necessary, one or more new NI codes are given. The SPL is always given. The expected start (COM) and stop (FIN) times may be given. This sequence repeats for each item in the list and the process is completed by a terminator (CRC) containing a cyclic redundancy check. Fig. 3 indicates how this information could be coded into 18-bit words which, in turn, could be coded into three bytes of teletext using a 24,18 Hamming code. Using this approach three extra packets would typically carry information for about eight programme items.

Similar coding could be used on a special independent data packet broadcast during a television programme 'trailer'. If the user, when watching the trailer, decided to select that programme the necessary data could be taken directly into storage. An example of such a data packet is given in Fig. 4.

As indicated earlier, a more efficient method for transmitting preselection information by teletext is needed. Teletext was designed (1970-74) when the real cost of a single page of memory could today buy several hundred pages of memory. It is no longer necessary in a new decoder for a specialised application with slowly-changing information to send all the pages all the time. It is quite practicable to store a database with details of the television programmes on 30 channnels for the next 30 days in non-volatile memory and keep this information updated using a transmission rate of about one data packet per second. A manufacturer always likes to personalise the product and he could be given complete freedom of how to display and select from programme listing information taken from a compactly-coded and future-proof data base structure. New forms of programme categorisation could be defined as required, using coding techniques similar to those used for the Service Identification (SI) system in the MAC/packet family [8].

PRACTICAL CONSIDERATIONS

It takes good imagination, or hard experience, to discover the problems in operating a new system. During the growth and development of the UK teletext system over the last fifteen years problems have been found and lessons have been learnt. Some of these can be translated into general principles to guide future similar work, and these have been applied here.

In particular, in broadcasting applications, every current and future development and application must be compatible with what has gone before. The lifetime of domestic equipment often exceeds ten years and, unlike the telecom' or cable operator, the broadcaster cannot supply different signals to suit different receivers. This is less of a problem with analogue systems, where most of the compatibility issues can be tested by calculation or laboratory experiment before a final test broadcast to all existing receivers. But in a digital system, however carefully the specification is written, it is the mass-produced decoders which effectively define the system. There have been several instances in teletext where unexpected decoder behaviour, sometimes discovered after several years when a new bit combination is brought into use, has adversely influenced the development of the service.

So it is particularly important that manufacturers are closely involved in the specification of new digital systems, and that these specifications be written in an unambiguous way, such as by using a 'flow diagram'.

CONCLUSION

This paper has given the historical background to the various television programme delivery systems currently under discussion in Europe. Using the format 1 BSDP as an example, a flexible basis for future expansion of the service has been indicated. This satisfies the known service requirements and preserves an efficient use of the valuable teletext capacity.

ACKNOWLEDGEMENT

The author wishes to thank the Director of Engineering of the BBC for permission to present this paper.

REFERENCES

[1] B.Marti, New Ancillary Services using a Television Channel, SMPTE Journal Vol.86, November 1977

[2] C.Gautier et al, EPEOS: Service d'enrigistrement automatique des programmes, Radiodiffusior Television No.40, 1975

[3] Broadcast Teletext Specification, BBC/IBA/BREMA, September 1976

[4] J P Chambers, BBC Datacast - the transmission system BBC Engineering Research Department Report 1988/1

[5] J P Chambers, Teletext - the Potential of an Extended System, IEE Conf. Pub. 191 (IBC 1980)

[6] Video Programme System, Technical Rules ARD/ZDF/ZVEI Nr. 8R2 (2nd Edition April 1987)

[7] Specification of the Domestic Video Programme Delivery Control System (PDC),doc.SPB 459rev., EBU Brussels, May 1989

[8] Specifications of the systems of the MAC/packet family, doc. Tech 3258, EBU Brussels, October 1986

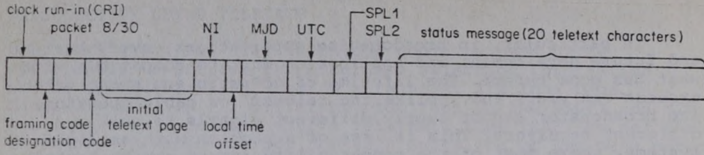


Fig.1 Structure of format 1 Broadcast Service Data Packet (BSDP)

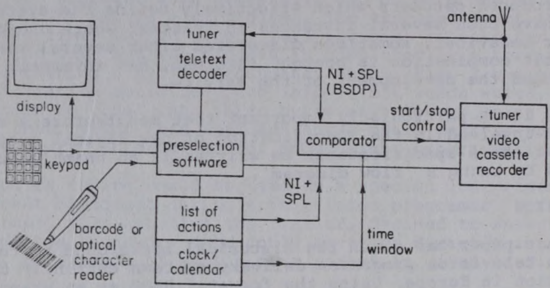


Fig.2 An example of the preselection function

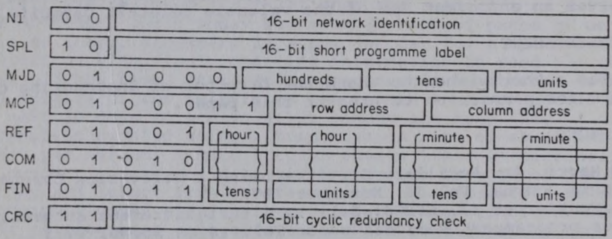


Fig.3 An 18-bit coding scheme for programme selection information groups

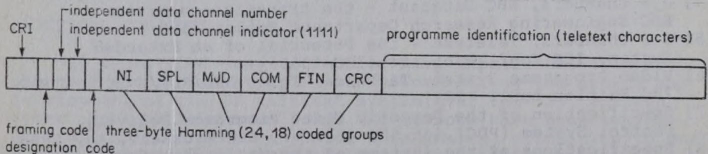


Fig.4 Possible structure of trailer preselection packet using 3-byte groups

STATUS REPORT ON THE STANDARDIZING WORK IN IEC ON TV AND DBS RECEIVERS

Tomio Kida

Television Research Laboratory, Television Sector
Matsushita Electric Industrial Co., Ltd.
1-1 Matsushita-cho, Ibaraki, OSAKA, JAPAN. 567

For the consumer, the quality of the TV and DBS images he receives depends upon how well the reception elements work. The IEC/SC12A/WG7's committee results are a complete series of international standards which provide ways of measuring the technical characteristics of reception equipment. These standards used worldwide by manufacturers, testing laboratories and national certification authorities assure that equipment in the reception system brings you the best in sound and picture quality. Now I would like to speak about the work that we at SC12A/WG7 have done, about the present status to date and plans for the future and about the background and trends.

INTRODUCTION

It goes without saying that today's television receivers are more than a means of receiving and viewing signals of terrestrial TV broadcast stations. As shown in Fig. 1, there has been great advances in diversification and it must be thought of as one system in the home. The speed of technical advances in the characteristics of the basic TV receiver year by year is really surprising. In order that the TV receivers watched by people worldwide have the best characteristics, IEC brings together specialists from each country, establishes methods of measuring international standards and offers standards to each country. This is the basis for the start of IEC 107.

PROGRESS TOWARD DIVERSIFICATION OF TV RECEIVER AND COMPATIBILITY OF INTERNATIONAL STANDARDS

Approximately 62 million color TV receivers were produced last year (1989) worldwide and approximately 63.9 million will be produced in 1990. The figures are shown in Fig. 2. Production distribution is as follows; North America 31%, Europe 23%, Japan 17%, ROW (Rest of the world) 29% (USSR, China, Asia, South America, Middle-East, etc.). The diversification of the color TV receivers is shown in Fig. 1 and it has moved from monaural sound of normal TV broadcasting to stereo and multi-channel sound. In 1978 in Japan, in 1984 in the U.S.A. and in Germany (each broadcasting system is slightly different), TV multi-channel sound broadcasting was initiated. Currently stereo TV programs are the rule. The basic differences in these broadcasting systems are shown in Fig. 3. The Japanese and U.S.A. subcarrier system [U.S.A. uses SAP (Separate Audio Program)] is summarized in IEC 107 part 3 and the German two carrier FM system is in IEC 107 part 4. These were published from the end of 1988 to February of 1989. Furthermore, there is a connection with TVs that receive non-broadcast signals such as those from video recorders, video games and computers and CATV. CATV in particular has seen rapid growth in the last 15 years. The compatibility of these was published in IEC 107 part 6 in the beginning of 1989.

Worldwide communication satellites (CS) have made rapid progress and currently there are approximately 40 geosynchronous satellites used for communications. In addition, there will be 14 broadcasting satellites (BS) this year if we include broadcasting satellites being used for broadcasting, being tested and being planned. If we look at DBS (Direct Broadcasting Satellites), we see that, as shown in

Fig. 7, the number of households receiving these broadcasts in the U.S.A. and Japan has reached approximately 3 million in the U.S.A. (C/Ku Band) and approximately 2 million in Japan (Ku-Band) as of the end of 1989. England (BSB), France (TDF), Germany (TVSAT), etc. use the Ku-Band and broadcasting will begin this year (1990).

Japan, the first in the world to begin satellite broadcasting, started its use in 1984. IEC/SC12A/WG7 and WG8 has been involved in this type of movement by planning international standards with work being shared in the following way.

* DBS tuner units ----- 12A (C.O) 132-I, II (IEC/SC12A/WG7)
* Sound/Date Decoder units for digital sub-carrier/NTSC systems -------- 12A(S) xxx (IEC/SC12A/WG7)
* MAC decoder unit ---- 12A(S) xxx (IEC/SC12A/WG7)
* Outdoor unit -------- 12A(CO) 131 (IEC/SC12A/WG8)
* Overall performance - 12A(S) 259 (IEC/SC12A/WG8)
* Receiving antennas -- 12A(S) xxx (IEC/SC12A/WG8)

We expect to complete the work on the international standards for antennas, tuner units and decoders during 1990. The total retail price for a 45øcm - 60øcm receiving antenna (+ outdoor unit) + DBS tuner unit will be below $700 and in future there will be further penetration of the market.

Let's look at future trends in television technology. In this sense, it goes without saying that IEC/SC12A/WG7 must be involved in this work in future. As shown in Fig. 1, the diversification of the television receiver is going forward and Fig. 8 shows the changes made year by year (including future prospects) in the new technical system for broadcasting and receiving in order to provide more beautiful and more varied information. As you already know, there are three color television systems (NTSC/PAL/SECAM) in existence worldwide and the figure classifies how each technology will advance by the next generation (21st century). Basically, it is a matter of obtaining a high quality image by improving the transmission and reception technology for current broadcasting or of deciding on a new system, namely High Definition Television, which is not compatible with current broadcasting. (Depending on the method, there is also a way of taking compatibility into consideration). There is no uniform system worldwide for either EDTV (Extended Definition Television) and HDTV (High Definition Televisions) and currently they are being discussed at every chance but in 1989 Japan started experimental broadcasts of EDTV and HDTV.

Due to this trend, semiconductor and TV receiving technology has advanced. In particular, a major transition from analog technology to digital technology is continuing and this technology is being introduced into TV receivers. HDTV is gaining attention as the next generation TV and three systems, Japanese, U.S.A. and European, are being studied. Fig. 9 shows an estimate of the future diffusion of HDTV worldwide.

The future work of IEC/SC12A/WG7 is not only to create international standards for the new technology mentioned above but it also plans discussions on the revision of 107 (recommended methods of measurement on receivers for broadcast transmissions), on methods of measurements on teletext receiving equipment, on LCD (liquid crystal display) TV, on digital TV and SC receivers, etc.

CONCLUSION

I have just given a report on the current conditions surrounding TV receivers but today's technical progress and international standards cannot be furthered by the power of a single country alone but the participation, discussion and cooperation of each country is required. I also ask for positive participation and cooperation from your country in the future.

Finally, I would like to say that I am honored and grateful to Dr. Paul Ferenczy for his invitation to me to attend this THE 5TH CONFERENCE.

REFERENCES

[1] Utilization of Satellite for Communications and Broadcasting, THE JOURNAL OF THE INSTITUTE OF TELEVISION ENGINEERS OF JAPAN Vol. 43 No. 9 (September 1989).

[2] Text of the 26th Electronics Industry Technical Conference, ELECTRONIC INDUSTRIES ASSOCIATION OF JAPAN (1989).

[3] Recommended methods of measurement on receivers for television broadcast transmissions and General considerations: Electrical measurements other than those at audio-frequencies, IEC Publication 107-1 (1977).

[4] Electrical measurements on multichannel sound television receivers using subcarrier systems, IEC Publication 107-3 (1988).

[5] Electrical measurements on multichannel sound television receivers using two-carrier FM-system, IEC Publication 107-4, (1988).

[6] Measurement under condition different from broadcast signal standards, IEC Publication 107-6, (1989).

[7] NETWORK NHK, (July 1989).

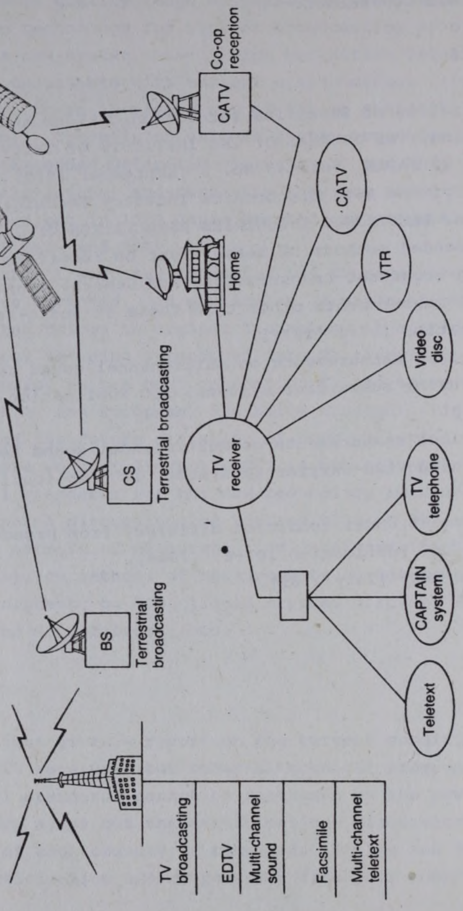


Fig. 1 Diversification of television reception system

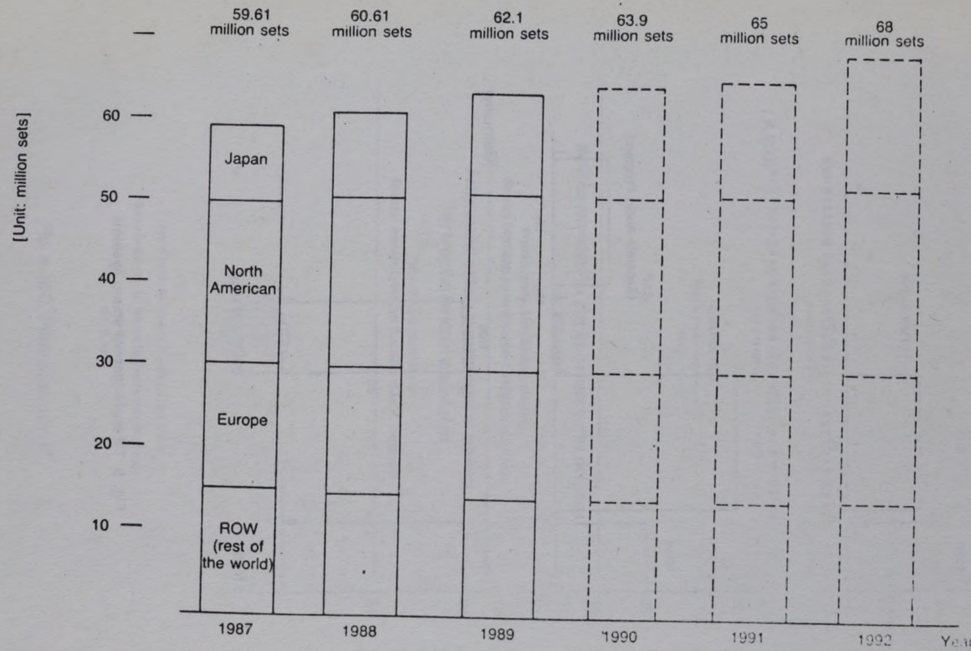


Fig. 2 Worldwide total demand (color television)

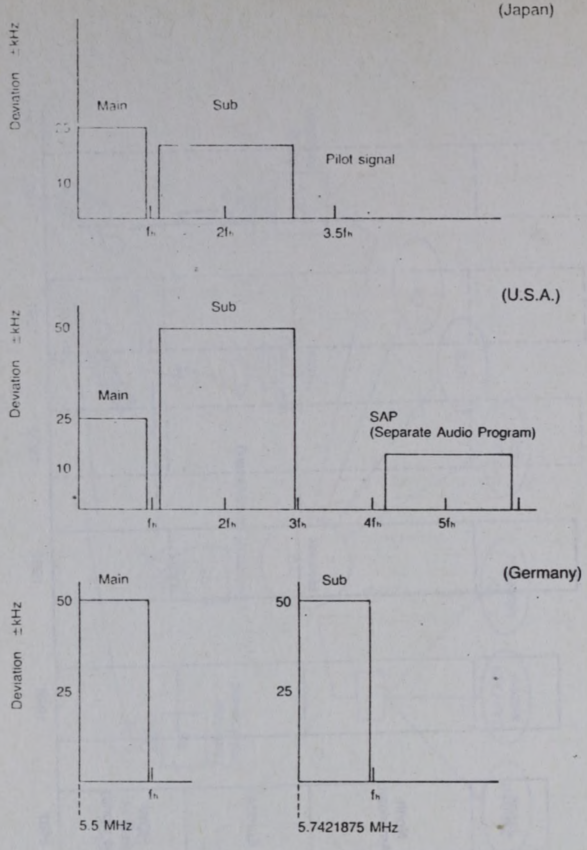


Fig. 3 TV multi-channel sound systems

Publication 107-1

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

NORME DE LA CEI

INTERNATIONAL ELECTROTECHNICAL COMMISSION

IEC STANDARD

Publication 107-1

Deuxième édition — Second edition

1977

Méthodes recommandées pour les mesures sur les récepteurs de télévision

Première partie: Considérations générales

Mesures électriques autres que celles à fréquences acoustiques

---

Recommended methods of measurement on receivers for television broadcast transmissions

Part 1: General considerations

Electrical measurements other than those at audio-frequencies

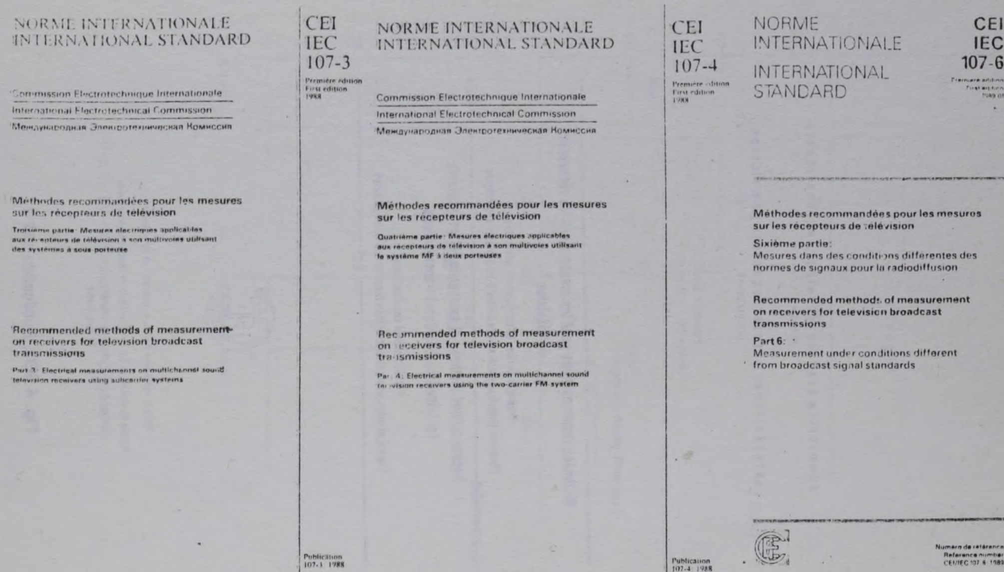
---

Bureau Central de la Commission Electrotechnique Internationale

1, rue de Varembé

Genève, Suisse

Fig. 4 IEC, Publication 107-1



NORME INTERNATIONALE
INTERNATIONAL STANDARD

Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

Méthodes recommandées pour les mesures sur les récepteurs de télévision

Troisième partie: Mesures électriques applicables aux récepteurs de télévision à son multivoies utilisant des systèmes à sous porteuse

Recommended methods of measurement on receivers for television broadcast transmissions

Part 3: Electrical measurements on multichannel sound television receivers using subcarrier systems

CEI
IEC
107-3

Première édition
First edition
1988

NORME INTERNATIONALE
INTERNATIONAL STANDARD

Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

Méthodes recommandées pour les mesures sur les récepteurs de télévision

Quatrième partie: Mesures électriques applicables aux récepteurs de télévision à son multivoies utilisant le système MF à deux porteuses

Recommended methods of measurement on receivers for television broadcast transmissions

Part 4: Electrical measurements on multichannel sound television receivers using the two-carrier FM system

Publication 107-3: 1988

CEI
IEC
107-4

Première édition
First edition
1988

Publication 107-4: 1988

NORME INTERNATIONALE
INTERNATIONAL STANDARD

CEI
IEC
107-6

Première édition
First edition
1989-01

Méthodes recommandées pour les mesures sur les récepteurs de télévision

Sixième partie:
Mesures dans des conditions différentes des normes de signaux pour la radiodiffusion

Recommended methods of measurement on receivers for television broadcast transmissions

Part 6:
Measurement under conditions different from broadcast signal standards

Numéro de référence
Reference number
CEI/IEC 107-6: 1989

Fig. 5 IEC, 107-3, -4, -6

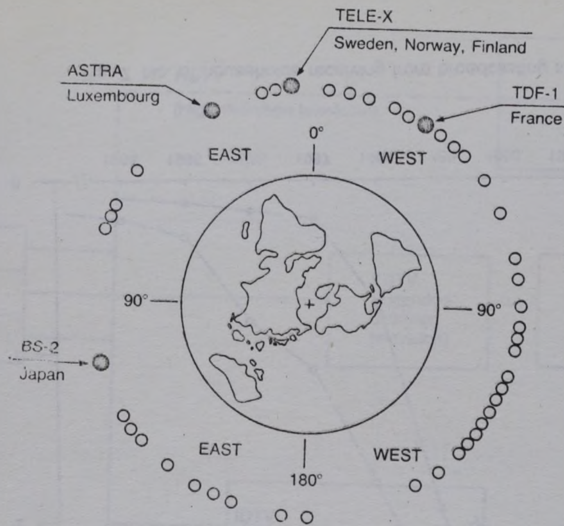


Fig. 6 Existing BS (Broadcasting Satellites) ◎
and CS (Communication Satellites) ○

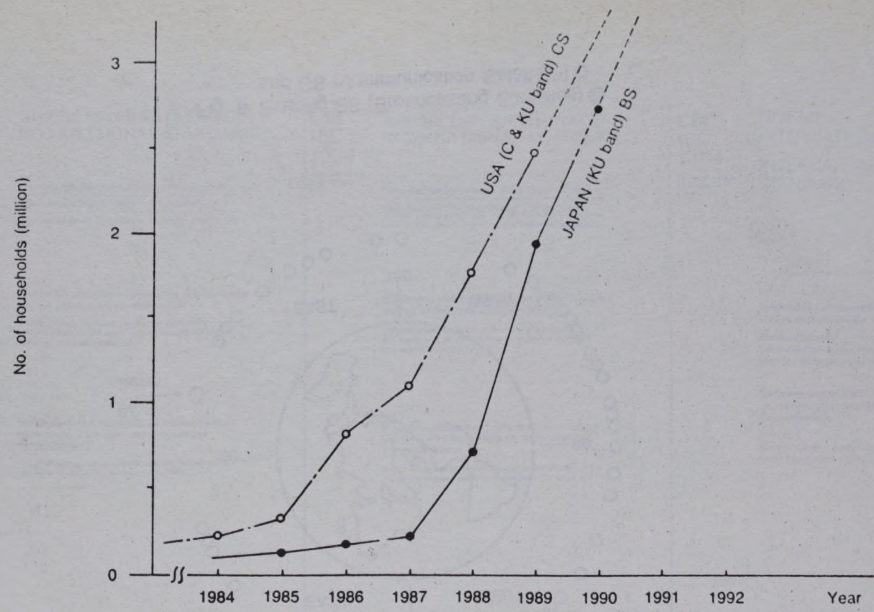


Fig. 7 No. of households receiving from broadcasting satellites

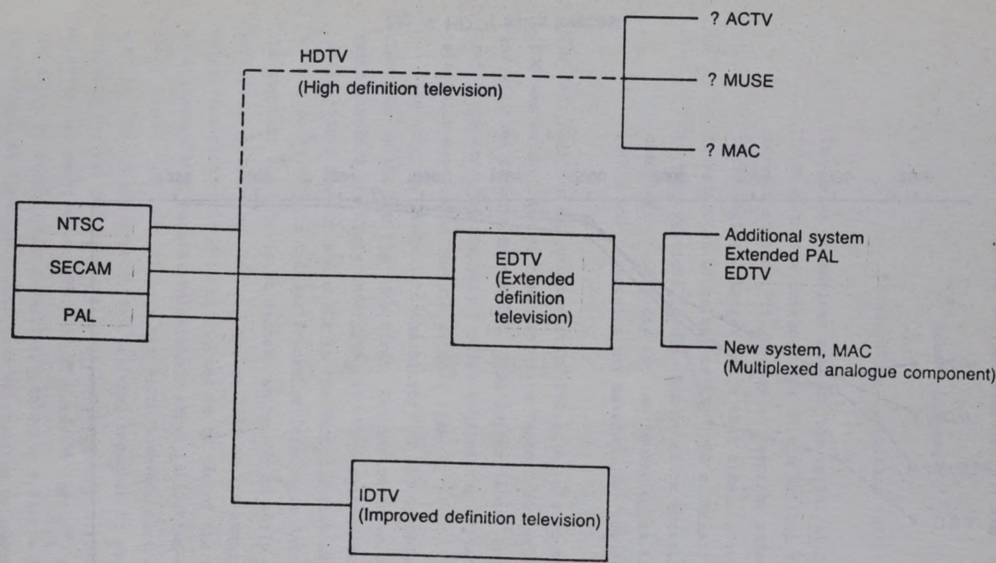


Fig. 8 Progress in television systems

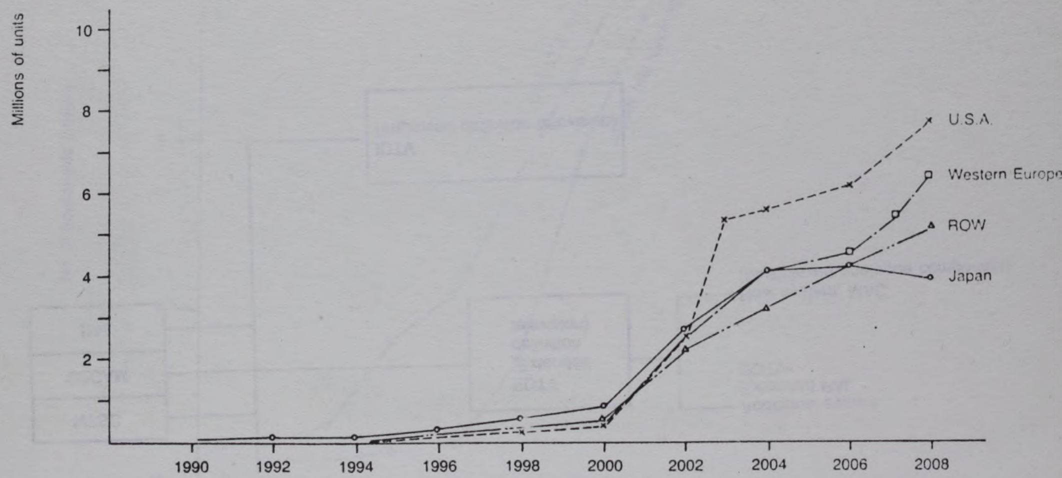


Fig. 9 HDTV sales forecast

A TECHNICAL REVIEW OF BRITISH TELEVISION : PAST PRESENT & FUTURE

Robert Longman

Broadcasting Consultant (UK)

The paper summarises some of the technical developments leading to the introduction of the British television service in 1936. It goes on to describe some of the technological changes since that time, including the introduction of colour in the 1960's. Finally it looks to the technical future of television broadcasting and considers present day and new technologies in relation to the way television may develop over the next decade.

The fact that the BBC started it's public television service as early as 1936 was as much due to administrative factors as technological ones. It was what the founder of the BBC, John Reith (later Lord Reith) called the" brute force of monopoly " which enabled the unitary BBC to get a television service on the air at that time.

The more one looks into the history of any invention, the less clear one is who had the idea first. Television is no exception as the names involved are truly international. Two organistion much involved in the 1930's however where RCA in the United States and EMI in the U.K.

To us in Britain the early work of John Logie Baird is regarded as the start of our television system, as he was an early pioneer with low definition television. As long ago as 1924 he was experimenting with television pictures and is considered to be one of the first people to have demonstrated genuine television: shown in his two-room apartment in Soho, London, in 1926. It is a sad fact, however, that he gave birth to what in the end was a technical failure, based as it was on a mechanical scanning system. But he pressed the BBC to start, in 1932, a limited experimental service using his 30 line system -no mean task at the time. His early work was truly inventive, employing a Nipkow disc rotating at 10 rev/sec. At first he transmitted silhouettes but by 1926 he was able to demonstrate pictures in which tonal gradations, on moving images, made it possible to recognise facial features and expressions.

In Baird's system light reflected from the subject was focused by lenses in the scanning disc onto a photo-electric cell which generated a signal for transmission to the receiver. At the receiver this was used to drive a neon tube, which was viewed through a scanning disc rotating in synchronism with the transmitter: producing a 89mm x 38mm flickering pink picture composed 30 vertical lines. The first experimental programmes from the Baird studio were transmitted "on air" in 1929.

The BBC took full responsibility for these 30-line transmissisions in 1932 and opened a studio in Broadcasting House, London. Compared with with the primitive facilities in the Baird studio the BBC studio had technical improvements, more space and camera flexibility.

By this time Baird had a rival - EMI in London who were working on a full electronic system and the Emitron camera tube. This company took the courageous decision to use a higher definition of of 405 lines and offered an interlaced picture of 50 fields/sec, which considerably reduced the flicker. Baird on the other hand up-rated his system to 240 lines, 25 frames/sec, using improved forms of scanning.

Eventually the Government recommended there should be a public service run by the BBC. Because there was now two possible systems it was decided to have transmissions alternately by EMI and Baird, to discover which gave the best results. Alexandra Palace in North London was chosen for the studios and the transmitter, with the full public service starting on the 2nd November 1936- the opening ceremony being transmitted first on on the Baird system and then by EMI. Although the Baird system did not measure up to the EMI system, both in terms of flexibility and quality, the two standards were used until 1937, when it was decided that future transmissions would be on the 405 line electronic system. All very sad for Baird but right decision.

The cameras had fixed lenses and depth of field, with limited sensitivity and exessive lighting levels. The cameramen had to work with an optical viewfinder, which produced an inverted picture. Continuous shading adjustments had to be made and it was not possible to cut between cameras - only fade or mix. Post-production editing was still a dream as there was no recording; a severe limitation.

During the 1939-45 war television was closed down. The British government however set up another committee to consider the future of television and alternate standards were examined, but it was accepted that an earlier restart was possible if the pre-war 405-line standards were used after the war. So at a time when things in the UK were still difficult the BBC were financially and technologically in a position to resume it's interrupted service - the re-opening day being 7th June 1946. Within a week, Baird, still the most controversial figure in the history of British television, had died. He had been a strong publicist for television in Britain and great inventor - a sad moment in the UK with the loss of such a respected pioneer.

Now more sensitive cameras were required as a matter of urgency. EMI developed a low velocity tube with orthogonal scanning know as the CPS Emitron - A Cathode potential Stabilised Tube. The tonal gradation of this new tube was very good but it could be overloaded by excessive contrast. PYE TVT also manufactured the Photicon which was similar to a Super Emitron - an Emitron with an image section but much smaller in size. Eventually these tubes were replaced by the Image Orthicon which was to be the major pick-up tube in use for the next decade or so.

In 1946 programmes were restricted to the service area of the London transmitter working on VHF and the development of a new network of transmitters to cover the UK was put in hand, to be phased over future years. By 1955 coverage had been extended to 93.5% of UK and was still increasing. Programme output was also expanded to meet the needs of the growing number of viewers and new studios were required. In 1949 the BBC acquired the Gaumont British Film Studios in Lime Grove, West London. This gave them four new television studios in which they installed more sophisticated vision and sound mixing facilities, with seperate control rooms for production, sound, video and lighting operations.

The use of film as a programme ingredient had grown, but the continuous motion Mechau mirror drum projectors were sill in use, which had been the basis of the service since it was introduced. A new development by Rank Cintel Ltd however provided a twin lens flying- spot continuous motion telecine which gave outstanding improvement in picture quality, and was mainly used for high quality film programmes during prime-time.

COMMERCIAL TELEVISION AND CONTINUING TECHNICAL DEVELOPMENTS

The BBC's steady if sedate progress was challenged in September 1955 by the arrival of Independent Television (ITV). This was commercial television with a difference having it's own federal structure, with control via the IBA. A gleaming toothpaste advertisment was the first television commercial to be screened and competition had arrived. Since then ITV (now called ITV Association) has been successful both in programming and technical impact and have been involved in the introduction in many new technical developments, with collaboration between the broadcasters on major technological changes.

By 1958 everyone knew that priority should be given to the development of a television magnetic recording system. The BBC Research Department had been carrying out a long term investigation into this possibility and that year unveiled VERA - Vision Electronic Recording Apparatus - a machine using 12.5mm tape running at 5.08m/sec. The video channel was split into two bands recorded on two tracks, with the audio recorded on a third track. The machine was of course a research tool, but it pointed the way forward and was used a few times on transmission.

By this time however the Ampex Corporation of California had amazed the television world at the NAB that year by showing their quadruplex 2" recorder, which was a standard set to be the backbone of television for the next twenty-five years. If one had to select the most important development of the 1950's it would be the VTR.

Camera movement was also improved with a British firm, Vinten Ltd, developing the fixed centre of gravity pan and tilt head and later the first three stage hydro-pneumatic camera pedestal. There were many other improvements in smooth level studio floors, and lighting systems; all these being incorporated in the purpose-built studio complex at the new BBC Television Centre at White City, London, opened around that time.

Yet another committee recommended a second BBC network on the new European 625-line standard, to be transmitted on UHF. It was recognised that the existing BBC network, and the ITV channels, would have to be duplicated on UHF to prepare for the eventual withdrawal of the 405-line standard. A frequency allocation plan for the UHF bands was worked out, which allocated four frequencies to each transmitter site covering the two BBC and one ITV network, the fourth channel frequencies being left for further development (now in use and called Channel Four). As the UHF networks were intended for both the BBC and ITV, common transmitter masts were used with special transmitter combining systems. This enabled a single receiving aerial to be used in the home.

By 1963 the battle for the colour system to be used in the U.K. had yet to be fought out. Three sytems were available - the NTSC system introduced with such remarkable speed in the United States; two variants of PAL and of course SECAM with it's variants. This long saga is a lecture intself but in the end the U.K. opted for PAL and BBC2 was the first of our networks to go over to colour transmissions, on UHF, in 1967; with BBC1 and ITV moving into colour by the end of 1969. There are many views about the choice of colour systems but PAL has proved to be extremely rugged, easy to handle in complex signal paths, and resistant to phase and differential distortions.

Around the same time sound-in-syncs was developed by the BBC, providing audio in the vision waveform, using digital signals in the line-sync pulse period. This made it possible to economise in the use of separate analogue sound circuits for programme distribution - a technique which was later taken up by Eurovision. The use of new digital techniques was also applied to the vertical interval period in the vision waveform to carry teletex information and now used with good effect on all the U.K. networks, with a high percentage of the audience having teletext decoder receivers. At this time other digital signals were introduced to carry out remote transmitter switching, synchronising information and test signals.

By the 1960's modern studio centres were introduced, including the new BBC Television Centre, which had been designed and developed to a considerable level of sophistication and high programme productivity, even on the most complex productions. To acheive this a considerable amount of investment was put into the video and audio facilities involved, including semi-automated lighting systems to provide a rapid turn-around of the studios during night- time rigging and setting operations.

Similarly, in the field of outside broadcasts, there has been a move to design units tailored to meet the specific needs of major productions, ranging from single camera units, to eight camera units for large O.B.work, such as state occasions, sport, party conferences etc.

A LOOK TO THE FUTURE

Changes to our television operations in the future will depend very much on the way new equipment can be applied to the broadcasting chain, and the working life of the existing equipment. With the de-regulation of some of the U.K. television industry organisations, resulting in major management and structural changes - plus the addition of more networks - technology will be required to be more adaptive to broadcasting arrangements as they evolve in the future.

For instance there are already at least seven recording formats in use and every indication of more to come. Also, in recent years, we have seen a change from the 30mm lead-oxide camera tube to smaller tube target formats, and now have introduced the new all solid-state cameras employing charged coupled device (CCD) image sensors (700 pixels per line); giving full broadcast quality. Such cameras provide operational advantage in pushing forward programme flexibility, due to increased reliability and a considerable reduction in line-up periods.

Great strides are taking place in digital recording formats and they are already being exploited in post-production areas - along with the use of digital mixing facilities. Analogue recorders reduce the picture quality as the number of generations increase. The digital recorder overcomes this limitation and the only degradation is the initial digitisation of the signal, until the point of ultimate failure. The new D1 format, for component distribution, has 8-bit samples, with a 13.5 Mhz sampling frequency for luminance, and 6.75 Mhz for the colour difference signals: giving an overall bit rate of 216 M/bits.

The D1 standard is useful in post- production areas but cannot be easily applied to the tv chain in a main broadcast centre. Another standard, called D2, is therefore becoming available which could be a direct replacement for the existing C-format machines. This is a composite digital machine (working in PAL) which provides the operational facilities of an analogue machine, such as slow motion, still frame and picture in shuttle - and would be easy to use in existing studio centre television operations.

Looking a little further to the future what could now emerge is a smaller digital machine, using 12.7mm tape, for use in the current affairs and news-gathering areas of work. The technical challenge is however great as the packing density on the tape is considerable.

Much thought is being given to the future of terrestial versus satellite transmissions. The existing four British Television networks are transmitted on UHF and now cover 99.3% of the population. To achieve this penetration currently 900 sites are involved with a total of 3500 transmitters. Common transmitter siting is used in order that the viewer can have a single UHF antenna set up to receive all four networks. A recent study has now shown that a fifth network could be engineered between Bands 4 & 5, on channels at present allocated to aeronautical and radio navigation. Preliminary investigations show that a 70% coverage of the U.K. using these channels would be possible and plans are being considered for a fifth UHF terrestial network in the future.

The long awaited introduction of stereo sound, digitally encoded, on some of the U.K. terrestial transmissions is gradually being acheived employing a standard recently developed by the BBC Research Department. The system has a sampling frequency of 32 Khz with a resolution of 14 bits per sample. Two digital NICAM encoded sound channels are employed transmitted on a second sound carrier set at a frequency 6.552 Mhz above the vision carrier. For some time now many of the programmes have been made in stereo, in preparation for the spread of this service.

The 1977 the World Administrative Radio Conference (WARC) plan regulated direct broadcasting by satellite (DBS) in the new frequency Band of 11.7 - 12.5 Ghz. The plan allocated either 4 or 5 channels to each country, regardless of it's size, by assigning frequencies, power, polarisation and orbital position; taking into account common languages, or interests of neighbouring countries. The plan was also based on satellites positioned at 6 degree intervals, all in a geo-stationary orbit, with edge of foot-print reception on a 90cm receiving dish. Since that time there have been improvements in the performance of low-noise amplifiers working at these frequencies, owing to great advances in gallium arsenide integrated circuit thechnology, and much smaller receiving dishes are now possible. Indeed 25cm square flat plate anntenas are proposed for reception of new high powered transponders.

The introduction of DBS provides broadcasters with an opportunity to improve on the existing PAL colour standard, which has been used for the past 23 years. Although PAL is a good colour transmission system it does suffer from interference between the luminance and chrominance, especially on fine detail in picture information; resulting in an effect know as cross-colour. The EBU have therefore recommended that Direct Broadcasting Satellite transmissions in Europe should be on, D-MAC, a Multiplex Analogue Component system, or a reduced bandwidth variant with less sound channels called D2-MAC, which is particularly useful on cable systems. The U.K. have therefore decided to use D-MAC and this has already been applied to the latest DBS satellite covering the U.K. launched in August 1989. This new MAC transmission standard, based on the research and development work of the IBA, avoids cross-colour and other forms of interference, by employing time-division multiplex techniques to transmit the video information - compressing the luminance and chrominance signals in time and then transmitting them sequentially. Eight digital sound channels can be included in the time-compressed system, along with other packets of data information.

A new high powered British operated satellite for DBS coverage of the U.K. is now in position at 31 degrees West which, this year, is to broadcast five new national channels using the D-MAC system. This will be operated by a new company called BSB (British Satellite Broadcasting). All the transmissions are to be encrypted, with local receiver decoders having their own unique number, making it possible for each decoder in the home to be individually addressed via the satellite link to authorise, on payment, the reception of the services offered.

Looking further to the future there seems to be little doubt that the next big step after the use of satellites in the development of television broadcasting will be High Definition Televison (HDTV).

HDTV will become neccessary as new and larger display receivers outgrow our present standards. The 625-line/50Hz field standard is acceptable for present day receivers but with the development of larger, and brighter, displays on the horizon large areas of flicker become a problem and the line structure can be seen.

The increase in line structure and resolution, plus the wide-screen format, also encourages the introduction of new production techniques and resultant viewer enjoyment. To fit in with the broadcasting environment however any new system needs to be compatible with our existing television networks. Broadcasting organisations are not going to make expensive programmes in HDTV for a minority audience and therefore require the main audience, during it's introduction, to be able to receive the programmes as well. HDTV could then be made available along side the main networks and grow at it's own pace.

Much work has taken place on the development of a 1125-line/60Hz, 2:1 interlace, wide screen system in Japan, employing bandwidth compression techniques to allow a single satellite channel to carry the HDTV signal(along with four audio channels). This compression system is called MUSE (Multiple sub-Nyquist Sampling Encoding) which is the transmission counterpart of the HDTV signal. The resulting pictures are excellent but many administrations have severe reservations about committing themselves to a an 1125-line/60Hz system in a 50Hz national environment, involving severe technical and practical constraints which are not easily overcome. Interest is therefore gaining ground for a system wich is evolutionary in it's approach, making it easier to introduce.

In Europe the resources of the TV industries and broadcasters (including the BBC and IBA) have come together with a pan-European technology to develop a new HDTV system - Eureka 95. This is compatible with existing equipment and has sufficient headroom for international programme exchange with other transmission standards. It employs a 1250-line/50Hz signal with an aspect ratio of 16:9, the 1250-line figure being double the 625-lines used in Europe. Because of wider bandwidth the HDTV signal is sub-sampled by a factor of four and processed by a motion adaptive bandwith reduction technique. This ingenious arrangement relies on a still picture scene (that is a picture without movement) being built up over 4 rather than 2 fields, with exellent resolution. For a moving picture however the eye is less sensitive to moving objects and the image is built up by spatial interpolation using signals sampled from a reduced number of fields. The signal is sub-sampled in such a way that a basic 625-line MAC receiver can display a compatible picture without any noticable impairment. At the HD-MAC receiver the picture can be reconstructed to provide a 1250 line/50Hz wide-screen display. To help in this process the video path has an associated data digitally assisted television signal (DATV) carrying control information in the vertical interval period - related to movement portrayal in the picture. In future therefore receivers could display a picture with a 16:9 aspect ratio at 1250-lines, with a picture rate of 100Hz to overcome flicker.

HDTV, and the use of direct broadcasting satellites making it possible for the HD-MAC signal of 10.125 Mhz bandwith to be transmitted to the home, will be an area of considerable interest and activity in the 1990's. The new standards have already been evaluated on selected material and there are plans to use the Eureka-95 standard on a range of productions, working towards coverage of some of the Olympic Games held in Spain in 1992, when it is expected there will be a number of receivers available. HDTV standards are to be the subject of debate at the CCIR meeting to be held later this year.

CONCLUSION

Looking to the future the next decade will result in new production opportunities in which the technology is no longer a limiting factor. The programme makers will have a range of new broadcasting tools at their disposal, to be used with full operational flexibility. The number of television networks, and the organisations providing programmes and facilities, should continue to grow within an expanding technical infrastructure. This will greatly accelerate communication opportunities in bringing people together, using the new satellite links into the home with high quality television signals spanning the world.

IBM PC/XT COMPATIBLE PCB AND SOFTWARE FOR VIDEOTAPE SUBTITLING USING THE NEW GENERATION TELETEXT IC

DR. ROUMEN BIMBALOV

Committee of Communications and Informatic
Sofia-1000, 6 Gurko Str., BULGARIA

The developed subtitling system is relatively unexpensive and easily available to all who deal with such activity. Main part of the system is the printed card described in the paper. The card is designed to be built in a personal computer of the IBM PC/XT type. To generate the subtitles a character generator of the SAA 5243 series (EURO CCT) is used. This makes possible the subtitling in various languages and writing in full the corresponding accentuated letters. The input and output are both either composite video signals (white subtitles on a black background) or RGB signals (colour subtitles). To control the printed card the respective software has been developed supporting the following functions: character set and subtitle layout selection, subtitle editor and subtitle timer.

INTRODUCTION

There are three ways to perform a syncronized translation of a videofilm speech:

- complete re-sounding of the film (the speech being in the corresponding language);
- synchronized translation of the speech on the background of the original sound;
- subtitling.

Irrespectively of the numerous advantages of subtitling today only a negligible part of the videofilms is translated by this method. The relatively high price of the subtitling devices is one reason for their limited use.

Using the developed PCB it becomes possible a cheap and highly efficient subtitling system to be built on the basis of the widely-used IBM PC/XT computer. In fact the price of a such system is determined only by the price of the PCB and the controling software as standard devices can be used for the rest of the system elements (computer, videotape recorders, monitoring TV set).

The PCB configuration and its operation as well as the main functions of the controling software are described below.

CIRCUIT DESCRIPTION

The block diagram of the subtitling device is shown in Fig.1. The circuitry design has been very simplified by use of a character generator of the SAA 5243 series intended to be built-in into the new generation of teletext decoders (Computer Controled Teletext).

As a matter of fact the SAA 5243 IC operates in an environment typical for the single-page teletext decoder [1]. The only difference is that while the phase synchronization between input videosignal and the clock frequency F6 (6 MHz) in the teletext decoder is done by the SAA 5231 video-processor (VIP2), in our case separate PLL and VCO is used. The use of VIP2 is not justified because only one of its function would be performed in the circuitry being described.

The character generator of SA5243 operates in a mode of external synchronization (slaved timing mode) by the input signal. In this mode the RGB and Y outputs of the EURO CCT (the subtitles) are in a strict synchronization with the input signals (the original video picture) and can be mixed through simple multiplexing to the circuitry output. The multiplexer is controlled by the BLAN signal generated by SA5243 in accordance with the content of RAM and R4-R8 internal registers.

From the above it follows that the mechanism of inserting the subtitles into the original video picture differs in no way from that of teletext decoder. However, in contrast to the teletext decoder the subtitles are loaded into the RAM using computer commands transmitted along the I^2C bus. The interface between computer and I^2C bus is realized with a simple logic circuit controlled by the computer DATA bus lines D0 and D1 when data are written to a particular address.

DEVICE CONTROL

The subtitling device is completely controlled through commands sent by the computer along the I^2C bus. The integrated circuit continuously operates in a slave receiver mode at address 0010001 (11H) [2].

The control involves initialization of internal registers and writing a subtitle into RAM. The change of subtitles in tact with the sound background may be considered as a sequence of the writings of separate subtitles. This is done under the supervising of system software and will be considered in more details in the following chapter.

During initialization the internal registers R1-R10 of SAA5243 are loaded with the necessary values to provide for a correct operation of the IC in the given environment as well as to determine the subtitle location, their background (colour or a picture of reduced contrast) and the letter size (normal or doubled height).

In Fig.2a an initialization example is given where the subtitles appear in the lowest two rows (23 and 24) on a colour background; the letter height being normal. The registers R2, R3,R4 and R8 are initialized (reset) when the power supply is switched on.

The register R1 is initialized only once in the beginning of operation and the registers R5-R10 are initialized before writing-in each subtitle.

The subtitle writing into RAM is performed by writing in the register R11 (Fig.2b). Each subtitle represents a string of 40xY bytes where Y is the maximum number of subtitle rows. This parameter is defined when subtitles are edited. In the case when a subtitle can be located in smaller number of rows the rest of rows are filled with code 20H (SPACE). In each row the text is enclosed between the control codes ''Start box'' and ''End box''. Only the characters between these codes (maximum 38 characters in one row) appear on the screen.

After each writing of a subtitle the bits D0-D2 in register R7 are changed from 0 to 1 which enables the subtitle to appear on the screen. The subtitle disappears when the registers R5-R10 are initialized.

SYSTEM SOFTWARE

Using the developed system software the subtitles are input edited and synchronized. The text entered through the keyboard or copied from a floppy disk is edited and divided into subtitles with the help of a special text editor. When this editor is started a menu appears which is used for the selection of character set and subtitle layout (max. number of used rows, subtitle location, colour, background, etc.). After the final subtitle forming the editor automatically transforms the text of each subtitle in a string of length 40xY bytes where Y is the maximum number of rows. The place of the text in the string is determined by the selected subtitle layout (centered, left or right equalized, filling from above or below the required number of rows).

The subtitle synchronization with the sound accompaniment is performed in the following way. During the first playback of the film the subtitles are manually changed by the operator. The destination videotape recorder does not record, and the picture is observed on the tv-monitor (Fig.3). During this operation the control software keeps in memory the time elapsed from the film beginning till the occurring of each subtitle on the display as well as the time of its stay on the screen. At the following playback the subtitles are automatically changed by the control software on the basis of the time constants memorized during the manual playback. At the second playback the videotape recorder again does not record. The recording is carried out only at the third playback after eliminating the eventual errors (lack of synchronization between some subtitles and the accompaniing sound).

CONCLUSION

The developed subtitling system has been experimented for some months yet in the technical laboratory of the Telematic Service Direction at the Committee of Communications and Informatics (Bulgarian PTT). The results obtained show that the subtitle quality is characterized with a high professional level when operating with both RGB signals (U-matic VTR) and videosignals (home VTR of VHS system).

REFERENCE

[1] J.R.KINGHORN, Computer Controlled Teletext User's Manual (Belgium, Brussel, 1983)

[2] PHILIPS COMPONENTS, I^2C-bus Compatible ICs, (Netherlands, Eindhoven, 1989)

[3] PHILIPS, Enhanced Computer-Controlled Teletext Circuit SAA5243, Technical publication 255 (Netherlands, Eindhoven, 1987)

[4] P.S.DYER, User Manual of Stand-Alone Teletext Software, Philips Components Applications Report (UK, London, 1989)

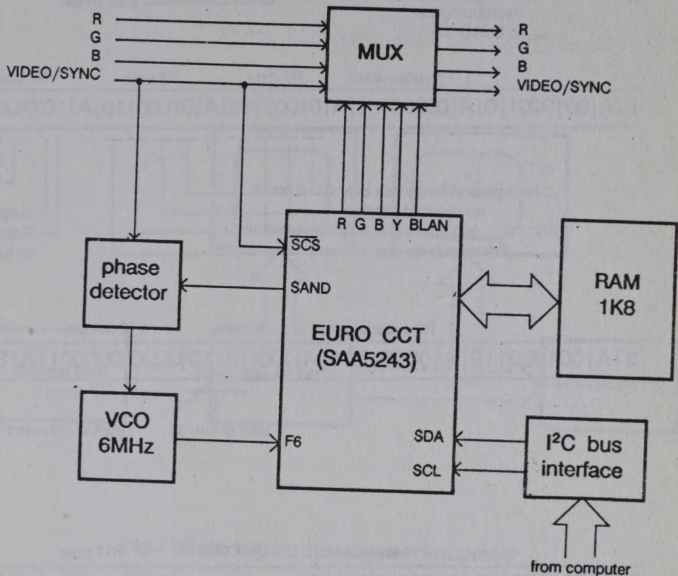


Fig.1 Block diagram of the PCB

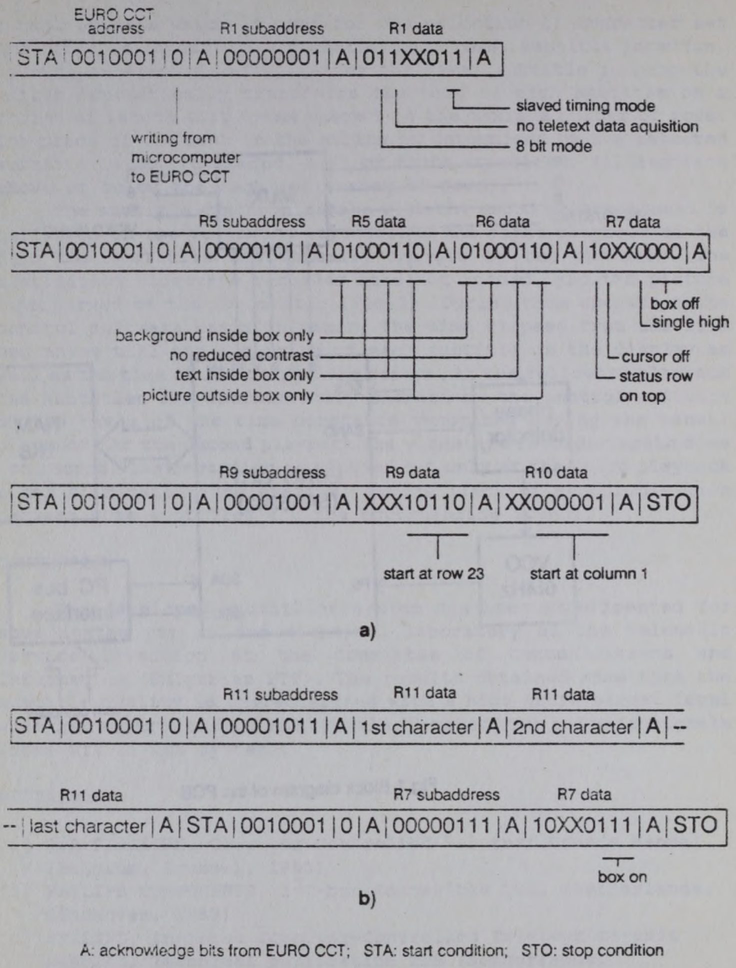


Fig.2 I^2C bus commands to EURO CCT
a) initialization sample; **b)** writing of subtitle into RAM

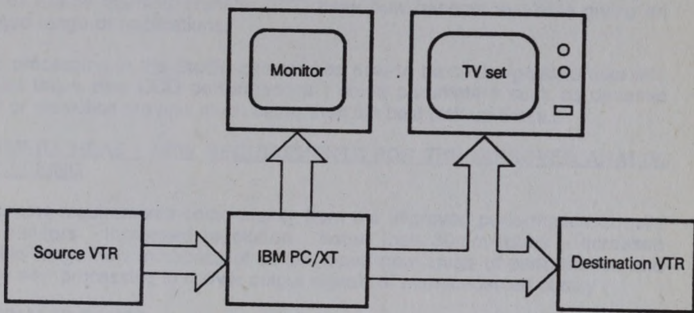


Fig.3 Block diagram of the system equipment

TRENDS IN CCD STUDIO CAMERAS

Bernard TICHIT

Thomson Video Equipement
Paris, France

Over these last few years , performance of solid state image sensors (CCD) has been dramatically improved.
The initial technologies such as Frame Transfer (FT) and Interline transfer (IT) have been much improved in all performance parameters ; new technologies such as Frame Interline Transfer (FIT) have now become available giving an enlarged range of applications.

Video processing in the Studio camera has now to be re-designed to take into account these new CCD performances ; some parameters such as dynamic range or resolution are now much better than the best pick-up tubes...

1- CAMERA HEAD - NEW REQUIREMENTS FOR THE IMPROVED ANALOG PROCESSING

These new requirements come mainly from the improved performance of solid state sensors . Increased resolution , better than 30mm tubes , increased dynamic range now in excess of 80 dB ,open new areas of performance and require new processing to deliver output signals of unprecedented quality .

1.1 DYNAMIC RANGE

The new 80 ...83 dB dynamic range of new sensors will bring the following advantages:

1.1.1 Signal To Noise Ratio

is now in excess of 60 dB in nominal conditions ,giving extremely quiet and clean pictures ,and allowing an increase in gain of up to +24 dB for low light conditions with an acceptable level of noise .

1.1.2 The GAMMA LAW

can be easily adjusted close to the theoretical law (with initial slope of 5 if required) without the usual noise in dark areas .

1.1.3 The HIGHLIGHTS HEADROOM

can be as large as 20 dB (10 times) allowing very precise WHITE COMPRESSION with colour restoration. (will be later explained in detail)

1.2 RESOLUTION

The new 760 ... 800 pixels per line CCDs have many advantages :

1.2.1 The OPTICAL FILTERING required to remove all the aliasing components due to spectrum folding of high spatial frequencies can be easily designed without any compromise . Aliasing can be reduced to a quite negligible level without significant resolution loss in the 5.5 MHz bandwidth.
A typical M.T.F. (Modulation Transfer Function) of 65% can be achieved at 400 TV lines (5.1 MHz) with the new sensors and a third order OPTICAL LOW-PASS FILTER .

1.2.2 RESOLUTION UNIFORMITY is excellent ,close to perfect (remember the problems of spot astigmatism found in pick-up tubes)
The limitation comes only from the zoom lens in full aperture conditions (when the corner resolution decreases) .

1.2.3 PERFECT REGISTRATION of the 3 CCDs gives a much higher UNIFORMITY in luminance resolution that could hardly be found in Tube Cameras .
This is also made possible by the large improvement of ZOOM LENS performances (will be discussed later ,see 1.3.2).

This also suggests that the IMAGE ENHANCER (or contour corrector) can now be designed to take into account the 3 channels . It is now possible because of perfect spatial correlation between the 3 CCDs .

1.3 NEW PROBLEMS ASSOCIATED WITH THE USE OF CCDs

CCDs do require correction of some defects in a completely different way from tubes :

1.3.1 PIXEL UNIFORMITY

As every pixel has a different Black level and different Sensitivity from others, an individual pixel correction could be required .
This kind of defect is highly dependent on the pixel structure (photodiode, photomos ...) and the organization of transfer (IT, FIT, FT).
In addition , the black uniformity is temperature dependant because of dark current increase with temperature rise .
This uniformity correction circuit can be constructed around a memory storing for every pixel 2 bytes (one for black ,one for sensitivity) ;
the total memory size should be about : 500 k x3 x2 = 3 Mbytes to perform the fine correction of the 3 CCDs .

This kind of correction is only required if CCD uniformity is bad ,some structures such as IT gives excellent uniformity of a few % and hence do not really require this correction .
However this circuitry could seem expensive to-day but it seems also difficult to make ZERO DEFECT sensors ,so this system is worth considering ,and will become very attractive in a few years when size and price of memory chips are reduced .

1.3.2 ZOOM LENS DISTORTIONS AND CHROMATIC ABERRATIONS

The problem of lens distortions and chromatic aberrations was easily solved with tube cameras where modulation of scannings allowed correction of all geometric defects .
Usually , on previous tube cameras, an "Automatic Set-Up" system associated with a pattern projector (or "Diascope") in the lens allowed automatic registration and the "Lens File " tables allowed correction of distortions .

These solutions cannot be any more used in CCD Cameras in such a simple way .
Fortunately , the Lens Manufacturers ,aware of all these problems, have been working to reduce all the chromatic aberrations to a low , negligible level . New lenses , specially designed for CCD are now available giving superior registration and resolution performance without the help of geometric corrections .

In addition , the Standardization of OPTICAL, MECHANICAL and ELECTRICAL interfaces as proposed by SMPTE is now a reality , giving a degree of interchangeability never attained before with previous tube cameras .

However, if the newly designed lens do not require registration corrections, they always have the basic optical limitations necessarily associated with the principle of zoom lens and prism beam splitter .
These usual defects (Vignetting , Shading , Flare ...) are worth being completely corrected by a new "Lens File" circuitry .

The "New Camera" will be using this new circuitry called "DYNAMIC LENS CORRECTION " or D.L.C. This subject will be developed later , (see 2.3).

2 . NEW FEATURES FOR A NEW CCD STUDIO CAMERA

We will describe some of the new systems that can be inplemented in a new CCD camera .
Some new features are made possible by the use of solid state sensors, the most obvious example is the shutter capability already widely developed on all the portable cameras from CONSUMER to ENG .

2.1 SHUTTER

The range of shutter speeds can be extended from normal integration time (1/50 or 1/60 th of a second) to an extremely short time (1/10000th) .

The camera sensitivity is however reduced proportionally ; this reduces the practical range to 1/1000th or 1/2000 th .

The new shutter facility will offer a set of speeds such as 1/60 , 1/125 , 1/250 ,1/500, 1/1000 and a continuously adjustable speed.

This idea of VARIABLE INTEGRATION TIME can be extended and generalized : instead of using shorter integration time, a longer time of 2 , 3 or 4 fields could also be possible to increase the camera sensitivity .
This facility could only be useful for nearly still pictures because lag will increase and the picture will be blurred on moving objects.
This new facility also requires the use of a digital frame store in the video processing , this is nearly a negligible extra cost if the camera is built with a fully digital video processing .
The use of such a memory could help to provide other types of processing such as Progressive scanning and interlace conversion .

This subject cannot be developped in this paper but will be developed in a future paper dedicated to the full facility digital processing camera .

2.2 DYNAMIC COLOUR RESTORER (D.C.R.)

The Dynamic colour restorer is a new system of contrast compression allowing correct restitution of overexposed areas in a widely contrasted picture. This system replaces the usual KNEE system and keeps in the highlights the exact ratio between R,G,B thus allowing to reproduce the exact colours .
This system is particularly performing well with the new CCDs since their wide dynamic range allow to keep 20 dB headroom for highlights .
The detailed principle of this system had previously been described in previous lectures (see references) .
The remote control panels allow the control of variable amount of compression : 1 , 2 or 3 lens stops can be selected .
The figure n° 1 shows the input/output transfer function .
The figure n° 2 shows the result compared with simple knee system .

2.3 DYNAMIC LENS CORRECTION (D.L.C.)

The aim of this system is to reduce the white non-uniformity arising from the use of zoom lens and prism splitting optics.
The defects are :
- VIGNETTING (losses of light in picture corners)
- VERTICAL COLOUR SHADING (due to the difference in the angle of incidence of light on the dichroïc coatings because of the variation of the exit pupil position).
- COLOUR BALANCE and FLARE

All these defects depend on many parameters :
- the type of lens
- the use of range extender
- the focal length used
- the object distance
- the iris setting

The new system contains 32 tables corresponding to 16 different zoom lenses with range extender ; the different parameters are encoded on 6 bits (64 positions).
The Figure n° 3 shows the block diagram of the camera and the inplemementation of this circuit.
The overall result is an extraordinary uniformity of picture , even in full aperture conditions or very long focal lengths.

3. CENTRAL CONTROL SYSTEM - REMOTE CONTROL PANELS

New requirements from the user are to simplify and improve the use of remote control panels in any configuration from a single camera alone to large systems of 16 cameras or more .

This central control system uses RS 422 with SMPTE protocol between all the panels and the CCU.
The System is composed of 5 different remote control panels

- OPERATIONAL CONTROL PANEL (OCP)
- SET-UP CONTROL PANEL (SCP)
- JOYSTICK CONTROL PANEL (JCP)
- MASTER CONTROL PANEL (MCP)
- COLOUR CONTROL PANEL (CCP)

These panels can be used individually or together in extremely flexible configurations .
A camera alone (which doesnot require central control) can be completely controlled by the OCP which has all the operational, set-up and monitoring controls .
The Master Control Panel and Colour Control Panel are centralized panels capable of controlling 8 cameras and can be cascaded to control 16 or more...

These MCP and CCP panels use large L.C.D. displays and are completely reconfigurable by software ; they meet the requirements of any type of camera : - ENG , EFP or STUDIO
- H.D.T.V. or Standard
- Tube or CCD .

These panels recognize automatically which type of camera is connected and provide the adequate controls .
Figure n° 4 shows an example of multiple panel interconnection,
Figure n°5 shows the Master Control Panel faceplate .

This unique remote control system provides versatility allowing to use many different types of cameras together .

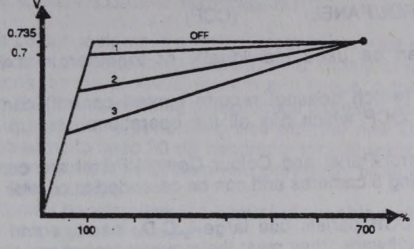
3 - CONCLUSIONS

This paper has described some new ideas for a CCD studio camera.
We have explained some new features and new circuitry such as D.L.C. and D.C.R. .
Most of the features described in this paper have been inplemented in the new THOMSON VIDEO EQUIPEMENT CCD Studio Camera TTV 1542 .

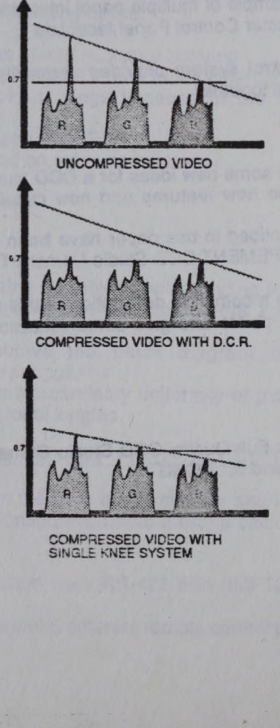
This paper could not give a complete description of this new product, we limited the explainations to new points and give some reflections on the future CCD CAMERAS .

REFERENCES: Towards Full Quality CCD Studio Cameras ; The Last Steps . I.B.C. 88 . J.P. LACOSTE and B. TICHIT .

The figure n° 1 shows the input/output transfer function



The figure n° 2 shows the result compared with simple knee system



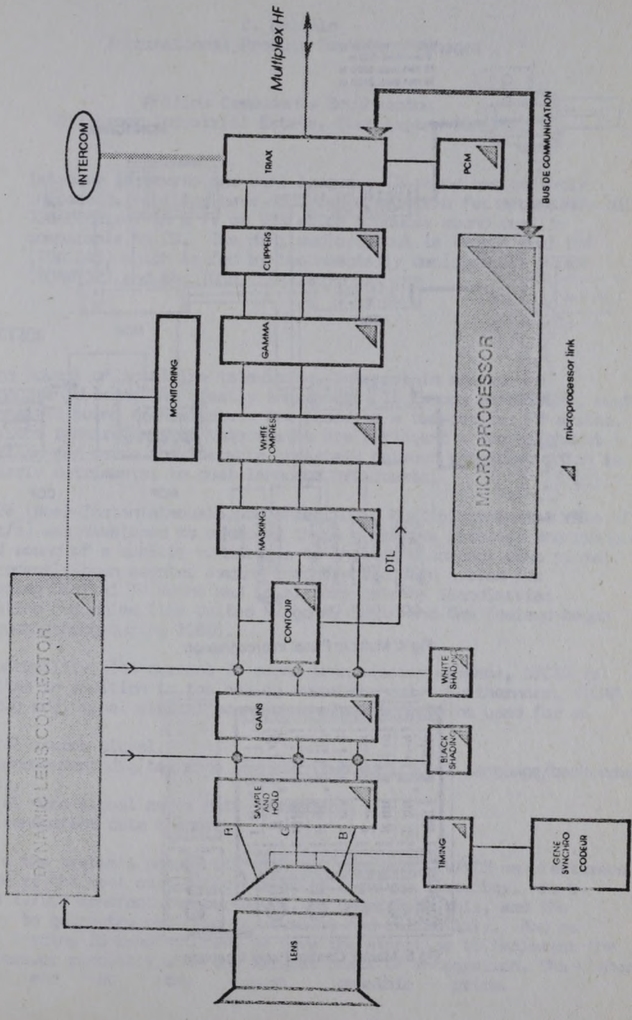


Fig 3: CAMERA HEAD BLOCK DIAGRAM

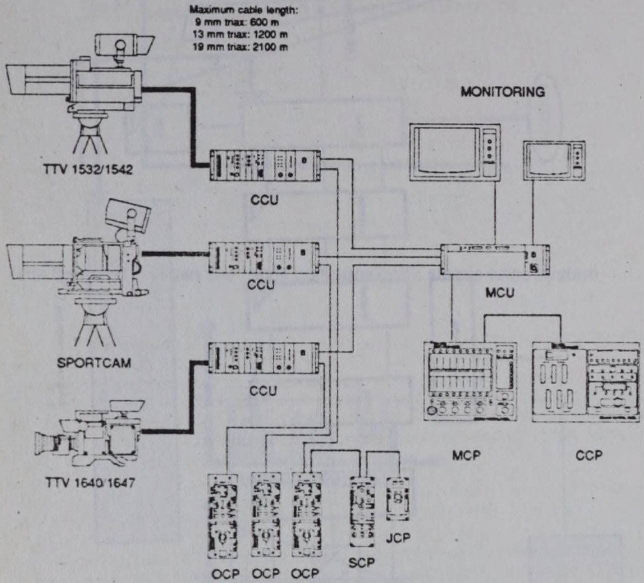


Fig 4: Multiple Panel Interconnexion

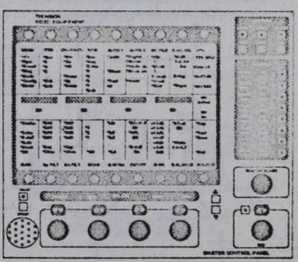


Fig 5: Master Control Panel faceplate

NICAM 728 - Digital TV Sound for the Nineties

C. Balchin
International Product Marketing Manager

Philips Components Southampton
Millbrook Industrial Estate, Southampton SO9 7BH.

Interest in stereo and dual language TV sound has recently increased. Philips have produced a solution for a complete NICAM 728 receiver in a TV or VCR which produces sound quality comparable to CD. The HiFi audio output is from a dual DAC (TDA1543) which is fed by two specially designed ICs NIDEM (TDA8732) and the TDSD (SAA7280).

INTRODUCTION

Since the advent of satellite television, interest in stereo and dual-language TV sound has greatly increased. In Europe at present, most two-channel TV sound transmissions are based on a two-carrier FM system. However, the requirements of this system are stringent - the slightest imperfection can cause considerable crosstalk between channels, which is particularly detrimental to dual-language broadcasts.

NICAM 728 (Near-Instantateously Companded Audio Multiplexing at a rate of 728 kbit/s) was developed to overcome these crosstalk problems and produce hi-fi TV sound of a quality comparable to that of a compact disc player. It has recently been adopted as the European standard system for broadcasting digital TV sound and is already used by Scandinavian broadcasting companies (the United Kingdom, Spain and New Zealand began NICAM broadcasting during 1989).

For compatibility with current TV sound transmission systems, NICAM is transmitted in addition to the analog sound channel. Furthermore, NICAM offers two additional digital sound channels which can be used for an extra:

- digital stereo signal,
- two independent digital mono signals (two additional language/background music),
- digital mono signal and a data channel or,
- one transparent data channel.

To ensure the system's popularity with the consumer, TV/VCR manufacturers will require the most cost-effective NICAM receiver circuitry. As a renowned TV/VCR manufacturer ourselves, we understand this, and the necessity to guarantee performance, quality and reliability. And as Europe's leading IC manufacturer, we have the expertise to implement the NICAM receiver circuitry with the largest scale of integration, the highest quality and at the lowest possible price.

NICAM SIGNAL FORMAT

The Nearly-Instantaneous Companded Audio Multiplex encoding process is shown in a signal flow diagram in Fig 1. At the beginning of the digital encoding process the audio sound signals are sampled at 32 KHz to a resolution of 14 bits per sample. To transmit full 14 bit samples plus associated framing control would take a greater bandwidth than is actually available in between the analogue fm sound carrier and upper adjacent video channel, as can be seen in Fig.2 illustrating the channel spectra for both system 1 (used in the UK) and system B/G (used in Scandinavia).

This is where the NIC (Nearly-Instantaneous Companded) comes into play in the NICAM definition. The 14 bit digital samples corresponding to each of the sound signals are grouped into two separate blocks of 32 samples. All of the samples in each 1ms block are then coded, using a 10 bit two's complement code, to an accuracy determined by the magnitude of the largest sample in the block, and a scale-factor code is formed to convey the degree of compression to the receiver.

A scale-factor code signifies where the 4 bits are extracted from in a 14 bit sample, to compress it to 10 bits. For low amplitude samples, for example, the bits are extracted from the most significant bits because all of the sample value information will only be contained in the least significant bits.

To each of the 10 bit samples a parity bit is added for error detection and scale factor signalling purposes. These two blocks of 32 samples are then multiplexed together and framing control bits are added to produce a continuous bit stream structured into 1ms frames containing 728 bits. Fig 3 shows the detailed contents of these 1ms frames. For stereo transmissions sound channels are transmitted from alternate.

The 704 bit sound/data block is interleaved to a depth of 16 bits in order to minimize the effect of multiple bit errors. Then in the last stage in the encoding process the transmitted bit-stream is scrambled for spectrum-shaping purposes by a modulo-two addition of a pseudo-random binary sequence (PRBS). The frame alignment word is not scrambled so that the beginning of the PRBS can be synchronised by the FAW. The generator polynomial of the PRBS is $X^9 + X^4 + 1$ and the initialisation word is 111111111 giving a PRBS of 720 bit length, so the same sequence is generated for each individual 728 bit frame.

It now becomes evident that there are no bits free in the 728 bit NICAM frame structure to transmit the scale-factor words associated with each sound signal block. The table below shows these scale factor words and indicate which coding range they represent and what protection range they give. These ranges are clarified in Fig.4 which shows how the original 14 bit two's complement coded sound samples are reduced to 10 bits dependent upon which coding range is chosen. The coding range is chosen from the magnitude of the largest sample in the 1ms frame structure as shown earlier in this section.

From Fig.4 we can see that a sample amplitude can be associated with one of the five coding ranges. Once the coding range is determined, by the above process, all the samples, for that particular channel of a 1ms time period, are reduced to 10 bits by extracting the four bits in the location shown in Fig.4.

CODING RANGE	PROTECTION RANGE	SCALE FACTOR RANGE R_2	R_1	R_0
1	1	1	1	1
2	2	1	1	0
3	3	1	0	1
4	4	0	1	1
5	5	1	0	0
5	6	0	1	0
5	7	0	0	1
5	7	0	0	0

These scale factor words are actually transmitted using a very clever method developed by the BBC called "in parity signalling". What this actually means is that the scale factor bits do not actually occupy any space in the frame structure, they are actually coded into the parity bits that are added to the end of each 10 bit sample transmitted. The parity bit is used to check the six most significant bits for the presence of errors. The parity group thus formed is even (i.e. the exclusive-or of the six msb's and the parity bit is zero). So this now created parity bit is modified by an exclusive-or with one of the scale factor bits shown in the table above.

Which scale factor bit is exclusive-or'ed with which parity bit depends upon whether a stereo or mono signal is being transmitted. For added protection against not receiving the correct range code, to allow correct expansion of the 32 samples in sound coding block, the scale factor bits are sent nine times each in a frame, so there are nine copies available of each bit which are coded into 54 of the 64 samples in a frame (2 coding blocks per frame times 3 scale factor bits times 9 copies equals 54). The last ten samples of the frame do not carry any scale factor information.

For transmission, the serial data is converted to two-bit parallel form. Each input-bit pair then determines the phase of the transmitted carrier, as follows:

input bit-pair A	B	carrier phase change (°)
0	0	0
0	1	-90
1	1	-180
1	0	-270

The carrier phase can assume one of four rest-states, separated by 90°. Each bit-pair will shift the phase of the carrier by a designated amount, with reference to the previous rest-state. This is known as differential quadrature phase-shift keyed (DQPSK) modulation. At the receiver, the data is recovered by comparing phase-shifts from one bit-pair to the next.

Table 1 gives the principal system characteristics.

TABLE 1
Principal system characteristics

frequency difference of second sound-carrier and vision carrier:	6.552 MHz (1), 5.85 MHz (B,G)
level of second sound-carrier referred to peak vision-carrier	-20dB
modulation of second sound-carrier:	DQPSK
bandwidth of transmitted PSK signal:	700 kHz
overall bit rate:	728 kbit/s
signal options	- stereo - independent mono - one mono plus 352 kbit/s data - 704 kbit/s data
audio sampling rate:	32 kHz
audio coding:	14 to 10 bit NIC
ancillary data capacity:	11 kbit/s

PHILIPS ICs FOR NICAM

A three-chip set is available for a complete NICAM receiver. The signal from the TV IF/demodulator is passed through a bandpass filter for input to the NICAM Demodulator (NIDEM) IC TDA8732. The demodulated NICAM signal is decoded by the SAA7280 TDSD (Terrestrial Digital Sound Decoder). The audio output is from a dual DAC (TDA1543), originally developed for our CD players.

The crystal-controlled frequencies have been carefully selected to minimise external components. The system can be controlled by either a microcomputer via the I^2C or by direct access, to the TDSD pins. The features of the ICs are:

DETAILED IC INFORMATION

TDA8732 NICAM-728 demodulator (NIDEM)

The TDA8732 is a dedicated bipolar IC providing a DQPSK (Differential Quadrature Phase-Shift Keying) demodulator for the NICAM 728 system. Available in a 20-pin DIL package, this IC interfaces with NICAM decoders and provides data synchronised to a 728 kHz clock. The TDA8732 contains:

- a quadrature demodulator based on a costas-loop which uses a single-pin crystal oscillator in the VCO.

- a carrier-phase recovery PLL to synchronise the sine and cosine reference carrier signals for quadrature demodulation.
- a bit-rate clock recovery PLL to synchronise the 728 kHz clock generated by the SAA7280 (or an internal clock 728 kHz clock provided for use with other decoders) with the input data rate
- a differential decoder with parallel to serial converter

Features of the TDA8732 include:

- limiting amplifier for QPSK input
- operation with PAL-B, -G and -I standards
- crystal-controlled bit-rate clock recovery
- 5 volt supplies to analog and digital circuitry.

SAA7280 Terrestrial digital sound decoder (TDSD)

The SAA7280 is a CMOS IC in a 28-pin DIL package that performs all the digital decoding functions for the NICAM 728 system. The demodulated signal taken from the TDA8732, is decoded, checked for errors, formatted and then fed to the dual DAC via a selectable sound bus. Because of the architecture used (carefully chosen reference oscillator frequency of 17.472 MHz and using only two PLLs), this chip required the minimum of peripheral components and an 3 x oversampling filter ensures the minimum analog filtering is required. Features include:

- full EBU NICAM 728 specification
- control via I^2C bus or IC pins
- 3 x digital oversampling filter (selectable)
- seven sample interpolator for erroneous samples
- on board RAM for de-interleaving and 10 to 14-bit word expansion
- three-state outputs for sound bus (I^2S Format)
- automatic decoding and output configuration, depending upon transmission:
  - digital stereo
  - digital mono and data
  - independent digital mono signals

TDA1543 dual DAC

The TDA1543 is a 16-bit digital-to-analog converter in an 8-pin DIL package. Designed as an economy version DAC, for hi-fi CD players and digital cassette recorders, it requires no peripheral components. Features include:

- low distortion
- single 5V power supply
- fast-settling output current (no deglitcher required)
- I^2S input format
- 4 x oversampling possible

NICAM
Near-Instantaneously Companded Audio Multiplex Encoding Process

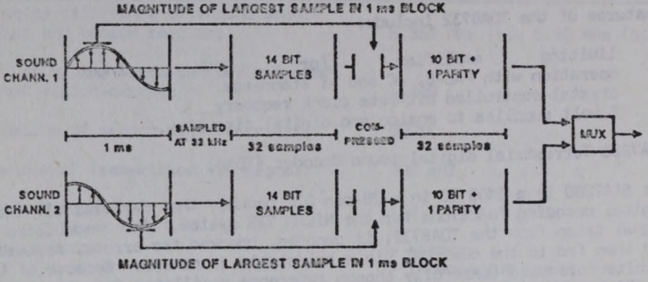


FIG. 1

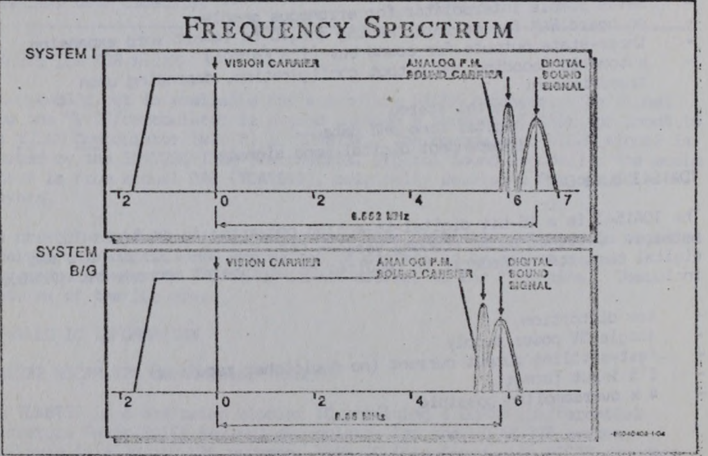


FIG. 2

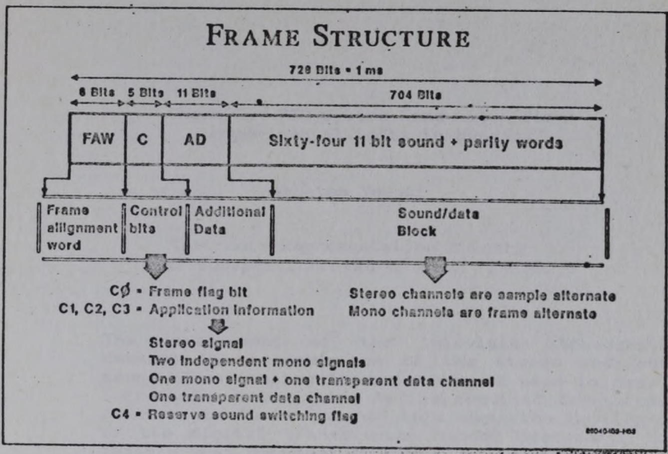


FIG. 3

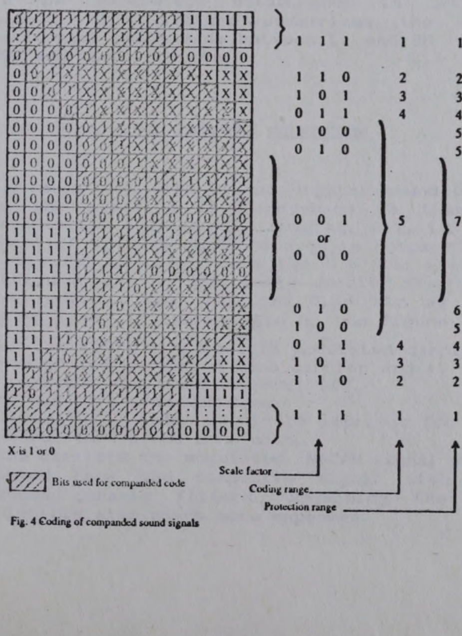


Fig. 4 Coding of companded sound signals

The NICAM 728 system and its first experimental tests in Hungary

Ágoston Tomosi

Tektronix Representation Hungary
1027 Budapest, Horvát u. 2-12. IV/39.

The development of the television broadcasting demands the transmission of the stereo incidental sound. First analog transmission was used in case of terrestrial television. As the required transmission features can't be assured this way, the development of the digital transmission became neccesary. More Western and Northern European television companies use the NICAM 728 digital sound transmission system with the parameters established in B/G and I standard. This lecture summarizes the Hungarian experimental tests made between 1. and 28. September 1989. and their results.

THE PROBLEMS OF THE DIGITAL CARRIER SELECTION

1. The carrier modulated with stereo digital sound should be placed in the standard frequency-band so that it is compatible with the existing instruments. [1], [2]. In the 8 MHz channel of the D/K standard used in Hungary there is a possibility for placing above the 6,5 MHz analog mono carrier. (Figure 1.) The applicable carrier frequency can be selected between 6,83 MHz and 6,86 Mhz as the odd harmonious of $f_H/2$. It can be seen on the figure that the spectrum of the ±240 kHz bandwidth modulated carrier meets the spectrum of the modulated mono carrier and it just has the place till the next channel. [3], [4].
   This method has more disadvantages:
   a., An extra NICAM coder should be improved for the D/K standard. This means more cost.
   b., In the carriers the modulated NICAM signal should be selected from the composite signal with special produced ceramic filters. Regarding the limited supply this also means more expenses.

c., In the Hungarian television system beside the standard 8 MHz channel allocation a lot of 7 MHz bandwidth CATV systems can be found. In these the so formed stereo signal can't be realized.

2. The carrier modulated with the stereo digital signal can be placed between the picture carrier and the sound carrier maintaining the compatibility. The location of the composite modulated signal of the standarnized I, B, G systems in the transmission channel can be seen on Figure 2. and in the D/K system between the two carriers can be seen on Figure 3. . Though the solution demands the limitation of the video bandwidth according to the B/G standard, it gives the following advantages:
   a., The composite D/K standard signal can be located in a 7 MHz channel
   b., A newly developed NICAM modulator is not necessary.
   c., Ceramic filters according to the B/G standard 5,85 MHz can be used in the receivers.

In accordance with the above mentioned points we made the experimental tests with the 2nd variant in Hungary.

PRODUCING OF THE COMPOSITE NICAM SIGNAL

The introduction of the NICAM signal into the composite signal can be made on different ways [5]:
   a., The signal source forwards a video signal and two sound signals to the transmitter, the NICAM ENCODER and the modulator is before the transmitter input.
   b., The NICAM ENCODER is in the studio, its signal is multiplexed and it is forwarded to the transmitter along with the video signal through a 2Mb/s sampling data channel. The demultiplexed NICAM signal is retreived and with that the transmitter can be modulated.
   c., The studio transmits the video signal and the two sound channels is sound-in-syncs mode through one microwave channel to the transmitter. There the signal is decoded, the NICAM ENCODER is fed with the two sound signals and the transmitter input is driven with that signal.

As during the experimental tests there was a very big disturbance on the microwave channel between the studio and the transmitter, after the laboratory tests the measuring set up was made in the transmitter room. The Hungarian PTT provided us the channel 41. transmitter. This is an IF-modulated 150 W transmitter which was optimised for intermodulation parameters before the experimental tests. Instead of the tramsmitter IF modulator a TR-2023 type TV IF MODULATOR and a NICAM CONVERTER was used. [6]. The set up is shown on Figure 4. It can be seen on this figure that the IF modulator does the band-limitation of the video signal the frequency transposing and the bandshaping of the side-band.

The NICAM CONVERTER produces the 32,4 MHz mono sound IF signal, the 33,05 MHz NICAM IF signal and the signals with coherent carrier.
SECAM and PAL colour bar signal or an electronic monoscope signal or a live video signal was used in the tests.
Sinusoidal measuring signals and a CD recordplayer signal were used as sound signals.
The NICAM signal was produced by a TEKTRONIX 728E ENCODER.
The spectrum of the composite IF signal can be seen on Figure 5.
This time the vision modulation is SECAM colour bar, the sound modulation on one channel was 1kHz, and no modulation on the other channel.
The spectrum of the channel 41. transmitter output signal can be seen on Figure 6. The measurement was made by TEKTRONIX 2710 spectrum analyzer at the Research Institute of the PTT, the picture was printed with the TEKTRONIX HC100 Printer-Plotter connented to the printer output. The Figure 7a shows the output signal of the channel 41. transmitter in the same way.
The measuring was made in the Budapest Technical University with TEKTRONIX 2710 spectrum analyzer directly on the end of the antenna cable. The picture modulation was a live picture, mono sound modulation a live sound, NICAM A channel 1000 Hz, B channel 0. It can be seen clearly that the NICAM carrier mixed with the two carrier doesn't cause any disturbance in the spectrum. The part of the former spectrum NICAM and mono sound carrier can be seen on Figure 7b in electronically magnified, the marker is on the sound carrier (before the measurement the spectrum analyzer wasn't calibrated).
A part of the NICAM carrier of the spectrum can be seen magnified on Figure 7c . The very good band-limitation in the NICAM component of the signal can be seen. This also can be found in the live modulation.
Figure 8a and 8b show the signal of the transposer working on channel 33. driven by the signal of the channel 41. transmitter at the Budapest Technical University's cable -end of the antenna. No distortion can be seen, see other remarks in the next chapter.
A part of the NICAM and mono carrier frequency spectrum of the channel 33. transposer signal can also be seen on Figure 9a, but in this case an East German made antenna-amplifier follows the antenna and its output was examined. The appearance of the intermodulation products is remarkable. The two markers can be found on the mono sound carrier and on the highest intermodulation component, the 300kHz frequency distance can be seen. The same can be seen on Figure 9b, but the second marker is on the second highest spurious signal, its distance is -1,04 MHz (below the NICAM spectrum).

SUBJECTIV CONCLUSIONS

During the broadcasting tests the picture and the sound of the receivers of different type and date of production were examined in several places with respect to the disturbance caused by the mixed NICAM carrier. This test was also made in the laboratory of Hiradástechnika Szövetkezet on channel 010. No disturbance originated from NICAM carrier was found in the receiver either tuned to channel 010 or channel 41. Measurements were made with professional demodulator on channels 010 and 41. No disturbance appeared.
This is not the case when the receivers were tuned to the transposer on channel 33. This time there were moving interfering signals on the picture. During the short series of tests the origin of the disturbance couldn't be found, but probably the reason is an error in the transposer. Average viewers noticed the same error on channel 33. during the live broadcasts, that's why the live broadcast tests had to be cut short and could be continued only during the broadcast breaks. Measurements were done in the stereo sound channel of the NICAM receiver (NOKIA 5581SK) to determine frequency response, distortion, signal/noise and crosstalk-attenuation parameters. All the results have proved the feasibility of the NICAM system. Measurements and subjectiv evaluations were also done with the stereo TV set of the INTERMETALL company. The results here were also excellent.

CONCLUSION

1. The experimental tests proved the possible installation of the 5,85 MHz carrier frequency NICAM signal in the D/K standard. [6].
2. The 5,85 / 6,5 MHz carrier frequencies proved to be compatible with the receivers already in use.
3. The 5 MHz video band limitation didn't prove to be damaging for the quality, the deterioration can be observed in colour bar and monoscope. Further tests are neccesary.
4. The state of the home transmitter network and the microwave distributive network should be examined concessing the NICAM subcarrier.
5. The CATV and the central antenna systems should be checked with respect to the NICAM signal.
6. The measurement methods should be evaluated for the composite TV signal containing the NICAM components.

EXPRESSION OF THANKS

I'd like to take the opportunity to thank the management of TEKTRONIX, personally Mr. Paul Dubery and Mr. Adolfo Rodriguez, to provide us with the 728E and 728D type instruments for the measurements. I'd also like to thank Mr József Zigó (Hiradástechnika Szövetkezet), who transformed the instruments and additional parts of HT very quickly so that they were suited for the task. Thanks for the help of Mr. Sandor Stefler and Elek Nemcsics, and the ideas and help of Mr. Prof. Pál Ferenczy. Last but not least I thank the help and cooperation of the employees of the Budapest Television Broadcasting Station.

REFERENCES

[1] A. J. Bower: NICAM 728 - Digital two channel sound for terrestrial television BBC Research Department, Kingwood Warren, Tadworth Surrey Kt 20 6NP

[2] Gunnar Beuter: NICAM 728 Introducion in Sweden. Swedish Telecom Radio Laboratory

[3] CCIR Draft 795-2: Transmission of two or more sound programmes or information channel in television

[4] EBU (1978): Specification for transmission of two-channel digital sound with terrestrial television systems B, G and I, EBU Documents SPB 424

[5] Tektronix: NICAM 728E Operators Manual

[6] Measurement report about the use of NICAM 728 digital sound carrier procedure in D/K standard systems. Manusript

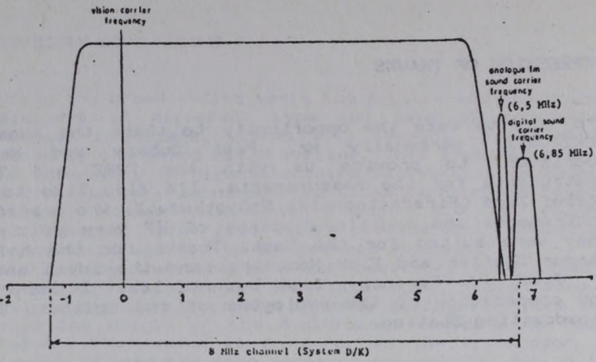


Figure 1. The spectrum of a D/K standard transmitter output signal with the digital sound carrier placed above the first sound carrier.

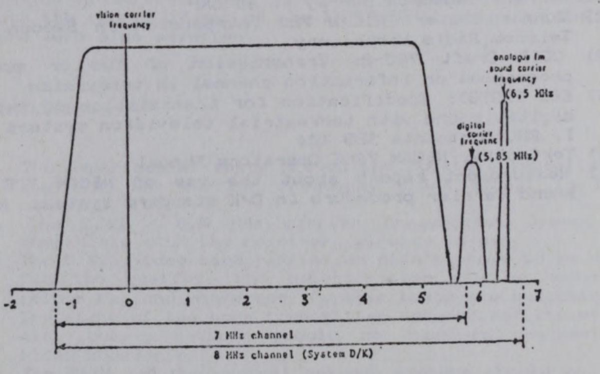


Figure 3. The spectrum of the D/K standard transmitter with the digital sound carrier placed between the vision carrier and the first sound carrier.

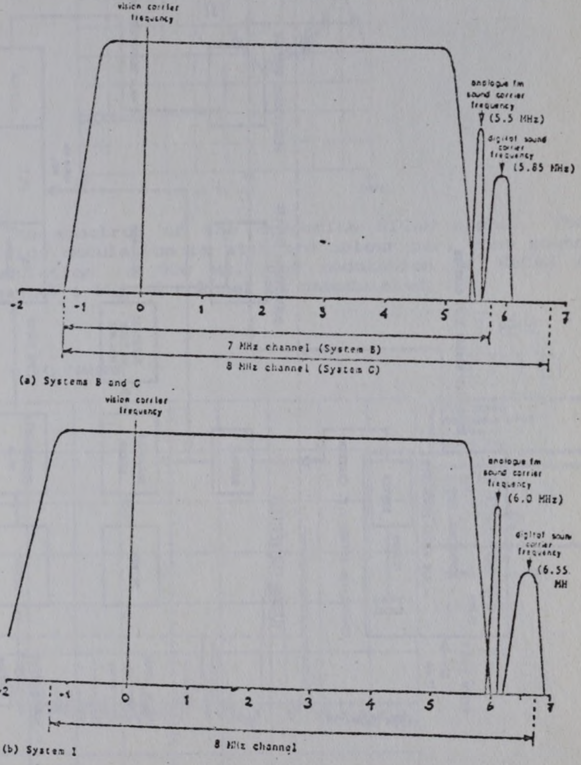


Figure 2. The spectrums of the output signals of B, G, I standard transmitters.

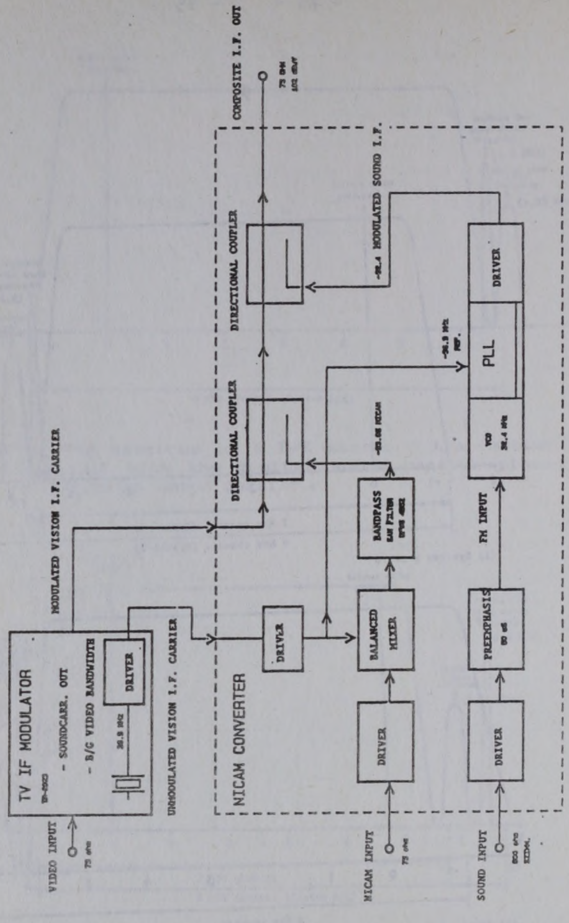


Figure 4. Modified I.F. modulator for the mixing of the NICAM signal.

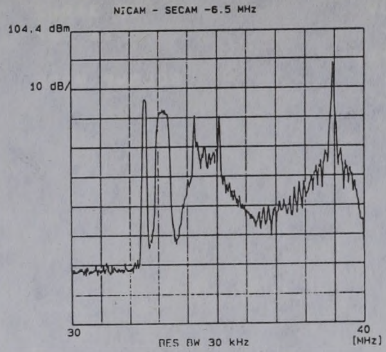


Figure 5. The spectrum of the composite NICAM signal. The vision modulation is standard colour-bar, mono sound modulation is 800 Hz, the modulation of NICAM A channel 1 kHz, B channel is unmodulated.

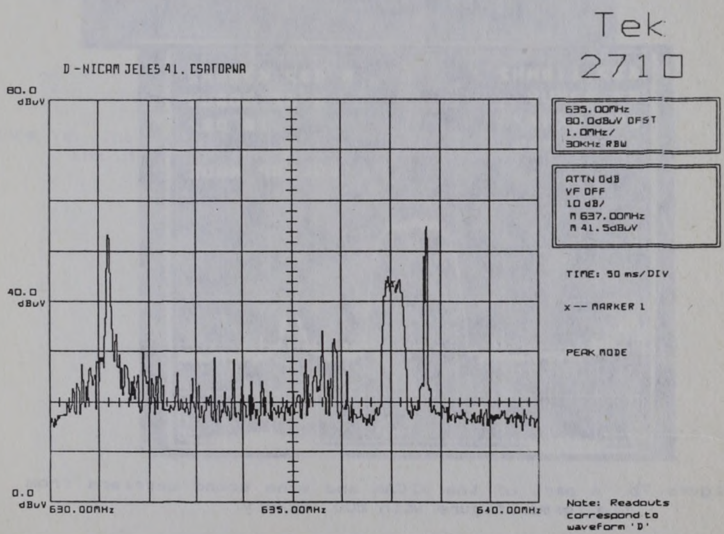


Figure 6. The spectrum of the transmitter on channel 41. Modulation is the same as on Figure 5.

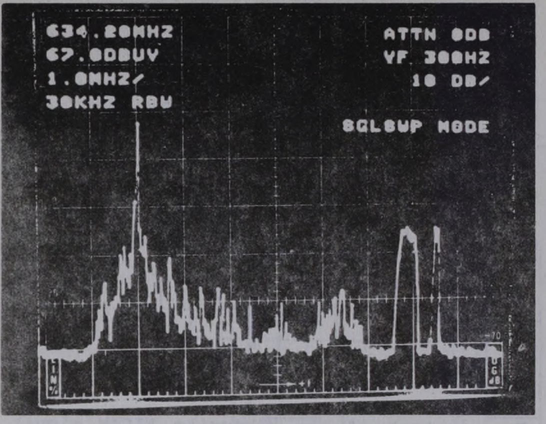


Figure 7a. The spectrum of the transmitter on channel 41. Vision modulation is a live picture, mono sound modulation is a live sound, the modulation of NICAM A channel 1 kHz, B channel is unmodulated.

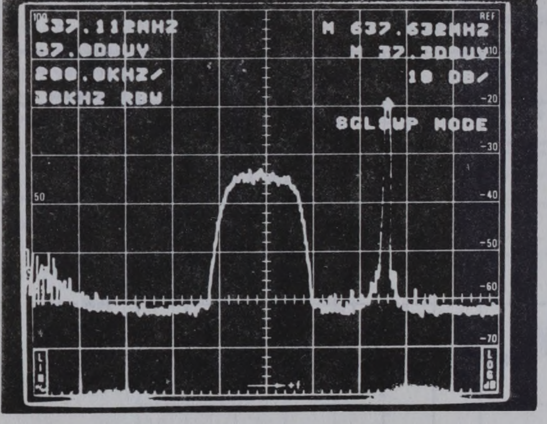


Figure 7b. A part of the NICAM and mono sound carriers from the former figure with 200 kHz/div.

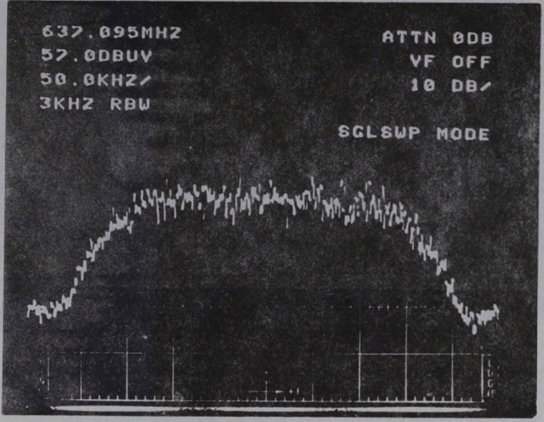


Figure 7c. The part of the spectrum from Figure 7a. with 50 kHz/div

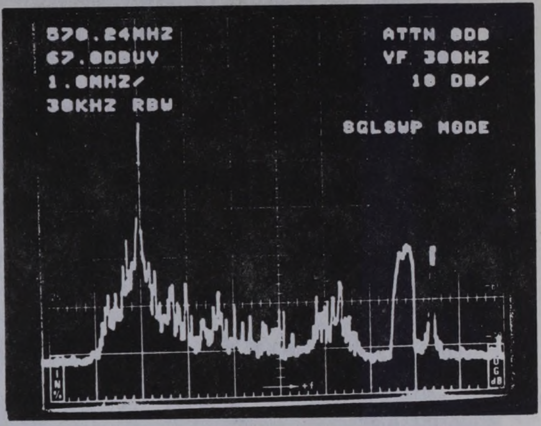


Figure 8a. The spectrum of the transposer on channel 33. .

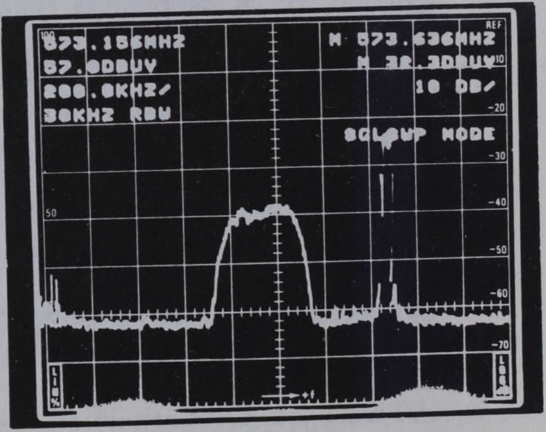


Figure 8b. A part of the NICAM and mono sound carriers from the former figure with 200 kHz/div.

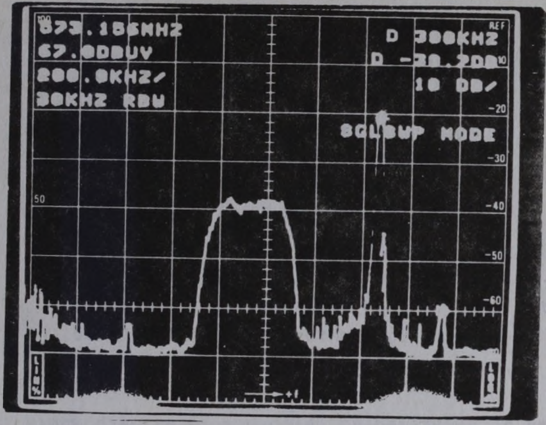


Figure 9a. Intermodulation signal components caused by the East German made distributing-amplifier. The measurement of the highest disturbing component.

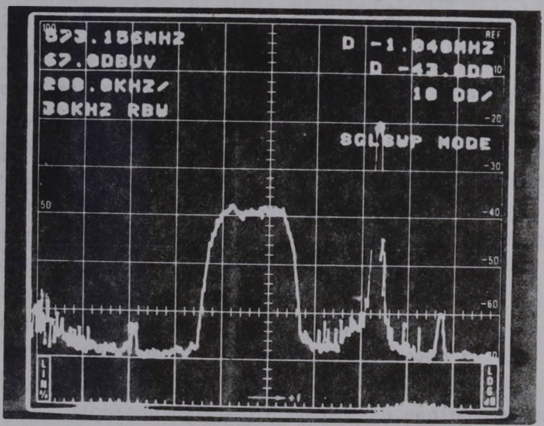
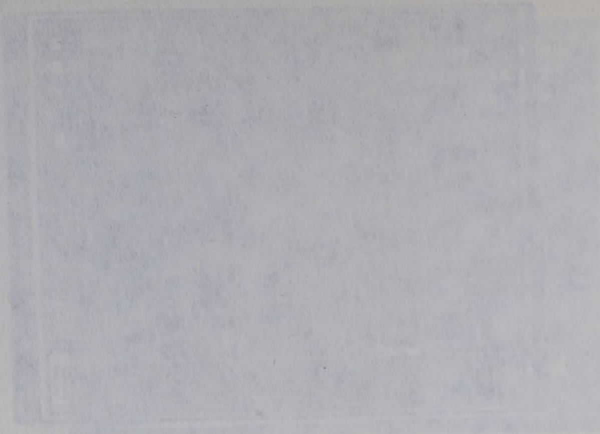
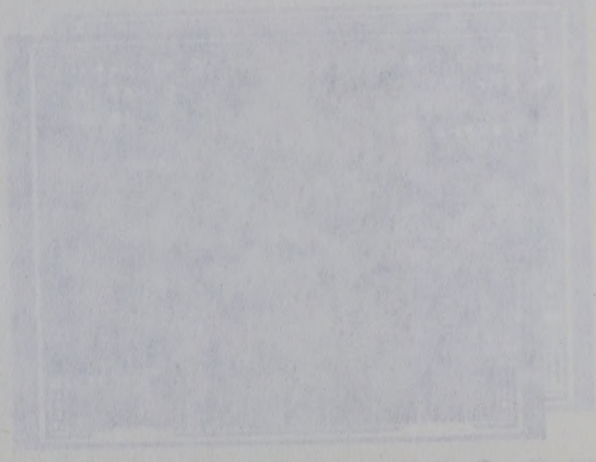


Figure 9b. The same as in Figure 9a., but this is the measurement of the second highest component.





Digital Transmission of TV Signals (34 Mbit/s)

DR. ANTHONY PÁLINSZKI
Technical University of Budapest
H-1111 Budapest Sztoczek u 2.

This paper describes a design of two coding systems for the transmission of a colour tv and audio programs at 34 Mbit/s. This article describes the used methods of the bit-rate reduction and the used adaptive systems.

The block diagram of a digital transmission is shown in Fig.1.
The data of the studio standard of a component coded tv signal are the following:

sampling frequency: 13,5 MHz for the luminance (Y) signal
-"- : 6,75 MHz for the two chrominance sign.
length of the code-words: 8 bit/sample.

These data give a bit rate of 216 Mbit/s. The digital telecommunications networks have a lower bit-rate, than 216 Mbit/s, for example 140 Mbit/s or 34 Mbit/s, so we have to reduce the average length of code-words to 5,2 bit/sample from 8 bit/sample (if the bit-rate is 140 Mbit/s) and to 1,3 bit/sample (if the bit-rate is 34 Mbit/s). A reduction of the average length of code-words (from 8 bit/sample to 1,3 bit/sam ple) is the most important aim. We can achieve this with the following measures:

a/ reduction of the sampling frequency
b/ skiping some of the samples
c/ adoption of the transforming coding systems
d/ adoption of prediction coding
e/ adoption of adaptive systems

The researchers int the world have elaborated a lot of solutions of the above possibilities. There will be shown two examples of those solutions. One of them is a sophisticated approach but in turn its picture quality is very good. [1.] The other one is a simple solution and of course its picture quality is deteriorated due to the simple solution. [2.]

First let us see the sophisticated solution. The major parameteres of motion compensated adaptive prediction coding are shown in Table 1. The adaptive prediction coding covers those coding methods in which a few different predictors are used at the same time and a selection algorithm chooses the actual predictor. In this solution three different predictors are used. There are as follows:

a/ motion-compensated interframe predictor

b/ interfield predictor

c/ intrafield predictor.

The actuel predictor is selected by a special algorithm called MAP (Medion Adaptive Pr ediction) selection. The MAP selection does not choose the optimum predictor which has the minimum prediction error b ut is an optimum selection for a low bit-rate coding because using MAP it is not necessary to send additional bits to the receiver for the identification.
The used three prediction algorithms are as follows (see Fig. 2.):

a/ intrafield prediction algorithm

for Y signals

$$P(j, n, k) = \frac{3}{4} S(j,n,k-2) + \frac{1}{4} S(j,n-1,k+2)$$

for R-Y, B-Y signals

$$P(j, n, k) = \frac{3}{4} S(j,n,k-4) + S(j,n-2,k) - \frac{3}{4} S(j,n-2,k-4)$$

b/ intefield prediction algorithm

for Y signals

$$P(j, n, k) = \frac{3}{4} S(j,n,k-2) + S(j-1,n,k) - \frac{3}{4} S(j-1,n,k-2)$$

for R-Y, B-Y signals

$$P(j, n, k) = \frac{3}{4} S(j,n,k-4) + S(j-1,n,k) - \frac{3}{4} S(j-1,n,k-4)$$

c/ interframe prediction algorithm

for Y signals

$$P(j, n, k) = S(j-2, n-M_1, k-M_2)$$

for R-Y, B-Y signals

$$P(j, n, k) = S(j-2, n-M_1, k-M_2)$$

The values of M_1 and M_2 are given by a motion detector which compares 8 x 16 pels of two successive frames. (If in the compared blocks of successive frames the speed approaches zero then the values of M_1 and M_2 go towards the zero too.) In order to further reduction of transmission rate other adaptive processes are used, these processes are as follows

a/ adoption of the adaptive quantization including a choice from eight different quantizing characteristics

b/ adoption of the variable length binary codes (1 bit ÷ 12 bit). It is similar to a Huffman code.

The 34 Mbit/s stream transmits two sound channels besides the video information. Protection of the coded signals against transmission errors is a double error correcting code.

A simple transmission method will be shown in the following. The major features of this method are given in Table 2. The HDPCM coding of Y signals means that samples made by prediction have a code length of 5 bits and every 9th sample, made without prediction, has a code-length of 8 bits. In the DPCM coding a MAP selection choose the actual predictor from three different intrafield predictors. The used three intrafield prediction algorithms are as follows:

for Y signals and for R-Y, B-Y signals:

$$P(j, n, k) = S(j,n,k-1)$$

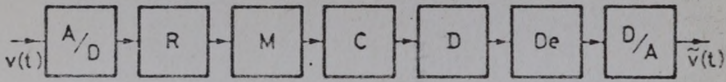
$$P(j, n, k) = \frac{3}{4} S(j,n,k-1) + \frac{1}{4} S(j,n-1,k+1)$$

$$P(j, n, k) = \frac{3}{4} S(j,n,k-1) + \frac{3}{4} S(j,n-1,k) - \frac{1}{2} S(j,n-1,k-1)$$

This transmission method has a further adaptive process over the MAP selection: it uses eight different sliding quantizing characteristics. The 34 Mbit/s stream can transmit two HQ and one MQ sound channels besides the video information. Protection of the coded video and sound signals against transmission errors is a Hamming error correcting code. The block diagram of the HDPCM coding system is shown in Fig.3.

1./ S.Matsumoto, H.Murakami, H. Yamamoto,
Coding Performance of Motion-Compensated Interframe, Interfield, and Interfield Adaptive Prediction Coding for Composite and Component TV Signals. SMPTE Journal, May 1986

2./ P.Ferenczy, F.Kis-Szölgyémi, A.Pálinszki,
34 Mbit/s-os KODEK rendszerterve
BME Híradástechnikai Elektronika Intézet, 1987.



v(t), ṽ(t): analog. tv signal   R : reduction of redundancy

M : modulator   C : channel   D : demodulator   De : decoder

Figure 1.

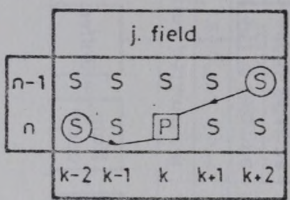
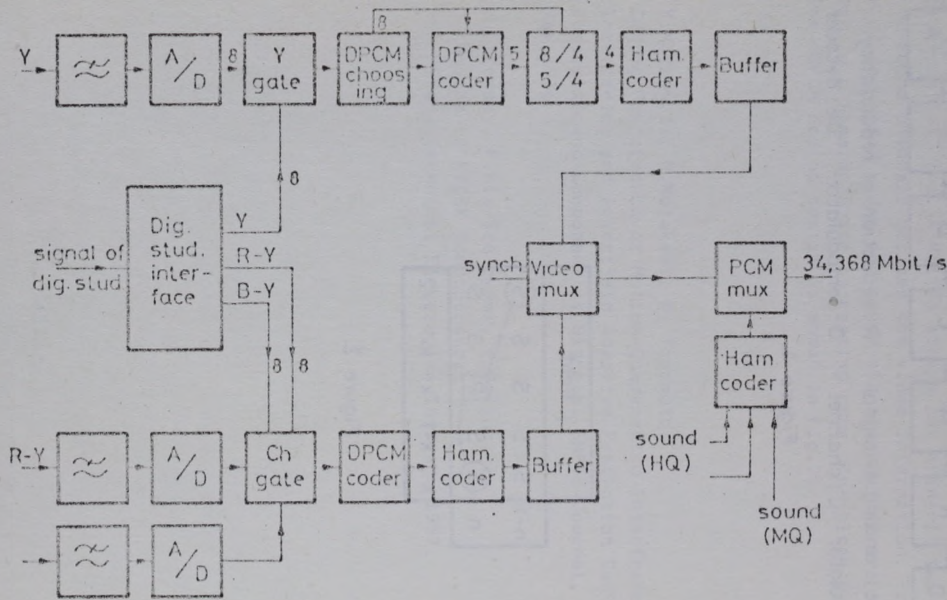


Figure 2.



Y
A/D
8
Y gate
DPCM choosing
8
DPCM coder
5
8/4 5/4
4
Ham. coder
Buffer
8
signal of dig. stud.
Dig. stud. interface
Y
R-Y
B-Y
8
8
synch
Video mux
PCM mux
34,368 Mbit/s
Ham coder
R-Y
A/D
Ch gate
DPCM coder
Ham. coder
Buffer
sound (HQ)
sound (MQ)
A/D

Figure 3.

	Sampling fr.	Transmitted samples
Luminance signal (Y)	13,5 MHz	every samples
Chrominance signal (R-Y)	6,75 MHz	samples of the odd lines
B - Y		samples of the even lines

Table 1.

	Sampling fr.	Transmitted samples	Coding
Y signal	13,5 MHz	every 2nd sample	Hybrid DPCM (5/8)
R-Y signal	6,75 MHz	every 2nd field every 2nd line every 2nd sample	DPCM (8 bit)
B-Y signal			

Table 2.

HIGH QUALITY TRANSMISSION OF VIDEO AND AUDIO

Heinrich E. Haase

Philips Kommunikations Industrie AG
Nürnberg - West-Germany

Increasing interest on unlimited access to TV and Sound-programs and the introduction of new TV-standards in the near future requires the performance transmission of such signals from the studio to every subscriber. Depending on the distances between the studio and the subscriber different requirements on the quality of transmission systems are to be considered.
The paper explains the stringent requirements, which are needed for high quality transmission.
It also stresses the technical and economical advantages of digital TV and Audio transmission in optical networks.
A practical system for transmission of a single TV-program for highest quality level and a system proposal for a multi-channel transmission system will be explained.

Structure:

1. Introduction
2. Structures for TV-and Audio-transmission
3. Requirements on TV-and Audio-transmission systems - now and in the future -
4. Advantages of digital and analog transmission via optical fibre
5. Digital transmission with Systems like DIGAS and DAVOS
6. Proposal for multifunctional multichannel transmission

1. Introduction

The transmission of TV-signals in sufficient quality requires
sophisticated "high-quality" TV-transmission-systems.
Depending on the structure of TV-transmission networks different quality requirements are requested.
With respect to the future different new TV-standards are to be transmitted.
All these points of view are the basis for a consideration regarding to existing transmission systems and systems under development.

2. Structures for TV- and Audio transmission

To get an overview about the possible structures for TV- and Audio transmission networks some ways are given below: (Fig.1)

a. Transmission from the camera to the studio
Highest quality is required for such a transmission. The most usefull way is to transmit the camera-signal with RGB-standard via coaxial cables, but also FBAS-transmission has to be considered.
Regarding to EMC- and mains distortion-problems an optical
fibre solution would be more convenient.

b. Transmission from studio to studio
Possible application for a transmission like this is the program transfer from a private studio to a public studio.

c. Transmission of TV-programs within the TV-network
The video- and audiosignals are transmitted via TV-lines from the studio to the TV-transmitter (Fig.2)
The same way can be seen at the receiving side.

d. Transmission of TV-programs within PCM-trunk-networks
The use of the existing PCM-hierarchy-network like 140Mbit/s and 565Mbit/s is a very cheap way for a long distance transmission of TV-programs.

e. Program feeding lines in CATV networks
For the distribution of TV-programs from a main distribution center to a primary mainstation (fig.3) systems for a lot of signals are needed.

3. Requirements on TV- and Audio transmission systems

With respect to the structures described under 2. some points of view have to be considered for actual transmission lines:

- Transmission of Video- and Audiosignals via Singlemode-fibre respectively Multimode-fibre at a wavelength of 1300nm.
- Transmission of a CCVS signal of the TV-standars PAL, SECAM or NTSC in accordance with CCIR-Recommendation 470-1.
- simultaneous transmission of two corresponding TV Audio signals
- transmission of a CCVS signal with integrated audio signals
  (e.g. sound in sync, sound in vision)
- For the applications considered under 2 a-d the weighted signal to noise ratio must be at least 64 dB
- For the application 2e a weighted to noise ratio of at least 56dB is nescessary
- For the application 2c it must be possible to cascade more than 5 systems
- For the application considered under 2ea standardized CMI-signal for to feed into th 4th PCM hierarchy stage is required
- picture coding has to be made with at least 9bit resolution, the audio coding with 14bit resolution

For future applications and developments the following points have to be implemented within new systems:

- Transmission of more than one channel per optical fibre
- Transmission of new TV-standards like B-MAC, D-MAC, D2-MAC,
  HD-MAC a.s.o.
- For the application 2d it must also be possible to transmit DBS-signals for digital sound programs and the traditionel FM-programs
- For studio applications a codec for component signals is requested

The basis for all these requirements is the use of digital coding and the use of optical fibre.

4. Advantages of digital TV-transmission systems via optical fibre

For the digital transmission of CCVS-signals it is reasonable to apply composite coding.

The pulse code modulation is well suited for the digital transmission on fibre optic systems. The signal is first sampled, then quantized and finally transmitted in coded form. The major advantages of digital transmission are its lower susceptibility to interferences and its independance of the signal to noise ratio with respect to the distance which has to be passed by.

Only the actual A/D-conversion is decisive for the quality of the digital signal whereas analog transmission systems may influence and worsen the signal.

Nevertheless there are many cases for using analog systems as a convenient and low-priced alternative within small and distance-limited networks.

The most important advantages of optical transmission are in catchwords:

- large bandwidth capacity
- low attenuation values
- galvanic isolation between input and output
- indifference to electrical and magnetical interferences
- no crosstalk
- high security towards interception
- low cable weight
- small cable diameter
- in comparison to copper glass is available in almost unlimited quantities as resource

5. Digital transmission by means of the sytems DAVOS and DIGAS

All the considered requirements for actual applications leaded to the digital transmissiomn systems DAVOS and DIGAS.

5.1 DAVOS

Philips Kommunikations Industrie AG developed a TV-transmission system for highest quality requirements.

The name of the system is composed of the first letters of the essential system features:

D for digital
A for Audio
V for Video
O for Optical
S for System

The system family DAVOS consist of a system for transmitting TV- and Audio signals via optical fibre and a system with a standardized CMI-interface for the use within PCM-networks.

DAVOS-SM
The Fig.4 shows the DAVOS-SM system in function blocks:

The video signal is routed to the video input circuit where it is equalized and possible interference voltages are eliminated.

In the succeding video signal coder the signal can optionally be clamped.
The video signal coder also contains the A/D-converter. This is made with 9bit resolution to achieve the required signal-to-noise ratio of more than 64dB.
Also the system clock frequency, the line-coding and the parallel-serial-conversion are generated by the video signal coder.

The audio signal coder operates in parallel to the video signal coder. Here the conversion of the analog audio signals into digital signals with a resolution of 14bit take place.

The last module on the transmitting side is the optical transmitter. It converts the electrical signal into an optical signal.
The conversion is done by means of a single-mode Laser diode which
is operating at a maximum optical output power of -6dBm for Laser safety reasons. Special circuitry prevents higher Laser outputs than 0dBm in case of faults.

At the receiving side, the signal is first applied to the optical receiver, which performs the reconversion of the optical into an electrical signal by means of an Avalanche Photo Diode.

In the succeeding video signal decoder the serial/parallel conversion and splitting up into video, audio and sync data takes place. A D/A converter combined with an amplifier delivers a 0dBV video output signal.

The audio signal decoder operates in parallel to the video signal decoder and performs the D/A conversion of the two audio signals.

To calculate the max. distance between transmitter and receiver which can be passed by a calculation example is shown below:

The max. output power is	- 6dBm
The max. sensitivity of the receiver is	- 37dBm
the result	31dB
System reserve has to be subtracted	3dB
for absolute power measurement accuracy	1dB
the result	27dB

This means for the optical losses of the route 27dB are at disposal.
With a cable attenuation of approx. 0.4dB/km a range of more than 60km can be reached

DAVOS-CMI

To enter the 4th hierarchy of PCM-systems DAVOS-CMI was developed.

Instead of the optical transmitter a CMI-coder is used, which delivers at its output a standardized CMI-signal with a data rate of 139.264 Mbit/s acc. to CCITT Rec. G.703.
On the receiving end the optical receiver is replaced by a CMI-decoder.

Mechanical variants of DAVOS

Fig.5 shows the possible mechanical configurations of the system DAVOS.
The following versions are available:

- fixed connections	DAVOS 7R slim line rack
- flexible connections	DAVOS subrack 19"
- portable version	DAVOS suitcase

5.2 DIGAS

For the same applications considered within 2 very often a system for multichannel audio transmission is requested.

The system DIGAS is very well suited for the transmission of
high quality audio-signals on a singlemode or multimode optical fibre.
Different types of transmitted information can be distinguished:

- up to 12 high quality audio channels (bandwidth 40Hz to 15kHz)
- up to 4 low quality sound channels (bandwidth 300Hz to 3400Hz)
- up to 12 ancillary digital signals for additional audio informations
- all high-quality audio channels can substituded by sound codecs for to use the system e.g. for the connection of a stadium to a O.B. van.

The high quality audio channels are linear coded with 14 bits.

This leads to no data reduction. The total data rate per channel is around 640kbit/s.
The low quality sound channels are internally processed acc. to CCITT Rec. G.711

The ancillary digital signals are inserted by a symmetrical interface V.11.

All these discussed signals are put together to a data stream
with a data rate of 8,448 Mbit/s.(FIG.6)

This data stream is then CMI-coded and transmitted by a laser-diode (similar to the optical transmitter of the DAVOS
system) to the receiver side via an optical fibre.

Different types of optical fibre like singlemode or multimode can be used.

With a typical optical attenuation of 0,4dB/km a distance of more than 60km can be passed by. Independant of the length the bit error rate is at least 10 -10 errors/sec.

Fig.7 shows the mechanical construction of the transmitting side. The housing is compatible to 19"-racks as well as to slim line racks of the DBP-standard socalled "7R".

The systems up to here described are the answers to the todays
requirements for the transmission of video and audio.

But regarding to new TV-standards it is nescessary to consider
and to develop new transmission systems.

One response to the new requirements is the above described proposal for a multi channel transmission system.

6. Digital Multi Channel Transmission System

Especially in some European countries D/D2-MAC was defined as a new transmission standard for satellite transmission. TV-Sat 2 is now working and in summary 5 TV-programs in D2-MAC standard can be received.
D2-MAC was choosen as a basis for new transmission standards for HDTV.
Within the EUREKA EU95 project European companies and public organizations have defined the future standard, the socalled HD-MAC standard.

For both standards D/D2-MAC and HD-MAC systems for the transmission are necessary.

For the interconnection of studios and satellite uplink stations systems with high quality and a lower number of channels have to be defined, for applications within CATV-networks e.g. for program feeding lines are requested.

Fig.8 shows the first step of a proposal to a multifunctionalmultichannel transmission system.

The system is able to transmit the following features:

- Transmission of one channel of standards D/D2/HD-MAC for interconnections of studios
- Transmission of at least 2 channels of the "traditiónal" standards like PAL, SECAM or NTSC for multichannel applications (video and two corresponding TV-audio channels.
- For the same case digitalizing of digital audio and analog FM audio channels.

Furthermore the standardized output of 140Mbit/s for interconnection applications is also well suited for future multichannel systems which will have a summary data rate of 2.5Gbit/s.

6.1 MAC - Codec

The coding method of MAC signals is according to Report 1096 (Doc.CMTT/325-E).
The codec allows the processing of digital and analogue MAC-signals.
Because not to avoid a quality degradition by the interconnection of the studio D/D2/HD-MAC-Encoder with a transmission system the use of digital data stream of 162Mbit/s is more sufficent.
For CATV applications the analogue input can be used.

For MAC transmission the source data rate of 162 Mbit/s must be adapted to the standardized line transmission rate of 140Mbit/s.

Two different coding algoritms are used for the data rate reduction. This is necessary to ensure the 162Mbit/s reconstruction without any degradations.(Fig.9)

In every line the MAC signal is splitted into the parts duobinary data burst and a remaining signal part.
The data rate reduction of the duobinary data burst is performed by decoding the duobinary data to a binary code.
The remaining signal part is fed to a 7bit Hybrid-DPCM and for reduction of the transmission error sensitivity every nineth HDPCM value is replaced by the original PCM value.

The source data rate of the coded MAC signal is 124.75 Mbit/s. This signal is combined with an error correction, a plesiochronous 2.048 Mbit/s data channel, a synchronous 1.024Mbit/s data channel and some 64kbit/s channels in a multiplexer to a summary data rate of 139.264Mbit/s. This signal is then coded to a CMI-signal.

6.2 PAL/SECAM/NTSC-codec

For high quality requirements (e.g. signal to noise ratio > 64dB) a codec will be available which is transmitting one video and two corresponding audio channels via one optical fibre within 140Mbit/s. In this case a 9bit linear PCM coding for video and a 14bit linear PCM coding for audio is used.

For applications within CATV-networks e.g. for the interconnection of a main distribution center with a primary main station the quality requirements e.g. on the signal to noise ratio (> 56 dB) are lower. In this way two channels can be transmitted in a standard 140Mbit/s channel.
The coding method is a 6bit HDPCM coding with a sampling rate of 11.125MHz for video and 14bit linear PCM for audio. The sum data rate for video is about 67Mbit/s.

6.3 Multi channel version

Together with a Multiplexer 140Mbit/s to 565 Mbit/s or 622 Mbit/s a 8 channel version is possible.(Fig.10)

In a second step by using a Multiplexer to 2.5Gbit/s the system is well suited for the transmission of 32 PAL channels or any combination between PAL/SECAM/ NTSC channels and D/D2/HD-MAC programs. (Fig.11)

Within the CATV-application the signal-demodulation
and modulation from any VHF/UHF channel to VHF
is also included.

To be compatible with the standard PCM-hierarchy
a solution with standard CMI-coded 140Mbit/s signals
is more sufficient than any other proposal outside
of this hierarchy.

To increase the number of transmitted channels it
also could be possible to use 34Mbit/s systems.
But regarding to the quality and to the todays prices
this solution wouldn't be very competitive to existing
microwave systems.

PHILIPS

Applications for TV-transmission-systems

- Transmission from the camera to the studio
- Transmission from studio to studio
- Transmission within the TV-network
- Programm-feeding-line in wideband Communication networks

Figure 1

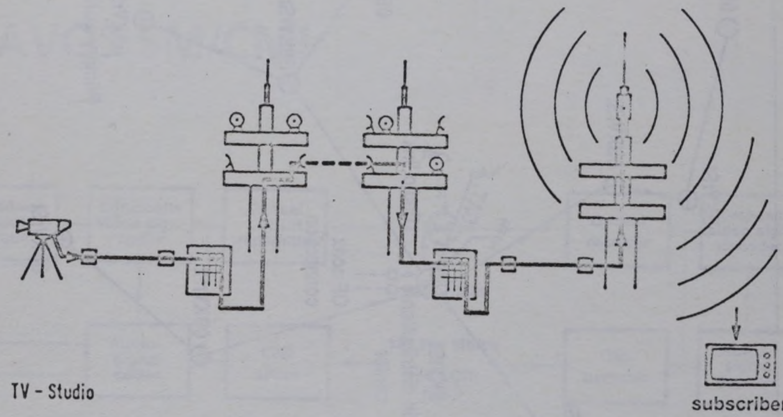


Figure 2: Shows the principle way of the TV-signal from the studio to the subscriber

PHILIPS

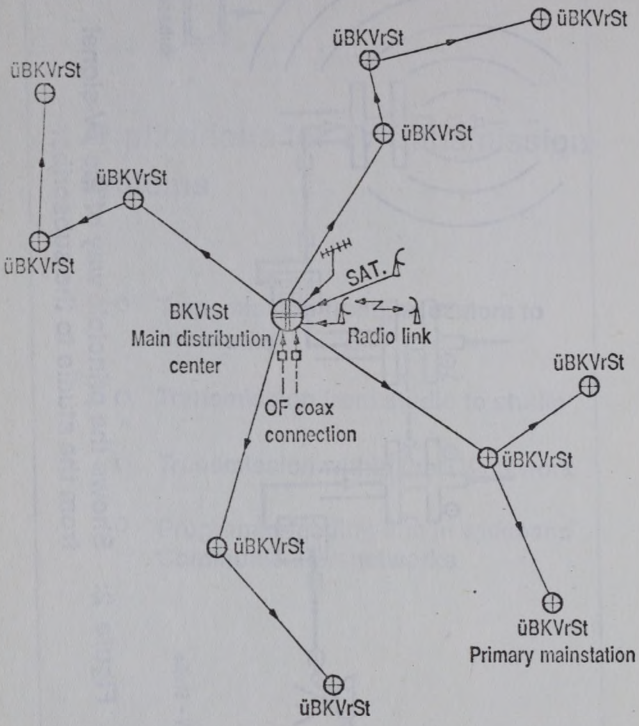


Figure 3: Structure of Wideband-Distribution Networks

PHILIPS

DAVOS SM/CMI

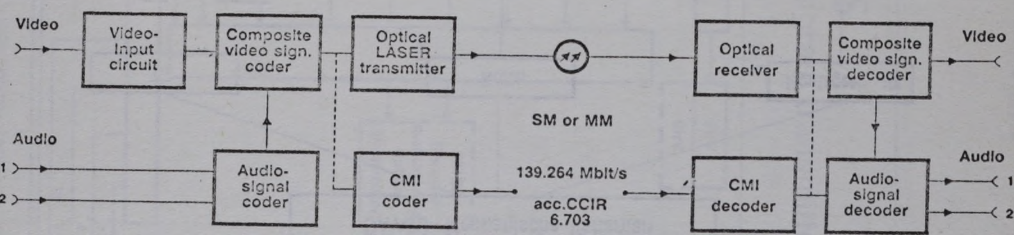
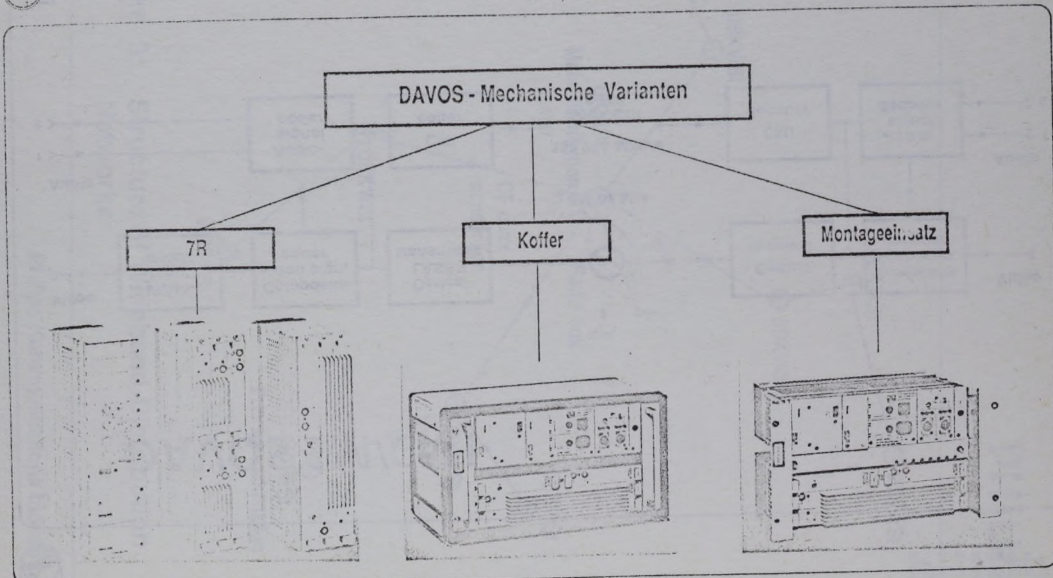


Figure 4

Philips Kommunikations Industrie AG

PHILIPS



0000205 A 8.88
Figure 5

Philips Kommunikations Industrie AG

PHILIPS

DIGAS
block diagram transmitter

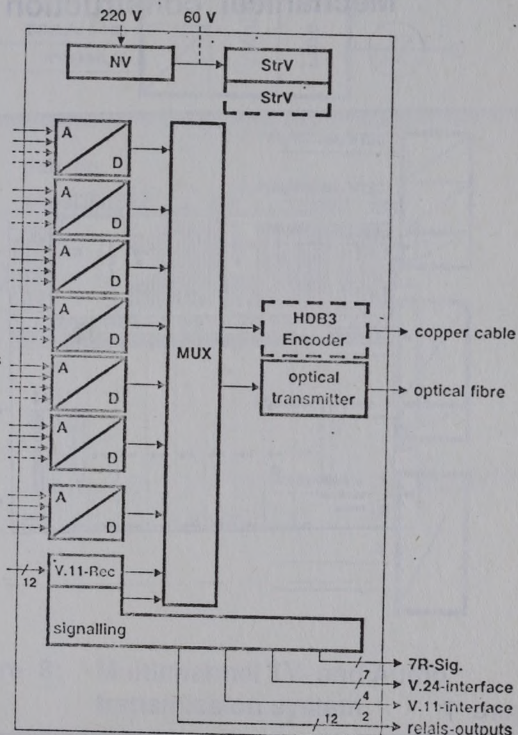


Figure 6

Philips Kommunikations Industrie AG

PHILIPS

DIGAS
Mechanical construction

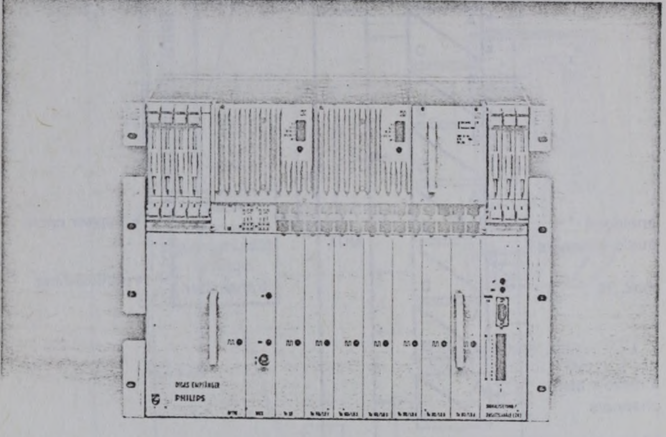


Figure 7

PHILIPS

PHILIPS

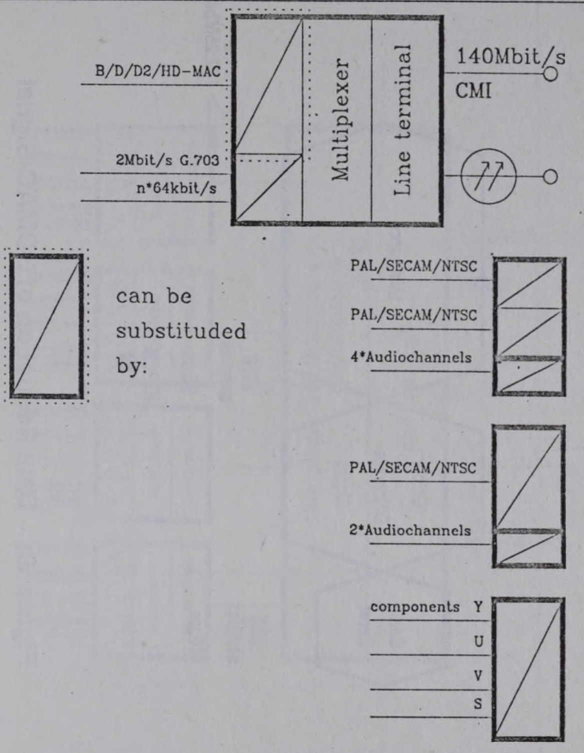


Figure 8: Multichannel TV- and Audio transmission system

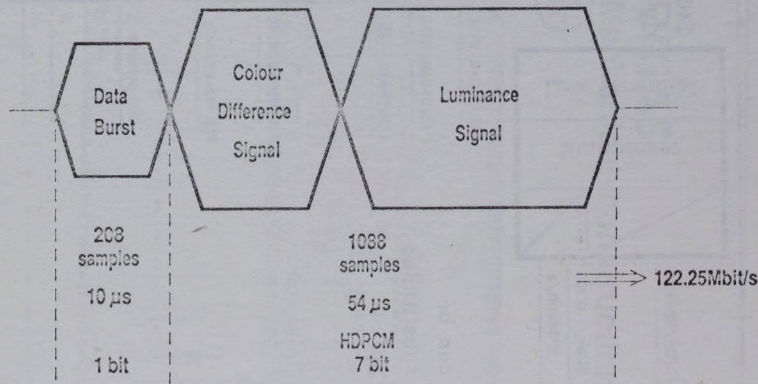


Figure 9: Data Reduction of HDMAC-Signal

PHILIPS

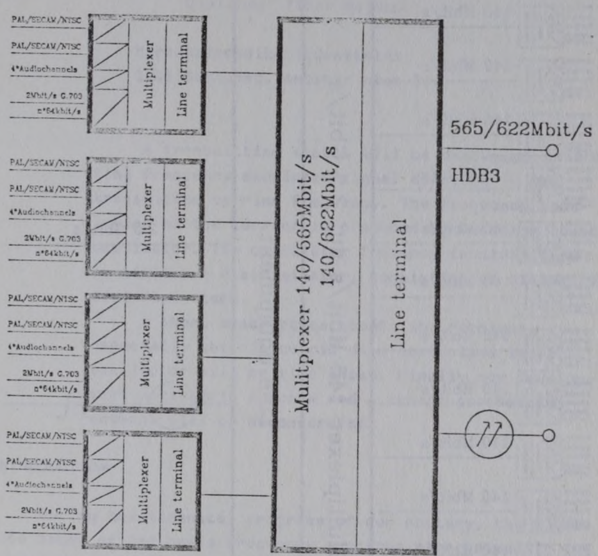
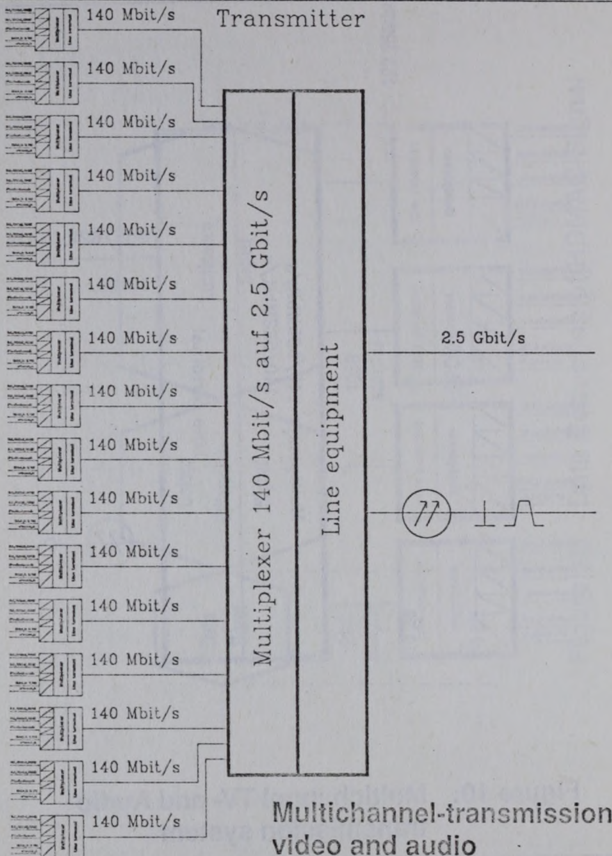


Figure 10: Multichannel TV- and Audio transmission system

PHILIPS



Multichannel-transmission of video and audio

Figure 11

Philips Kommunikations Industrie AG

VIDEO, AUDIO AND DATA TRANSMISSION IN THE "C" MICROWAVE BAND

Dipl.Eng. Tibor Hajder

Hiradástechnika Szövetkezet
1116.Budapest.Temesvár utca 20.

A transmitting system will be discussed, generating frequency modulated signal directly on the transmitted carrier freqvency. The freqvency modulation of the carrier is produced by varactor tuned oscillator. The oscillator frquency is stabilized by microwave discriminator, consisting of dielectric disc resonators.

A short description about the receiver, especially the dielectric disc controlled local oscillator will be also shown. Finally new development microstrip antenna and a common paraboloid antenna will be demonstrated.

INTRODUCTION

During the technical progress of our century, the microwave bands of the radio freqvency spectrum were primarily intended for use by military equipments. Especially high energy microwave frequency pulses and extreme large continuous power transmitting was used to detect enemy vessels, aeroplanes, tanks etc. with sensitive receiver from large distance. The second part of the World-War II. microwave radio telephones were developed and used for battlefield communication especially in the S-microwave band. At the end of the War, pilotless radio controlled gliding bombs and small robot planes were used to raid on extremely armoured enemy targets.

In these weapons video camera and a small transmitter was built, sending video modulated high frequency information to the operator of the masterplane.

After the World-War II. the results of the great technical development were transferred into the civil industry. This effort produced multichannel radiotelephone equipments, microwave transceivers for TV field report, microwave TV-signal distribution networks, etc.

In the Cooperative Hiradástechnika a small, simple and lightweight microwave transmitter and receiver have been developed, especially for field application. This equipment makes two way communication possible at a maximum range of 10 km. The transmitting frequencies are 4410 and 4610 MHz, with 20 MHz bandwidth. The transmitter part of this system is a direct freq ency modulated small power equipment, stabilized by dielectric disc resonators as frequency discriminator. The receiver is a single transposed superheterodyn with 450 MHz IF frequency. In the blanking interval of he TV signal, data transmission is possible by means of interface circuit. The portable apparatus can be dismantle into transmitter, receiver and power-supply modul-parts, and easily assemble them together. The dismantled moduls can be put into a supporting bag.

Three types of antenna have been developed for different usage. A thermo-controlled weather protecting case can be equipped also for permanent free air operation. Beside this, a little bit larger spherical radom gives a more perfect protection against strong windstorm and incident glare of the sun. This system is primarily intended for use in rough and hard terrains, for example on hilly, swampy lands and between the opposite banks of rivers.

TRANSMITTER

The signal generating stage of the transmitter is a voltage controlled oscillator (VCO), frequency modulated by a varactor diode. The modulating signal is originated from the video preemphasis network, according to the CCIR.Rec. 405-1. The VCO is a grounded collector modified Collpitts oscillator with a short stub in the base circuit, loaded by a varactor and a series capacitance. The modulating signal is connected to the varactor by means of a choke. The audio frequency subcarriers are also connected to this point. After the VCO an attennuator provides the separation of the VCO and the next two stage amplifier. The output power of this amplifier is tipically 40 mW. Between the output of the amplifier and the antenna connector there is a coupling network, containing three dielectric disc resonators. Two of them produce the S-shaped frequency - amplitude transmission for automatic frequency control. One of the disc is tuned a litte bit higher, and the other a little bit lower that of the operating freqvency. From the main line of the coupling network a small power is coupled to a quarter wave stub on the oppotite side of the resonator.An envelope detector diode is on the end of the stub. Three of such detector are employed with positive and negative detectors for the AFC discriminator and a separate detector for the "search and lock" circuit.

The search and lock circuit consists of a sawtooth generator which controls the VCO also. This signal sweeps a broad frequency range, and when the frequency of the VCO is quasi coincident with the center frequency of the discriminator,the third detector (positive polarity) inhibits the sawtooth generator by means of a comparator, and the AFC loop will be locked. A loop filter insures the separation of the video signal and the low frequency control signal.

In the audio channels of the equipment two VLSI circuit (HTM 003) are employed. The HTM 003 is a frequency modulated PLL circuit with current controlled oscillator. Between the audio input and the PLL, there is a preemphasis circuit providing for the 50 μsec precorrection. The PLL consist of reference frequency oscillator, reference devider, programmable devider and phase comparator and current controlled oscillator. In the programmable devider an extremely great deviding ratio insures the stability of the PLL system at maximum frequency deviation.

The resultant phase deviation less than 1 radian in the worst case. The subcarriers are 7,0 and 7,5 MHz, with 50 kHz peak deviation. Two audio channels can be transmitted simultaneously. On the Fig.1 the block diagram of the transmitter is shown.

RECEIVER

The receiver system is single transposed equipment with a waveguide filter, a low noise amplifier in the frontend. A rat-race (3/2 λg ring) mixer converts the input signal to the 450 MHz intermediate frequency. With the exception of waveguide bandpass filter, the frontend circuits are manufactured on softboard (Cu Clad 217) material. The other lower frequency circuits are produced on epoxy PC material.

After mixing, the IF signal is amplified to 1 mW level to drive th FM detektor integrated circuit.The detected video signal drives the deemphasis, clamper and the video amplifier circuits, and finally the output video connector.

The detection of the subcarriers are realised by common quadrature detector IC, incorporating deemphasis, muting, AF amplifier circuits. From the output of this IC, the IF signal is amplified to + 6 dBm level. Two identical FM detector and amplifier are employed in this receiver.

In the local oscillator of the receiver dielectric resonator ensures highly stable microwave signal for the mixing process. A grounded emitter transistor is employed with microstrip line in the base, and other microstrip line in the collector circuit. Between the collector and the base line a dielectric disc realizes the feedback for oscillation, see Fig 2. Near the base line is an output coupling open circuited line, producing + 10 dBm oscillator level at the end of it. In the dielectric resonator TE $o1\delta$ can be generated because of the positions of the coupling lines. The frequency of the oscillator may be fine tuned by eddy-current slugs above the disc. In the discriminator stage of the transmitter the same slugs give fine tuning possibility. In the receiver local oscillator, a further line can be found. This line is terminated by a varactor diode, making electronic fine tuning possible for automatic frequvency control. Automatic gain control is also realized by dual FET amplifier stage.

ANTENNAS

Two microstrip patch antennas have been developed at the Technical University of Budapest, Dept.of Microwave Communication. The first is 0,45x0,45 m^2 aperture consisting of two orthogonally polarised antennas with min. 22 dB gain in the main direction. The stripline antenna consists of a great number of elementary radiator patch.In this antenna systems the patches are rectangular shaped copper foils. The elementary patches are interconnected with stripline power distribution network, incorporating quarter wave transformers. These antennas are selective, and besides the selestivily, the orthogonally polarised excitement gives extremely good separation between the two system.

The second micristrip antenna is 0,25x0,25 m^2 aperture. The gain is 17 dB in the main direction.

The third antenna is a 0,5 m diameter paraboloid, with reflector-dipol feeder is in the focus of that.The gain is 22 dB in the main radiation direction. The feeder part is protected by a plastic cap against rain and moisture.

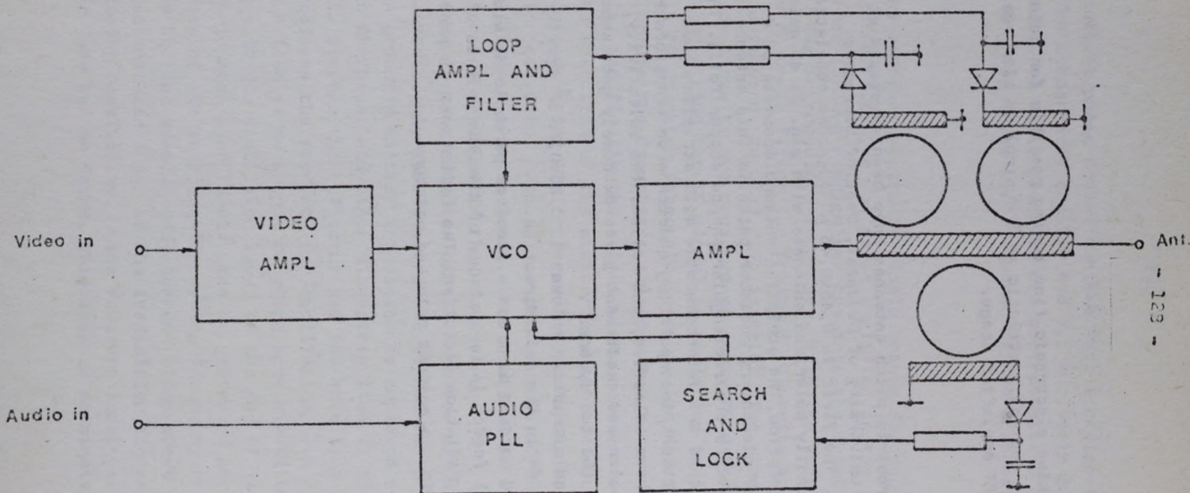

Video in
Audio in
VIDEO AMPL
LOOP AMPL AND FILTER
VCO
AUDIO PLL
AMPL
SEARCH AND LOCK
Ant.

FIG. 1

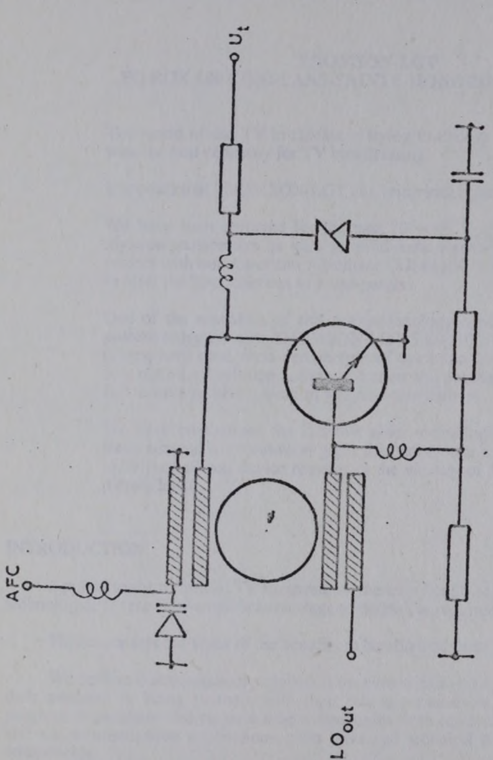


FIG.2

"UHF SOLID STATE TRANSMITTERS A PART OF THE MULTITECHNOLOGY APPROACH"

J.M. BARRIERE

THOMSON-LGT
PO BOX 150 CONFLANS-SAINTE-HONORINE - FRANCE -

The world of the TV broadcast is trying to choose the most advanced technology with the best economy for TV broadcasting.

It appears that THOMSON-LGT can bring into light some interesting points.

We have been involved for the past 20 years in the development of tetrode and klystron transmitters as well as solid-state transmitters, lately in the Klystrode® project with our American subsidiary COMARK. This knowledge could help today to offer the best solutions to broadcasters.

One of the outcomes of this multitechnology approach gives the opportunity to present today the new THOMSON-LGT 5 kW/10 kW solid-state transmitter which corresponds now, for a certain type of operation (24 hours/one transmitter), to the best optimized solution both in operation and purchase cost compared to the classic full reserve passive operation with two transmitters.

We have emphasized the fact that other technologies for higher power are much more adapted to economical goals than solid-state technology as long as the single individual silicon device remains in the vicinity of 30 % efficiency for an average picture level.

INTRODUCTION

Applied to the terrestrial TV transmitters, the term "multitechnology" refers to the different technologies for the final amplification stage to obtain the required output power.

This paper sets out some of the benefits to be obtained from a multitechnology approach.

We believe that equipment suppliers must evolve from being simply manufacturers selling their products to being partners with their possible customers, especially since gains from progress in transistor and vacuum tube technologies from research supported by military, space and telecommunication applications, offer advanced technical solutions in the field of power components.

® Klystrode is a registered trademark of Varian Associates, Inc.

It seemed to us that our company combined all the elements that would allow us today to offer a set of technological solutions that fit each power level and standard, and that we could consequently take advantage of our experience to supply an estimation of the actual operating costs of high power transmitters.

STATE OF THE ART

What is the state of the art in RF Power components for 10 to 30/40 kW transmitter output power (figure 1)?

This picture shows two types of technology applied to different levels of output power. The firs group are the well established technologies, and one can notice that the tetrode has only one source of supply with a tendency to have a second source at 10 kW whereas the klystron technology is available from three manufacturers from 10 to 60 kW output power.

The emerging technologies are principally 100 W to 150 W transistors in parallel, klystrode tubes and more recently MSDC klystrons at 40/60 kW.

In these new technologies, the sourcing obviously comes from of a single manufacturer. One can expect however, that these emerging technologies will not remain single-sourced devices.

THOMSON-LGT EXPERTISE

Our long experience in the different technologies of power amplification components allows us to take a balanced and objective approach (figure 2).

Up to now, for transistors, THOMSON-LGT has been quite successfully resorting to the abilities of THOMSON-SGS and MOTOROLA (ex-TRW), particularly by creating second sources up to a 50 W level in UHF.

The purchase of the American company COMARK by THOMSON allowed us to be involved in the Klystrode® project since 1987. The research and development phase concerning both modulation (and correction) stages and preamplifiers has been carried out in France, and there exists a close collaboration with the COMARK plant at Southwich, where the Klystrode® transmitter is manufactured.

Moreover, the skill acquired by THOMSON-LGT in manufacturing tetrode amplifiers is part of the basic experience of the company.

There is no single answer applying to all the requirements of the technological choice in the field of power amplification.

A PREFERENCE VALUATION OF THE POWER COMPONENT

CHARACTERISTICS	Air klystrode			Pulsed klystron			MSDC Klystron	Tetrode			Transistor		
	10	20	30/40	10	20	30/40	≥ 40	10	20	30	10	20	30.
Cooling	XXXX	XXXX	XXXX	XXXX	XX	XX	X	XXXX	X	X	XXX	XXX	XX
Excitation power	XXX	XXX	XXX	XXXX	XXXX	XXXX	XXXX	XXX	XX	X	XX	XX	XX
Linearization	XXX	XXX	XXX	XX	XX	XX	XX	XXX	XXX	XX	XX	XX	XX
Maintenance facility	XX	XX	XX	XX	XX	XX	X	XX	XX	XX	XXXX	XXX	XXX
Consumption	XXX	XXX	XXXX	XX	XX	XX	XXXX	XXX	XXX	XXX	XXX	XX	X
Spare parts	XX	XX	XX	XXX	XXX	XXX	XX	X	X	X	XXXX	XXXX	XXXX
Pre-heating time	XX	XX	XX	XX	XX	XX	XX	XXX	XXX	XXX	XXXX	XXXX	XXXX

The above table is a comparison between four existing technologies, made by means of six criteria and weighted according to the different levels of RF power. These valuations may vary according to the improvements made in power components by the different manufacturers.

The line concerning the cooling refers to the ease of handling the coolant. Air is taken as the best coolant and can be used for transistor, tetrode up to (10 kW), klystrodes up to 40 kW and klystron up to 15 kW.

Water for a potential difference of 0 V is used for klystron up to 70 kW.

Deionized water able to withstand 7/8 kV is used for tetrode from 20 to 30 kW and the water must withstand 25 kV for MSDC klystrons.

The excitation power is related to the gain of the component and a good score is given to the klystron with its 40/50 dB gain; second, the klystrode with 23 dB the tetrode 14 to 15 dB and the transistor comes in the last position with an average of 7.5 dB.

Linearization has been judjed by the amount of correction applied to the RF amplifier. It is remarkable to see that medium gain RF components get the best scores when components such as klystron with pulsed operation have a high level of correction and high non-linearity.

The maintenance facility parameter deals with safety requirements, usual intervention for necessary tube changing, disparity of subassemblies; for this parameter, solid state components with no high voltage, no regular changes of the RF device and a complete redundancy with identical amplifiers in parallel offer a very good maintenance facility.

The power consumption criterion is weighted by the figure of merit of the RF component which is given for an average picture; in any case the klystrode tube which is a compromise between gain coming from the klystron and the linearity from the tetrode meets the best efficiency in every simulation.

- spare parts: deals with the intervention frequency and the cost of the RF component. :

  Heating time is the ability of the device to withstand RF power in case of emergency switch on.

  But all these parameters taken separatly do not answer necessarily the needs of a customer. The Operating Cost which is a combination of all the parameters gives more clearly the advantage of any particular technology.

OPERATING COST

In figure 3, the three following criteria have been taken into account:

- the cost of the tubes, or power components, which is estimated yearly,
- the power consumption, which is estimated, with an average picture, at 18 h/day, and 6.6 cents/kW for a one year period,
- the maintenance costs, which are based on an average number of 12 interventions per year for tube transmitters and 2 interventions per year for solid-state transmitters, this for 2 technicians/engineers.

We have considered the need for immediate intervention after a minus 3 dB loss in the output power.

For transmitter equipped with a single RF component in active or passive reserve operation, the intervention is carried out at once, for transmitters equipped with multi power amplifiers working in parallel; maintenance teams are sent once the number of non working amplifiers matches the - 3 dB zone which gives a free scope for action.

For solid-state transmitters, the spare parts holdings can be envisaged as one complete module per station and, at a regional base, a complete set of transistors corresponding to one stage.

These curves show the operating cost of one transmitter with an output power of 10, 20 and 30 kW for the well established technologies such as pulsed klystron and tetrode and the new technologies as klystrode or solid state.

One can see that emerging technologies have a great future when comparing the operating cost.

Pulsed klystron and tetrode RF components have parallel curves with an advantage for the tetrode (this comparison includes the new TH 563 running at 30 kW).

For emerging technologies, a hybrid transmitter built with a klystrode tube for the vision carrier and a solid state amplifier for the sound carrier(s) compared to an all solid state transmitter has the same operating cost around 15 kW RF power, **but has a much lower operating cost above this power**.

It is easy, with the help of simulation, to look at the effect of the cost of energy on these curves.

We have plotted in figure 4 the operating curves of the well established technologies against the cost of kW/h.

You can see that if the price per kW/h is low the operating cost for the tetrode is not far from the klystron solution especially at 20 kW.

The increasing in energy cost up to 8.5 cents gives a clear advantage to the tetrode.

If we look now at the influence of energy cost on operating cost for emerging technologies (figure 5) we can notice that in countries where the kW per hour is expensive, the klystrode solution is better above 12 kW and the solid state approach is acceptable up to 20 kW for a low energy cost.

CAPITAL COST OF THE EQUIPMENT

Let us consider now the comparison of acquisition cost of the equipment.

With this chart (figure 6), the values have been standardized to a base 100 referred to the technology that is most utilized for a given power level.

For well established technologies the comparison is made between tube transmitters with a full reserve arrangement, whereas for the emerging technologies solid state amplifier have been introduced for the sound path as in the klystrode transmitters or totally involved as in all the solid state transmitters.

One can see then that at 20 kW, the tetrode tube transmitter is more profitable, and that at 30 kW the Klystrode® transmitter equipped with a passive reserve tube and a redundant solid state amplifier for the sound carriers is cheaper.

As we have no interest in promoting one particular technology we will focus our development abilities on the technology that is or will be, for a given power and standard, the more profitable in terms of purchase and operating costs, which vindicates today the presentation of the first 10 kW UHF solid-state equipment as part of the new 5 - 10 kW range.

SOLID-STATE 5/10 kW TRANSMITTER

These equipment are built up from identical 6 kW units and their design take into account important maintenance requirements (figure 7).

The main points of the equipment are:

-**A transmitter drive**, which can receive audio and video signals in the current standards and also the modulated NICAM 728 signal.

The conception of this new subassembly is largely based on specific plug-in, hybrid functional circuits, easily interchangeable and serviceable (figure 9).

We can see here chips themselves.

The small number of adjustments combined with a set of interdependent switches to switch out the different filters, permits rapid checking of the equipment and offers maintenance and operating security. The high-level frequency conversion gives a better signal-to-noise ratio. The RF output level varies from 250 mW to 750 mW. The subassemly is used for bands I to V without any change of subassembly apart from the reference oscillators and output rejection filters.

The link existing between this subassembly and the remote operation and self-diagnosis system is the other innovation in the range.

- **Maintenance aid system (supervisor)**

  As well as reducing the direct maintenance costs of this equipment, we also provide a facility for the user to check remotely the working order of the transmitter by means of a phone call.

The supervisor is a multitask, evolutive system that is part of transmission systems designed since 1988. As it uses microprocessor technology, its adaptability renders easy its matching with different transmitter configurations (twin transmitter drives for exemple).

A general or partial failure of components of the supervisor does not induce any malfunction in the transmission system.

The supervisor performs the following tasks:

- displaying of the transmission system operation mode,
- storage of events (incidents, ...),
- maintenance aid and failure diagnosis,
- remote control and remote signalling management,
- programming of the transmission system operation mode,
- remote interrogation, by means of a PC and through a serial link with a modem and an STS (Switched Telephone System) or RRS (Radio Relay System),
- direct interfacing with the customer's remote operation system will be available as soon as the IEC has issued a standard for the interface.

The software cyclically stores the status of the sensors distributed inside the transmitter; it compares the status with a nominal configuration. If there is an anomaly, the software initiates a set of subroutines.

COOLING SYSTEM

The cooling of a 6 kW unit is by an internal blower giving a level of acoustic noise equal or better than 61 dBA cooling system (figure 8). The air inlet is located at the top, bottom or the rear of the equipment (external blowers can be provided to meet special requirements). A plenum chamber is located under the parts that have to be cooled. This system is not complex and uses appropriate heat sinks to ensure a very good heat dissipation.

Each 200A - 28 V power supply unit supplies two amplifiers. This power supply unit is equipped with a ± 20% regulator.

Lightening protections together with a shielded transformer gives a very good rugedness to the whole transmitter.

The reliability of an electronic system is in close relationship with the junction temperature of the semi-conductors or the package temperature for other components.

That is why THOMSON-CSF has developed a thermal simulator that can calculate the key temperatures of each package or the isothermal surfaces for each layer of cards. This allows us to be aware of the temperature critical points on any card and to rapidly determine different types of applicable solutions (forced convection, thermal drain, etc.).

All our new products have been aided by the different CAD tools developed by THOMSON-CSF, improving the understanding of the availability factor.

The better knowledge of the junction temperatures and of the different loading ratios is a step towards a reliable calculation of the availability factor.

HIGH-GAIN AMPLIFIER

The high-gain amplifiers for this new range are fitted with independent wide-band preamplification units that can be easily tested. The last two stages have an optimized output power and three different types cover band IV and V without any RF matching adjustment. A gain and phase correction allows an easy adjustment in relationship with the coupling system (figure 10).

COUPLING SYSTEM

The Isolated Coupling System (figure 11) is a wide-band system and thanks to a 25 dB isolation and appropriate input/output connections it allows the replacement of high-gain units when the transmitter is in operation. These coupling systems may be associated, without any further loss, for a 12 kW output power transmitter.

The rule governing the decrease in power is indicated at the bottom left of figure 11.

Note that for a 10 kW (figure 12) transmitter with this isolator, a decrease in output power of only 2.5 dB if 4 power amplifiers are missing.

These items may be supplied in an active reserve configuration, with twin transmitter drives so that maintenance operations can be carried out on networks working 24 hours a day.

CONCLUSION

We intend to make available for its customers the best compromise as regards any given power level or standard. A well established company can aspire to objectivity in the domain of technological choices, especially when it has been careful not to favor one technology to the detriment of other ones **since drawbacks may show up once a choice has been settled**.

Once the ratio between the cost of maintenance of each of the technologies and configurations has been settled it appears with simulation that the cost of energy is the determining factor for the evolution of the operating cost. For well established technologies the tetrode tube is still the most economical technology to answer medium output power needs, together with a range of energy costs of 5 cents to 8,5 cents/kWh.

For emerging technologies the choice has to be made strictly regarding the cost of energy, the cross point for dentical operating cost between klystrode transmitter and all solid state transmitter is close to 20 kW with 5 cents/kWh and close to 12 kW with 8,5 cents/kWh.

Above 20 kW and with an energy cost of 5 cents/kWh the most economical technology is the klystrode technology with solid state power amplifier for the sound.

And in any case, wherever single sound is required, multiplex klystrodes can operate with a very low operating cost compared to all other technologies.

It is now more obvious to present a solid state transmitter range up to 10 kW, which meet both acquisition cost and operating cost requirements considering a complete built-in redundancy with a strong accent on maintenance and aid systems.

J.M. BARRIERE

BIBLIOGRAPHY

[1]. - Ostroff N.S./Korn A. "Klystrode equipped UHF transmitters for full time broadcast service". Montreux 1989.

[2] - Douglas P.G. "Modernising a National TV Transmitter Network". IBC, 1988.

[3] - Tupper I. "Comparative ownership costs of UHF TV transmitters, 5/15 kW peak sync." IEE, Jan. 1988.

[4] - Michel J. "L'amplification d'une onde modulée ou d'un signal, comportant deux ou plusieures raies spectrales" a THOMSON-CSF publication to be issued in 1989.

[5] - Barrière, J.M."D2 MAC packet in terrestrial TV transmitter". IBC, 1988.

Figure 1 - State of the art

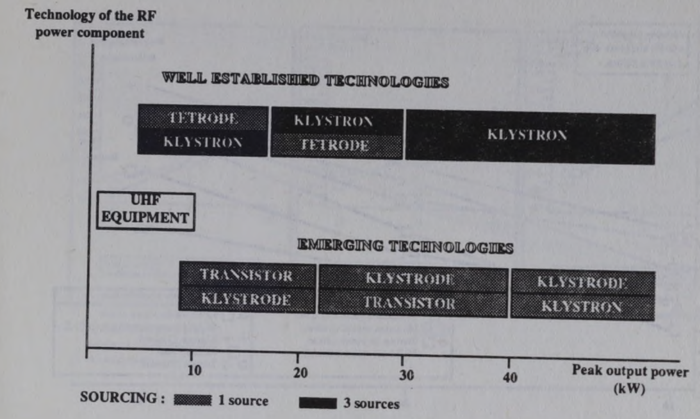


Figure 2 - THOMSON-LGT expertise

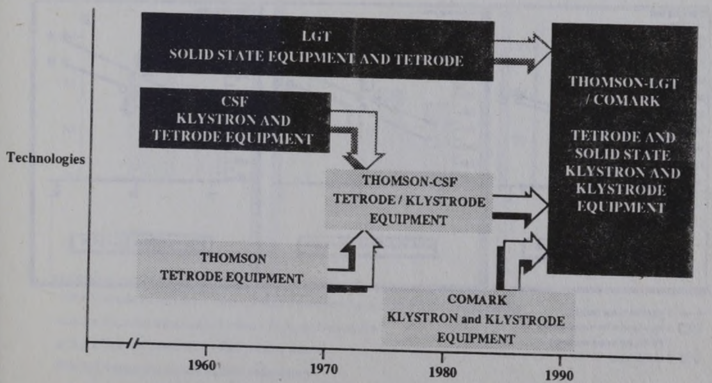


Figure 3 - Operating cost - Well established and emerging technologies

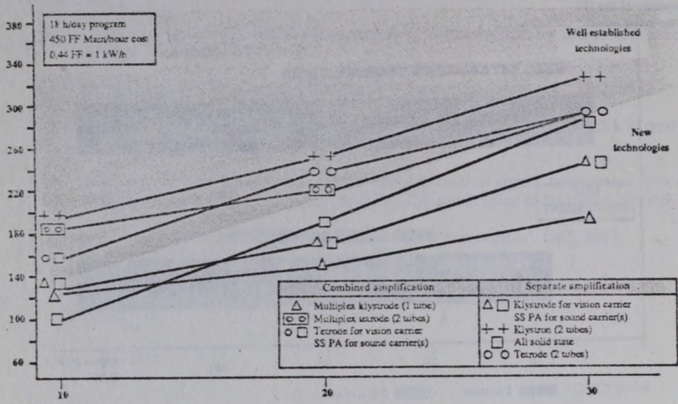


Figure 4 - Operating cost for well established technologies - Parameter = cost of energy

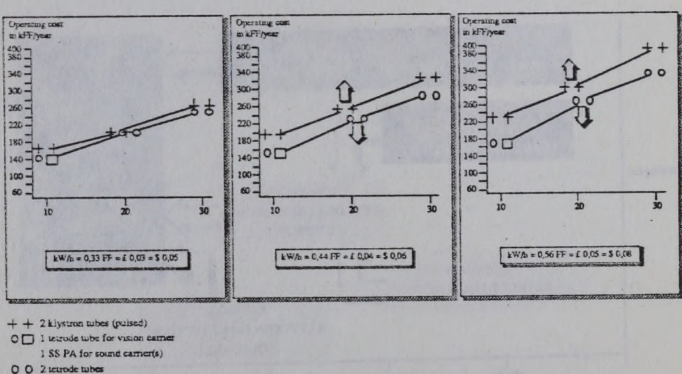
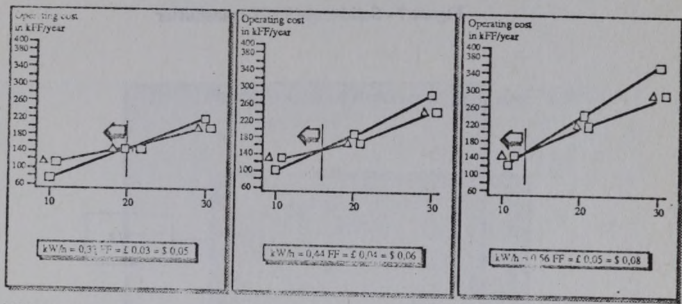
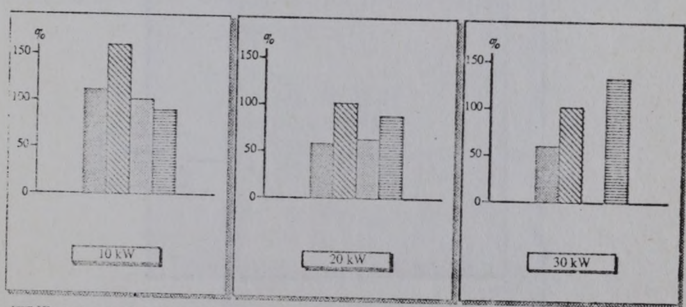


Figure 5 - Operating cost of emerging technologies - Parameter = cost of energy



Δ □ Klystrode for vision carrier
solid state for sound carrier(s)
□ All solid state

Figure 6 - Indication comparison of acquisition cost among different technologies



Klystrode transmitter 1 tube + Passive reserve tube and SS PA for sound carrier
2 x Klystron transmitter 2 tubes - Full passive reserve
2 x Tetrode transmitter - Full passive reserve
Solid state transmitter built in redundancy

Figure 7 - Solid-state 5 kW transmitter

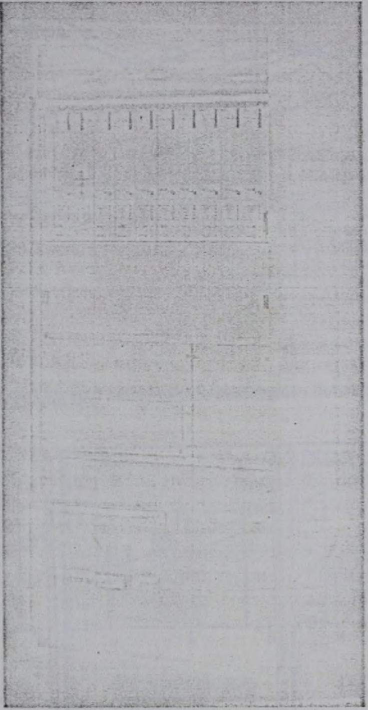


Figure 8 - Opened structure of 6 kW unit

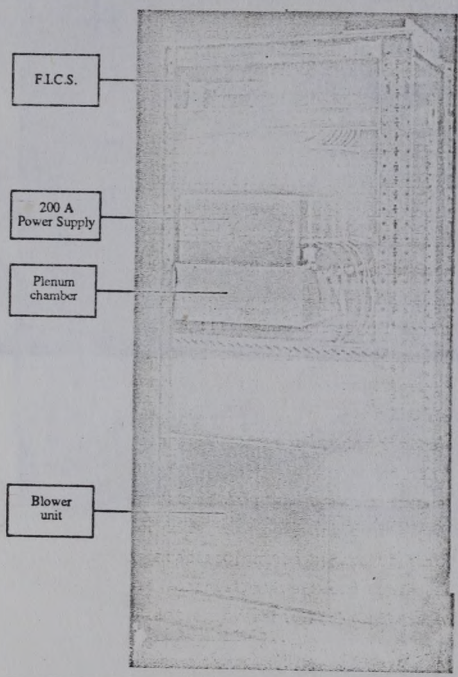


Figure 9 - Video processor board

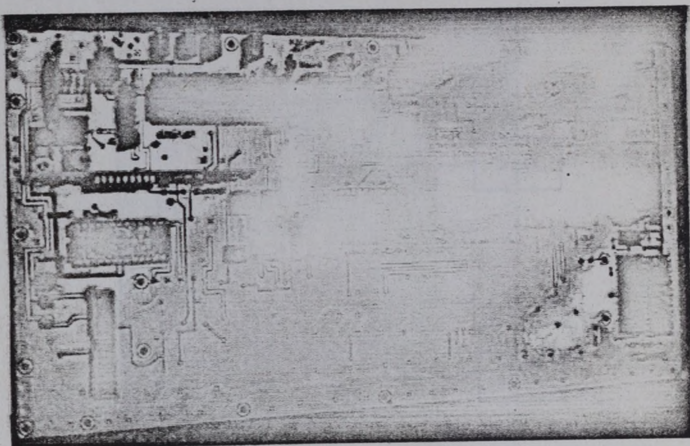


Figure 10

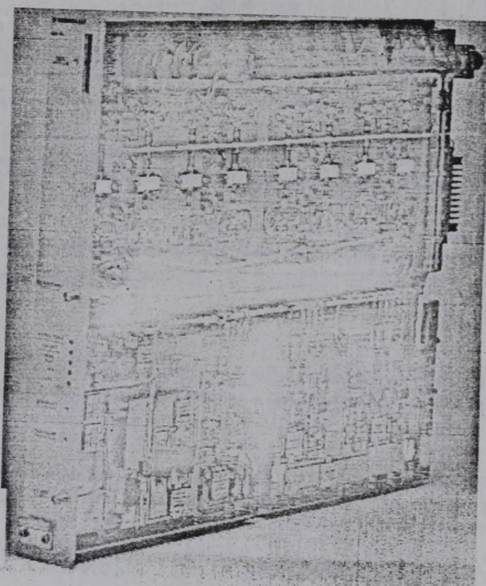
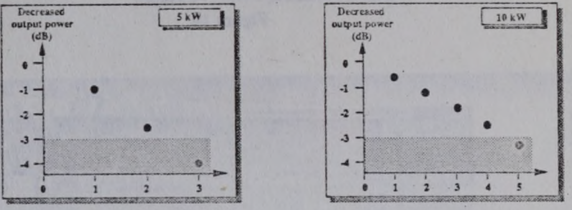


Figure 11 - Fully Isolated Coupling System (F.I.C.S.)*



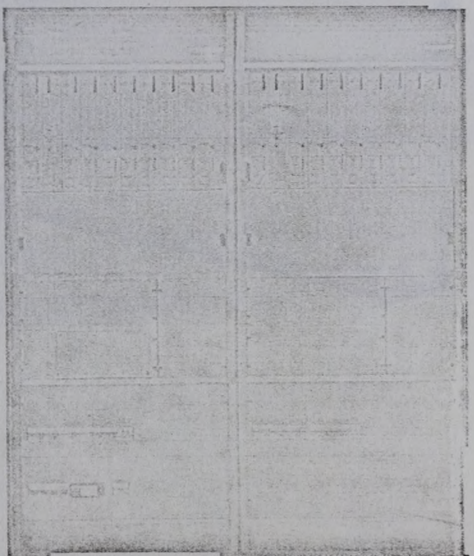
Decrease in power = $10 \log \frac{n^2}{(n-m)^2}$

with n = number of amplifiers in parallel

m = non-operating amplifier

* THOMSON-LGT patented system

Figure 12 - 10 kW UHF TV transmitter



MULTI-POINT MULTI-CHANNEL DISTRIBUTION SYSTEMS

DANIEL A. LAPRES

DPCI LTD.
11 RUE JULES CHAPLAIN
75006 PARIS
TEL: 33 1 4326 7790

This paper describes the operation of Multi-point Multi-channel Distribution Systems ("MMDS"), relates the history of their development, evaluates their merits in terms of a recommended set of criteria for selection among alternative technologies and proposes a specific and immediate application for MMDS in the European context.

MMDS is the designation adopted by the Federal Communications Commission (the "FCC") in the United States for a service distributing a plurality of commercial television channels using hertzian terrestrial point to multi-point equipment.

What distinguishes MMDS technology from other hertzian terrestrial systems is the range of frequencies which it exploits. Specifically, the frequencies allocated to this service in the United States are in the 2-3 Gigahertz band. Manufacturers in the United States have however customized equipment for operators using frequencies on either side of this bandwidth. The FCC refers to these frequencies as the "microwave" band.

Although the International Telecommunications Regulations allocation of this band on the European continent provides for multi-point services, many countries have in fact fully or almost fully attributed the frequencies in the relevant range. Consequently, adoption of MMDS technology would entail modifications to frequency attributions in those countries; alternatively exploitation of MMDS would have to be limited to a number of channels that would be be less than maximal.

The principal economic advantages associated with MMDS as compared with alternative technologies, such as cable and satellite, are:

- the low cost for connecting each subscriber,
- the short gestation period between construction of the infrastructure and commencement of commercial operations
- the consequent facility of financing.

In some countries of Western Europe (for example, the Netherlands), cable and satellite options already exercised by authorities may limit the feasibility of generalised resort to MMDS technology. But most of the European continent is as yet uncabled, so there is still time to review all available technological options before making irreversible commitments. Also even in cabled countries, certain services the economic viability of which depends upon low break-even points, such as educational television, may still be optimally transmitted using MMDS.

DESCRIPTION OF MMDS TECHNOLOGY

As with other hertzian services, communication is effected from the head station's transmitter through an antenna to the destinations where the signals are capted by an antenna, adapted to television set frequencies (UHF and VHF) by means of a down converter and passed over cables to each receiver television set. At the present time, the vast majority of equipment manufactured is intended for the United States market where NTSC specifications are applicable. However certain transmitter manufacturers have already delivered PAL and SECAM adapted transmitters.

Resort to microwave bandwidths subjects transmission to greater physical limitations than those associated with VHF and UHF transmissions.

The area which can be serviced from an MMDS transmitting antenna is circumscribed to a radius of some 40 kilometers. Line of sight problems arising from the presence of physical obstructions on the path of the signals create areas of shadow where signals are received in unsatisfactory condition, if at all. Depending on the topography of the service area, as many as 30 % of potential viewers may find themselves in the shadow. On the other hand, use of repeaters and relatively powerful transmitters (100 Watts) can greatly mitigate this problem enabling operators to achieve coverage rates approaching 95 %. Experience in the United States has demonstrated that image quality using MMDS technology is altogether comparable to, and maybe even better than, cable reception.

Several American companies offer encoding and decoding equipment for MMDS transmission. The range of this equipment includes models which permit pay-per-view programming.

HISTORY OF THE DEVELOPMENT OF MMDS

The United States began its use of microwave frequencies in 1963 with the establishment of the Instructional Television Fixed Service ("ITFS"). The purpose of the service was to provide a low cost means of delivering educational programs to schools and non-profit organisations. The Federal Communications Commission set aside the frequency band between 2.500 and 2.690 Gigahertz for the creation of 31 such educational channels. By 1982, 124 ITFS licensed operators were using some 808 channels. More than half the States had systems. The majority of systems were located within 25 miles major metropolitan areas. Nevertheless some 75 % of channels available for ITFS use had gone unclaimed.

In 1974, the FCC began authorising a new service which was also to exploit the microwave frequencies. This service which was called Multi-point Distribution Service ("MDS") was originally expected to be used primarily for the transmission of business data. Over the years the number of bandwidths attributed to MDS made possible the creation of up to eleven channels in the 2.150 to 2.644 frequencies range. But the possibilities for any one operator in a given territory to control more than one MDS station were severely limited. MDS operators were viewed as performing essentially a "common carrier" function in that the content of no more than 50 % of all transmissions could be of their own origination.

As of the end of 1982, there were 239 licensed MDS operators distributed throughout the States servicing more than 700,000 households. An additional 114 stations had been authorised and were under construction while almost 200 applications were pending.

Other microwave frequencies which were traditionally used in the United States for voice and data circuits were regrouped in 1975 by the FCC under the heading "Private Operational Fixed Microwave Service". In 1983 there more than 1,400 applications to use these frequencies to transmit entertainment programming.

Thus by the early 1980's, the FCC was faced with demand for entertainment channels which its allocation of frequencies was unable to satisfy whereas the frequencies it had allocated to educational television were largely unclaimed.

In the meantime MDS operators were demanding access to unused ITFS frequencies with a view to providing a service comparable to that offered by cable operators. They argued that they were unfairly hindered in their competition with cable operators who were authorised to deliver a multitude of entertainment channels whereas MDS licensees were limited for practical purposes to providing only one channel.

By 1983 the pressure on the FCC became irresistible and it decided to re-allocate eight ITFS frequencies to MDS operators and also to allow ITFS operators to share their frequencies with MDS operators. In this manner, MDS operators could expand their service into a multi-channel service, that is MMDS.

In support of its decision, the FCC invoked the interest of expanding consumer options through the provision of multi-channel entertainment television in competition with cable in markets where the latter was present and in substitution for cable where the latter was not present and might not be for many years. The FCC also referred to the interest in encouraging technological and industrial development.

In response to its call for applications for MMDS licenses the FCC was deluged by more than 16,500 filings. Under these circumstances the Commission decided to proceed by lottery to make *a priori* attributions of licenses for each territory. Review of the lucky candidates' applications was undertaken to confirm their ability to execute their project. Also deadlines were set down for commencing construction and for starting commercial operations.

The first MMDS operation opened in Cleveland in 1986 and others followed in New York, Detroit and Washington (in 1988 and 1989). It must be admitted that the opening of MMDS operations did not proceed nearly as quickly as had been expected.

The reason most frequently given to explain this disappointment has been the difficulty, indeed the impossibility, of gaining access to attractive programming due to alleged unfair competition from cable operators. It is a fact that some of the most desirable entertainment channels belong to corporate groups which also own major cable operators; for example, the most popular cable entertainment channel (Home Box Office) belongs to the nation's second largest owner of cable systems (Time Inc.).

Under the threat of anti-trust action by MMDS operators, access to programming has recently improved and consequently solicitations of investment capital for MMDS operations are being received more favourably. As a result many more MMDS operations are now coming on line; the Wireless Cable Association estimates that there are now some 300,000 subscribers to MMDS distributed among the more than 20 operators.

Most noteworthy in the European context is that the use of MMDS has been approved in the Republic of Ireland where franchises have been awarded and some of which at least should commence operations in the near future. Also the Government of the United Kingdom was advised in the White Paper on Broadcasting to adopt MMDS technology; while it would appear that this decision has not yet been made as regards the British Isles, the U.K. Government has approved MMDS for use in Hong Kong.

THE EVALUATION OF TECHNOLOGICAL OPTIONS

In deciding which technology to adopt for distributing television programs decision-makers must seek to optimize the general interest in relation to the environment where the service is to function.

The alternative technologies

The model proposed in this paper considers three technologies:

- cable, whether coaxial or fiber optic, or any other variant relying on a trunk consisting of cable.
- hertzian space to ground technology, that is direct broadcast by satellite (DBS)
- hertzian terrestrial technologies, of which the only practical variant is the exploitation of microwave frequencies (MMDS) since VHF and UHF frequencies in all countries of North America and Western Europe are virtually saturated.

Of course the technologies are not necessarily mutually exclusive and in many cases would best be used as complements in the provision of services to a specific environment.

The service

All the technologies may be used for purposes other than television transmission. Other potential services include data transmission and tele-surveillance. What matters most in terms of the choice of technology is the number of channels to be communicated. In all hertzian systems this number is limited by the availability of a finite quantity of frequencies. Cable technology is also limited in the number of channels it can carry although the maximum load, especially where fiber optic cable is used, would be much higher than that afforded by any hertzian system.

But to the extent that the primary purpose of the technology were to be the transmission of television programs, there is a practical limit to the number of channels that need be offered. Most experts, at least in the United States, agree that fifty channels are sufficient to satisfy the desires of viewers and that the marginal interest of each channel thereafter moves on a rapidly decreasing curve.

All three technologies are capable of carrying at least fifty channels. Of course the costs of doing so vary greatly among the technologies and more will be said on this subject below.

Since most countries already provide several channels of television through VHF and UHF technologies, the relevant question then is what technology is best suited to carrying the additional thirty or forty channels considered useful for satisfying public demand.

The environment

Certain technologies are better suited to specific environments. For instance, cable is definitely not well-suited to rural areas where population densities are low. Hertzian terrestrial technologies do not function at their best on highly accidented terrain.

The case of urban areas is more controversial. Cable operators have the advantage of amortizing their infrastructure, such as trunk cables, over more potential hook-ups than in rural areas. Thus the direct economic cost of cable technology is perhaps at its lowest in urban areas. On the other hand, calculations of the cost of building cable systems rarely take account of indirect social costs that result from the inconveniences attendant upon the execution of public works, in particular: traffic congestion and noise during trenching, and visual pollution due to surface wiring.

The general interest

In order to protect and further the general interest, certain criteria must be considered in determining the optimal choice of technology for distributing television programs.

- Cost:

All other things being equal, it is in the general interest to spend as little as possible on the function of carrying television signals. In other words, the burden of persuasion should be on the spokesmen of higher cost signal carrying technologies to show some overriding advantage to their system.

The cost associated with each technology involves both the investment in building its infrastructure (launching of a satellite, laying of the cable trunk, equipping a head station, etc.) and the price (whether capitalised and depreciated, or inventoried and negotiated) of each hook-up (antenna, converter, cable, and decoder).

For any given environment and service, each technology will have a specific cost. Nevertheless certain generalisations are valid for purposes of comparing the costs of the three technologies under consideration.

Clearly the launching of satellites and the laying of trunk cable are vastly more costly than the setting up of the head station required for MMDS operations. The following cost comparisons will serve to illustrate the point. Whereas five million French Francs would be sufficient to equip an MMDS head station transmitting twenty channels covering the entire Paris region (about two and half million households), the same amount would barely cover one months' rent of a single transponder on TDF1, the French DBS satellite, and would equip a mere one thousand cable subscribers (based on an estimated cost of five thousand French Francs per hook-up to the French cable system).

An equally important financial consideration involves the duration of the gestation period between the expenditure for building the system and the first commercial returns. In the case of satellites, their design, manufacture and launch are undertaken before subscriptions can be offered to potential customers. With cable systems, trunk and feeder lines to each household must be installed before marketing can be begun. Thus the greatest part of the infrastructure is built before any revenues can be generated. Moreover in the initial years only a fraction of households with cable hook-ups actually subscribe (a rate of 25 % in the first year and increases of 10 % every year thereafter would be considered a reasonable performance).

Consequently, the quantity of resources required to finance satellite and cable systems is available to only a few companies or even nations. And the risks of failure are so great that only very powerful concerns should venture into these fields.

On the other hand, the cost of building MMDS systems is only a fraction of the costs associated with cable. As compared with the above estimated cost of FF 5,000 to equip a cable subscriber in France, MMDS subscriber installations would cost about FF 1,000. (In each case the cost of decoders is excluded). Admittedly the MMDS operator would also have to recover the higher cost of its head station as compared with that of a cable system. But even assuming the difference to be FF 3,000,000 for the hypothetical twenty-channel system servicing the Paris Region, an MMDS operation would become overall less costly than a cable operator at the point of achieving 750 subscribers.

Also once the MMDS head station is set up, it can immediately begin to serve customers. The MMDS operator's major investment, that is the cost of purchasing reception equipment for its subscribers, may be incurred in conjunction with sales of subscriptions.

MMDS operations thus require much less investment than alternative technologies and the gestation period between the investment outlay and its generation of revenues is much shorter.

In conclusion on the matter of comparative costs, MMDS entails much lower start-up investments than either cable or satellite and also requires much less working capital since the cost of acquiring receiving equipment can largely be synchronised with the sales of subscriptions. Where the receiving equipment is kept on the books of the operator, deposits can be charged; alternatively, the receiving equipment can be sold to the subscriber. In either case, the operator's receipts can be used to finance its own purchases of equipment.

- Consumer benefits

Because of the comparative cost advantages of MMDS operations, they are better suited than either cable or satellite to satisfy a number of consumer interests.

As the MMDS operator's capital requirements are lower than its cable and satellite counterparts and as its revenues begin flowing more quickly, it can pass on to its customers the benefits of these financial savings through lower subscription prices. Thus more subscribers can afford MMDS transmitted signals than those carried by other technologies. MMDS operators are better able to service all classes of society.

To the extent that rapid satisfaction of consumer demand is a social goal, then MMDS is the preferred technological option. This choice is inherent in the policies adopted in Hong Kong where the cable franchisee has been granted the right immediately to establish MMDS operations pending construction of the cable network.

Also, since an MMDS operators can be profitable while offering programs at lower break-even points than competitors using the alternative technologies, they can carry lower added value programs, such as educational and other public service programs.

Alternatively, because of their lower prices for transmission services, MMDS operators can afford program producers an opportunity to spend more money on improving the quality of their product.

- Freedom of speech

Diversifying control of the instruments of transmission is one method for protecting freedom of speech. No doubt there are ways, however tortuous, of promoting this general interest even where the state exercises monopoly control over the signal distribution system. But the mere existence of alternative vehicles of expression limits the likelihood of arbitrary exclusion of marginal ideas or their spokesmen. In so far as MMDS is less expensive than alternative technologies, it better serves the general interest by facilitating the launching of a greater number of signal carrying services.

Also since cost of access to the media directly influences opportunity for expression, the general interest is, all other things being equal, best served where the cost of carrying television signals is minimised. As MMDS operators enjoy lower break-even points than operators of alternative technologies, they can pass this benefit on to suppliers of programming by charging lower prices for carrying their signals.

- Encouragement of competition

To the extent that competition is viewed as being at least *a priori* positive, the ease of access to the market for delivering televisions signals is a goal which serves the general interest. The larger the investments required for entry to the market, the greater the constraint on access. Delivery of television signals by satellite and by cable involve such large investments as practically to exclude all but the wealthiest companies from entering the competition. On the other hand, MMDS operations can be launched with quite small amounts of capital and development can be financed through positive cash flows generated in large part from customer deposits for or purchases of receiving equipment.

- Environmental impact

The major environmental impact of MMDS is the visibility of antennas. While this may be a disadvantage relative to cable (at least where cables are laid underground), there is of course no disadvantage relative to satellite communication which also requires antennas. On the other hand the laying of cable entails noise and visual pollution during the building and repair of the system, as well as often significant degrees of traffic congestion.

A SUGGESTED APPLICATION FOR MMDS IN EUROPE - EDUCATIONAL TELEVISION

Because education is generally recognized as a very significant contributor to economic growth and social development, it a virtually undisputed goal. All means of improving the delivery of educational services thus merit serious consideration. The advantage to be gained by distributing educational programs through television is that it costs more to transport students to the classroom than it does to televise the programs to the students. In France for example, it is estimated that some 20 to 30 % of corporate spending on continuing education is devoted to the cost of transporting employees to the classroom.

The principal impediment to increased use of television for delivering educational programs is that the cost of time on existing television distribution services is prohibitive. In France, the number of hours per year of educational programs on television has in twenty years fallen from over one thousand to less than one hundred. Given the small number of VHF and UHF frequencies allocated for television, these rare commodities have been employed for the gain of the highest possible margins, that is for broadcasting entertainment programming by national networks.

Among the alternative technologies only MMDS offers promise of a rapid and effective solution to the challenge of increasing educational television.

DBS is simply too expensive. The announced annual rental of a transponder on the French satellite TDF 1 is FF 70 million. Also DBS receiving equipment remains expensive, when it is available at all. Just how daunting these problems have been is manifested by the fact that, more than a year after their attribution, none of the TDF 1 channels (other than La Sept) are yet in operation .

Cable where it even exists in Europe is rarely profitable. It would probably take a decade for all the countries of Western Europe to be adequately cabled. For instance in France after almost ten years of efforts only some two and a half million of the possible twenty million households are hooked up and only 243,000 of these have actually subscribed to a cable service. Furthermore existing and planned cable systems generally provide for a quite limited number of channels; in France most systems have been designed to accommodate no more than twenty channels.

Under these circumstances cable operators can hardly be blamed if they choose to concentrate their efforts on programming which will attract the largest audiences and consequently generate the highest advertising revenues. Educational television does not fit into that category.

MMDS however is well suited to educational television. As already noted the investment required in fixed capital and working capital is relatively low. A study conducted with respect to the Paris Region has indicated that an investment of two million French Francs would suffice to launch a one channel educational television station transmitting five days a week twelve hours a day.

In the project as proposed, the MMDS operator would obtain a license for the appropriate frequencies and would rent out antenna time to providers of educational services. The latter would not only determine program content, they would also prospect for their customers, issue their own invoices and handle their own collections. Access to programming could be restricted by the use of encoding/decoding equipment. Such equipment might not be necessary where the provider of educational services enjoyed other means of ensuring payment, for example withholding of a diploma.

If antenna time were to be invoiced at FF 1,000 per hour, break even income would be achieved at one third utilisation of total annual antenna time.

Informal discussions with potential customers of the MMDS operator, in particular with suppliers of continuing educational in France, have served to confirm that a transmission cost of FF 1,000 per hour is eminently reasonable. The number of additional students needed to recover the FF 1,000 per hour for transmission costs of course varies according to the price per hour charged for the educational program. However as a general rule the smaller the potential audience, the higher the charge for the program; a post-doctoral course in computer engineering would be marketed at a much higher price per hour than a beginner course in English. Actually the most important financial consideration from the viewpoint of suppliers of educational programs would be the cost of converting classrooms into studios (FF 600,000).

Over and above the cost advantage of MMDS as compared to alternative technologies, there is the speed with which MMDS operations can be put into service. In a matter of a few months after attribution of frequencies, operations could be begun.

CONCLUSION

It would be opportune for European authorities to undertake the appropriate procedures to implement frequency reallocations with a view to granting licenses to MMDS operators. Where cable and satellite systems have already been launched MMDS might be restricted to the provision of services not optimally delivered by such existing systems; for example, MMDS might well be used for providing educational television. But where cable does not yet exist, such as in the countries of Eastern and Southern Europe, MMDS should be given serious consideration as a substitute delivery system.

OPTICAL TRANSMISSION IN TV DISTRIBUTION SYSTEMS

Tibor Berceli

Research Institute for Telecommunications
1026 Budapest, Gábor Áron-u 65, Hungary

In the TV distribution networks there is an increasing need to enhance the number of simultaneously transmitted TV programs. For this purpose, the present networks consisting of symmetric lines and coaxial cables can not be used. However, optical fibers offer a very broad transmission band. At the same time, the semiconductor lasers can be modulated by very high frequencies which can efficiently be detected by photo-detectors as well. Thus the optical fibers can be used for the transmission of 60 - 80 TV channels. In the paper, system and device considerations are presented. The different system constructions are compared and evaluated. The circuit requirements of semiconductor lasers and photo-detectors are discussed. Distortion and noise problems are considered.

INTRODUCTION

In the TV distribution systems two different connections are necessary: transmission of the signals from the center to the nodes, and distribution of the signals from the nodes to the subscribers. In the transmission part different media are at our disposal: coaxial cables, microwave radios, and optical fibers.

Coaxial cables are widely used for both transmission and distribution at the present. They have a broad band, and thus can carry a bunch of TV channels. However, the attenuation of coaxial cables is highly increasing with the frequency. Consequently, the distance between repeaters is shorter when the number of simultaneously transmitted TV channels is increased. For the same reason, coaxial cables require equalizers to get a flat amplitude response covering all of the transmitted TV channels.

The microwave radio has a wide transmission band, it can be used for much longer distances which does not depend on the number of the transmitted TV channels. By microwave radio a larger area can be covered, i.e. several nodes can be connected with the center applying a higher power transmitter and several receivers. However, the frequency spectrum is a natural resource which is limited. That is a big problem mainly in urban area.

Therefore, the best solution is the optical fiber transmission. The fibers have a very low attenuation, a very wide bandwidth, they do not interfere with electrical systems, and does not use a frequency spectrum in the free space. Beside, they are cheap, light and flexible.

OVERALL PERFORMANCE OF FIBER OPTIC LINKS

The overall performance of the fiber optic link transmitting the TV channels in the microwave band can be evaluated utilizing the block diagram of Fig. 1 and the expression for the total transducer gain G [1,2]:

$$G\,[\mathrm{dB}] = 10\log(L_{me}^2 L_{to}^2 L_{mo}^2 L_{fo}^2 L_{co}^2) \qquad (1)$$

where:

$$L_{me}^2 = (1-|S_{11}|^2)\,(1-|S_{22}|^2)\,\frac{R_D}{R_L}$$

L_{me}^2 : Microwave matching losses,

S_{11}, S_{22} : Reflection coefficients of laser and detector,

R_L, R_D : Laser and photodetector input resistance,

$L_{to}^2 = \eta_L^2\,\eta_D^2$

η_L, η_D: Responsivity of laser and detector ,

$L_{mo}^2 = K_L^2\,K_D^2$

K_L, K_D: Laser and detector coupling efficiency,

L_{fo}^2 : Fiber losses,

L_{co}^2 – Connector losses.

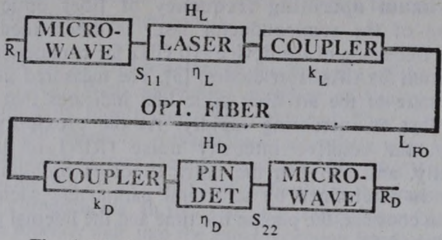


Fig. 1 Block diagram of a fiber optic link

In Eq. (1) the microwave matching loss depends on the circuit as well as on the operating frequency and bandwidth. The laser responsivity, of course, depends on the device structure, and material. The coupling efficiency between the electrooptic components and the fiber, and the losses of the connectors depend on the mechanical alignment. The only loss term that is dependent on the link length is that of the fiber itself. Design and optimization of high frequency fiber optic links must take these factors into consideration.

For example let us consider a 50 meters long fiber optic link comprised of commercially available Ortel semiconductor lasers and photo-detectors (SL-1020, PDO-25) modulated by a 2 GHz analog signal. The average loss will be 36 dB, distributed among the different components as shown in the pie chart of Fig. 2. It is clear that these losses must be significantly reduced before the full potential of optical interconnect can be realized.

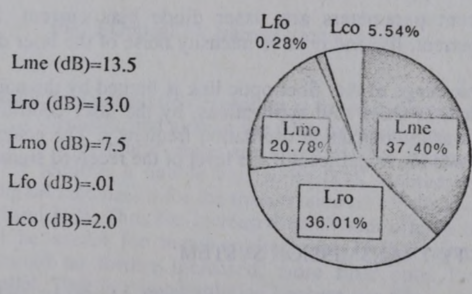


Fig. 2 Losses of a fiber optic link

The maximum operating frequency of fiber optic links with direct modulation of the semiconductor laser is determined by the relaxation oscillation frequency of the device (10 GHz for commercially available buried heterojunction GaAlAs laser diodes) [3]. The measured frequency response of a typical state of the art fiber optic link indicates that above 10 GHz the insertion loss is increasing rapidly. At the proximity of the relaxation frequency, the relative intensity noise (RIN) of the laser increases dramatically, and above it the noise becomes prohibitive. The relaxation frequency is determined by structural parameters such as the differential optical gain constant, the photon life time and the internal photon density in the active region [4-6].

The dynamic range of a fiber optic link is determined by the sensitivity and the 1 dB gain compression point as described in the following equation:

$$CDR\,[dB] = P_{1C}[dBm] + 174\,dBm - 10\log BW - NF \qquad (2)$$

Where P_{1C} is the input power at the 1 dB gain compression point, BW is the link bandwidth, 174 dBm stands for the room temperature thermal noise contribution and NF is the link noise figure given by :

$$NF = \underbrace{\frac{RIN(Ib,f)\,(Ib-Ith)^2 R_L}{KT}}_{\text{LASER CONTRIBUTION}} + \underbrace{\frac{2e\,(Ib-Ith)\,\sqrt{R_L R_D}}{GKT}}_{\text{DETECTOR CONTRIBUTION}}$$

The different parameters are: laser diode bias current, I_b, laser diode threshold current, I_{th}, and relative intensity noise of the laser diode, RIN.

The dynamic range of the fiber optic link is limited by the noise figure, which is dominated, in short haul applications, by the laser contribution. The laser noise peaks at the relaxation oscillation frequency. The noise contribution of the detectors is also significant if the level of the received signal is low.

OPTICAL TV TRANSMISSION SYSTEM

In Fig. 3 an optical transmission system applicable for several TV channels is shown. The signals of the channels are up-converted into the 0,4 - 0,9 GHz frequency band by applying subcarriers at the appropriate frequencies. The up-converted signals are combined by a branching filter and after amplification a semiconductor laser is modulated by this combined signal. At the receiver side a photo-detector [7,8] is used to regain the combined signal, and it is distributed among the subscribers.

In this arrangement the crucial problem is the linearity of the laser and the photo-detectors [9,10]. With increasing number of the channels to be transmitted, the linearity requirements are enhanced. That effect limits the number of transmitted channels. Nevertheless, recently a very high linearity has been attained and that assures the transmission of 60 - 80 TV channels. The linearity requirements can be met with less difficulty if the transmission band is shifted to higher frequencies. In this case, the transmission band has to be shifted back at the receiver side into the usual reception band of the television set.

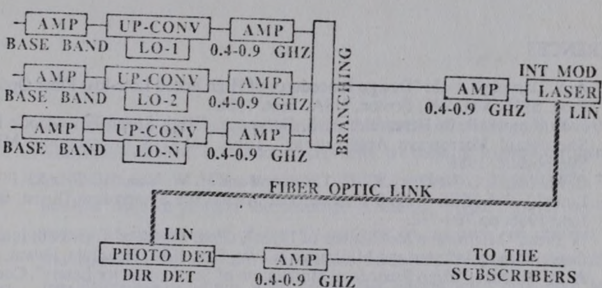


Fig. 3 Optical TV transmission system

The demand for higher transmission capacities is based in part on the need for more available TV channels, and also on the wish for improving the quality of the TV picture. In the future, more and more HDTV programs will be distributed which requires a double bandwidth [11]. Another trend is the application of digital modulation for the transmission of TV channels that also needs a wider band [12]. Thus the increased bandwidth offered by the fiber optic link will be useful for many applications. If the capacity of the transmission should be further increased, more fiber optic links can be installed in parallel. That is a good solution because the fiber optic links are inexpensive.

CONCLUSION

Optical fibers offer a very broad transmission band. Therefore, the best solution is the optical fiber transmission. Further, the fibers have a very low attenuation, they do not interfere with electrical systems, and does not use a frequency spectrum in the free space. Beside, they are cheap, light and flexible. At the same time, the semiconductor lasers can be modulated by very high frequencies which can efficiently be detected by photo-detectors as well. Thus the optical fibers can be used for the transmission of 60 - 80 TV channels. In the paper, system and device considerations have been presented. The different system constructions have been compared and evaluated. The circuit requirements of semiconductor lasers and photo-detectors have been discussed. Distortion and noise problems have been considered.

REFERENCES

1. A. S. Darvoush et al.: "Design Procedures of High Speed Low-loss Fiber Optic Links", Proc. SPIE Vol. 995, Boston, USA, Sept. 1988.
2. I. Koffmann, P. R. Herczfeld, A. S. Daryoush, "High Speed Fiber Optic Links for Short-Haul Microwave Applications", IEEE MTT-S International Microwave Symposium, 1988
3. C. M. Gee, I. L. Newberg, G. D. Thurmond and H. W. Yen, "10 GHz RF Fiber Optic Links", 1986 IEEE MTT-S International Microwave Symposium Digest, Baltimore, June 1986, pp 709-712.
4. T. Sueta, "Microwave Modulation of Light", Conf. Digest of Thirteenth International Conference on Infrared and Millimeter Waves, Dec. 1988, Honolulu, Hawai, p. M2.2.
5. A. P. DeFonzo, "High Frequency Modulation of Semiconductor Lasers", Conf. Digest of Thirteenth International Conference on Infrared and Millimeter Waves, Dec. 1988, Honolulu, Hawai, p. T2.2.
6. V. M. Contarino, A. S. Daryoush, and P. R. Herczfeld, "Large-signal Modulation of Semiconductor Lasers with Optical Feedback for Millimeter Wave Applications ", Proc. of IEEE MTT-S International Microwave Symposium, Las Vegas, 1987.
7. C. Rauscher, L. Goldberg and A. M. Yurek, "Self-Oscillating GaAs FET Demodulator and Downconverter for Microwave Modulated Optical Signals", 1986 IEEE MTT-S International Microwave Symposium Digest, Baltimore, June 1986, pp 721-724.
8. P. C. Claspy, S. M. Hill and K. B. Bashin, "Microwave Characteristics of GaAs MMIC Integrable Optical Detectors", Symposium Digest of IEEE/MTT-S International Microwave Symposium, Long Beach, June 1989.
9. W. I. Way and A. Afrashteh, "Linearity Characterization of Connectorized Laser Diodes under Microwave Intensity Modulation by AM/AM and AM/PM Measurements", 1986 IEEE MTT-S Int. Microwave Symp. Digest, Baltimore, June 1986, pp 659-662.
10. M. L. Majewski and L. A. Coldren, "Distortion Characteristics in Directly Modulated Laser Diodes by Microwave Signals", Symposium Digest of IEEE/MTT-S International Microwave Symposium, Long Beach, June 1989.
11. C. N. Lo and L. S. Smoot, "Integrated Fiber Optic Transmission of FM HDTV and 622 Mb/s Data", Symposium Digest of IEEE/MTT-S International Microwave Symposium, Long Beach, June 1989.
12. D. D. Tang, "Multi-Gigabit Fiber-Optic Video Distribution Network Using BPSK Microwave Subcarr[illegible]rs", Symposium Digest of IEEE/MTT-S International Microwave Symposium, Long Beach, June 1989.

Installation Problems of TV Stations

Attila Bartha
Hungarian Broadcasting Company
1088 Budapest, Trefort u. 2.

This lecture wants to transilluminate the circle of problems correlating with realization of TV stations, primarily on basis of experience gained in the course of TV repeater network projects. Investigates the possible ways of ceasing the coverage problems. Gives a survey on the history of development of the TV network in Hungary, on changes of the technical devices and the results achieved. Proposes possibilities for alternative solutions when taking the special local conditions into account, with a special regard to the CATV's initiations in progress at many places. Strengthening of the democracy renders selection of the sites also more complicate. Spreading of the TV broadcasts of commercial nature means a serious challenge with respect to the former monopol position and demands new ways of thinking. Finally, it outlines the expectable tendencies of the development.

TV broadcasting in Hungary was started in December of 1953, with a home-made 100/50 W transmitter, on OIRT Channel 1. The regular program broadcasting was started in May of 1956 from a temporary site but this time with use of a 10/0,4 kW BHG-made transmitter and a two-storied butterfly antenna installed on a mast of 50 m height. The building of the TV station today received in 1958 an RFT-made 30/10 kW transmitter whereby already a considerable coverage was achieved.

This was followed by Pécs, Sopron, Miskolc, Kékes, Szentes and Kabhegy, first with provisional solutions, then, the nowadays still operating stations were built in succession. In 1974, with putting the station of Nagykanizsa into operation, the construction of the main network of TV1 program was completed, except for Vasvár whose starting took place in this year only. (Figure 1).

During the course of the functioning, however, it was proven that certain larger coherent still uncovered resp. poorly covered areas exist. Station Csengöd which is in the preparation phase has been designed to cease the problems correlating with the improper TV program reception facilities on the area laying between rivers Duna and Tisza. At Tokaj, in consequence of an international agreement, broadcasting of the TV1 program on OIRT Channel 4 has to be ceased, in 1992. The broadcasts of the transmitter already operating on channel 43 - although the borderline of the theoretically covered area was only slightly modified - in consequences of the deviating wave propagation properties and in function of the terrain configurations are often not receivable on areas which at present are perfectly covered on channel 4. For the compensation of this shortcoming new main line stations will be built at Fehérgyarmat and on the Aggtelek area. In addition to this, both stations will be given a serious role in fulfilment of the nowadays openly declared task relating to coverage of the areas where Hungarians live out of our frontiers. (Figure 2).

For radiation of the TV 1 program initially high-power transmitters were employed. Thus, in Budapest an RFT-made 30 kW transmitter and at Szentes a 20/4 kW CSF-made French transmitter operating nowadays as a stand- by transmitter were installed, in 1959. The first product of the organized domestic transmitter production was formed by a 4 kW transmitter delivered to Kékes in 1960, which was followed by a 20 kW equipment, in 1962. These transmitters were built by the Electromechanical Enterprise and subsequent to this, till the early 80's this company resp. later its legal successor the BHG delivered the Band I-III main-line transmitters and antenna systems for the Hungarian Post.

Radiation of the 2nd Hungarian TV program was started from Budapest, in 1969, initially with a domestic EMV-made 4 kW transmitter, on channel 24. After Budapest, main stations at the countryside were installed in succession. By now it is achieved that at the main stations of the TV1 program the installation of the high-power transmitters of TV2 program will be completed everywhere, in 1990. (Figure 3). With this, however, the nation-wide coverage network is not finished at all, since in consequence of the Band IV-V propagation peculiarities, in these bands a greater station density is needed than in Bands I-III. (Figure 4).

Regarding manufacturer, at present all transmitters of the TV2 network are delivered by the Japanese firm NEC. The equipment installed from this year is formed already by air cooling transmitters of entirely semiconductor construction. The majority of the antenna systems operating this time is an up-to-date product of firm R&S and its legal successor, firm PRF.

In parallel with installation of the national main network, construction of a repeater network serving for coverage of smaller uncovered areas, settlements was started in 1963. The initial steps were, however, very slowly made. In 1963-64 3 stations were established, of which Ózd and Salgótarján were operated in attended mode whilst Szekszárd in remote controlled mode, from the beginning. The equipment employed here was formed by transmitters of the French firm LGT.

In 1968, the Electromechanical Company started development of the domestic 1-5-20 W repeater transmitter family, establishing with this an essential base for the further evolvement. In 1975, the first standard station characterized by a 30 m tubular mast and a traditional building was completed at Tatabánya. Between 1975 and 1980 the network was subject to an intensive development. Whilst in the former 12 years alltogether 8 stations were established, in this period 33 new sites were installed and, in addition, radiation of the TV2 program was also started. From 1979, the firm BHG started delivery of a new transmitter family of 20-40-80 W power series, fully semiconductorized design, with built-in stand-by and automatic protection switching. The Band III antenna systems were manufactured and installed by the firm Telecommunication Company (HTV).

Starting of the installation of the TV2-program repeater network was forced by population's demands. By the original plans, the realization of this network was scheduled after the nearly complete realization of the main network. Thus, it is no wonder that at the occurrence of this demand the BHG was not prepared for the production yet. As western imports were out of question, a private contractor recognizing the demand in a proper time and his later manufacturing partner became winners. From their appearance with the first primitive 10 W transmitter till delivery of the 80 W already professional equipment only 4 years lapsed. In the meantime, forty 5-20-40 W transmitters were produced by the NSZV Video-Technique Subsidiary Company, with relatively short delivery. For the stations the Band IV-V antenna systems were delivered by the BHG, delivering these items to date. (Figure 5).

The development of the repeater transmitter network was characterized in almost all periods by the lack of a uniform network conception. One of the main reasons of this is inherent to the improper knowledge of the national coverage conditions and, another reason, to the unavoidableness of local demands often supported also by financial resources. As the measurements whereby familiarizing with the correlations of the uncovered areas and optimization of the coverage could be archieved were only later made of territoral nature, the network evolved is far from ideal.

Besides the obligation for attaining the coverage, the demand for optimization of the mode of the solution comes more often to the agenda, primarily when expenses are involved. Thus, also at smaller settlements - with a special regard to reception of the satellite programs and distribution of the signal - the demand for installation of a cable television (CATV) network is coming to the foreground. The head station to be realized facilitates, in addition to the domestic program, forwarding of receivable foreign (traditional and satellite) programs to the flats and with this the repeater station with its limitations (transmitting domestic programs only, capable of realizing full coverage only in rare cases) looses a lot from its attraction. In my opinion, the most evident and rational solution is embodied in the Austrian example. The ORF, at settlements where the cable distribution system meets its specifications, to a certain proportion shares payment of the expenses. This done, the ORF fulfils its program broadcasting obligation whilst the maintenance, troubleshooting tasks will burden the owner of the cable television system.

A more and more serious problem is inherent to selection of the place of the transmitter stations. This holds true to both the sites of the main network TV2 program stations and the repeater network stations. The expectable monetary and moral revalorization of the land, the strengthening of the proprietror's attitude, the increasing acceptance of the environment protection aspects all show a tendency which renders our bargain posotion more troublesome. In the past, it was sufficient to refer only to a political or cultural political significance and we could almost at any place get an area for installation of a station.

The radio and television broadcasts of commercial resp. political nature, other than the main, state handled ones - under the pretext of the frequency moratorium - are being now placed to a parking orbit but the pressure for fighting frequencies will be restarted with a renewed force sebsequent to the elections to be held in March, this year. It seems to be sure - as having some experience in relation to the town television broadcasts radiated already in some settlements - that it would be a sine to preserve independent channels not accessible for others, for 1-2 hours of transmission weekly, even if these are initial figures only. As the television program making especially on the studio side is an expensive activity, waiting or hoping that the program time can be multiplied within a short period will prove dreaming only.

A solution seemingly acceptable and proposed by me is the following: anyone, e.g. the Hungarian Broadcasting Company (MMV) or any other enterprise if having sufficient capital should establish studios or a commercial transmittel or transmitter network. This then should be offered for leasing to inquirers on the area, with some time sharing. By this, three things could be achieved:

- the equipment and the staff of the studio could be professional and the technical level higher than otherwise;
- servicing of the transmitter would not burden the organization not professional in this field;
- the national treasure of shortage, the frequencies could be utilized with a higher efficiency, instead of extravagancy.

It is questionable whether the radiation monopoly will be attained or abandoned. Assumably it will be relieved; partly it is probable that the MMV converting into a shareholder's company in the second half of this year becomes opened for the foreign and domestic shareholders and, on the other hand, new undertakings, associations entirely independent of this company can be established. Nowadays, it is still felt that even in case of relieving the monopoly we shall have a favourable position which improves our facilities for widening the user's circle. The existence of national network, stations with road, power supply, building, tower, expandable stock of transmitters, modulation routes, measuring instruments, rationalized spares supply and experienced staff as a whole mean advantages which can be hardly compensated. In case of a larger area coverage, establishing of a transmitter station independent of the existing ones appears with a very considerable capital demand and it seems to be absolutely irrational. In case of smaller area e.g. town coverage demands the advantage menifests itself in our greater experience in investments and installations, and in existence of the service staff.

A more professzional solution is an own investment followed by leasing of the devices which, however, would be possible only in of drawing-in of foreign capital. A higher probabibility exists for the solution ensuring room, power, etc.

in our existing projects against a hiring fee and, operating the devices of the customers accommodated there, in form of a wage-work.

It is sure that our management has to be rationalized, the tariffs determined on a realistic basis, and seeking for possibilities of expanding services thus increasing the incomes is by all means needed.

It is a fact that the expenses of the repeater network are continuously growing. The sites are more and more hardly accessible, and the area coverable by a station is always smaller. A considerable fraction of the expenses is formed by the cost of the infrastructural road and the power. Let us remain at the access of the stations: This can be divided into two components:

- provisions for implementation, in the construction phase,
- provisions for operation, or in other words, for the servicing activities.

Recently, in spite of the fact that the services are equipped with landrover vehicles, according to the existing regulations, roads were built for a number of millions, whereby access to the stations is ensured theoretically independently of the weather conditions. This question, however, ought to be investigated according to fundamentally new aspects.

- The implementation phase with a good organization can be shrunk to a few months and these why not could be in the dry summer season? In this case the majority of the potential sites - at least to the direct vicinity of the station - can be accessed by a landrover vehicle. With a minimum effect on the expenses the access road can be built and, for example, even if the vehicles travel with a half load only, the expense increasing effect of this is negligible as compared to the standard road construction costs.
- Assigning of the place of the stations is made with use of landrover vehicles. These in some way, in majority of the cases on an earth road, are able to access the site variants defined in advance, where measurements are carried out by them. The measurements can be postponed in function of the weather conditions but this may not be done with the fault elimination. Nevertheless, rare is the season when the roads are absolutely unmotorable and with improvement of the reliability of the equipment the probability of failures falling to this season is very low. If the servicing resp. the investment costs are not made independent of each other, then, it is not necessary to choose the more expensive solution. If the worker performing the services is really well paid, he will find the solution for accessing the station and to fulfil the troubleshooting and repairing operations.

Finally, I want to summarize what I see as problems to be solved in the near resp. farther future. As part of the development, the construction of the TV2 main network has to be continued but only at places where it is really justified. The possibility of the introduction of the satellite program services has by all means to be investigated. The development of the TV repeater network has to be placed on a new base, examining the rationality and the possibility of combining with the cable television service. Beyond the problem of the repeaters, the far future is promising - and this is verified by foreign examples, too - a wider spreading of the cable television systems.

The replacement of the Band I stations has to be placed on the agenda. A special problem is the investigation of the vertical polarization. Should anything be stated in the literature, it is proven by practice and experience that the vertical polarization is accompanied by a considerable narrowing of the coverage. Interference problems appear in an increasing number. It is hoped that the Band I-III CCIR-OIRT overlapping can be eliminated at some time in the future. The opposition of evidently political initiation existing between the PAL and SECAM systems has also worth of mentioning here.

Fig. 1.
Coverage of TV-1 program
1990.

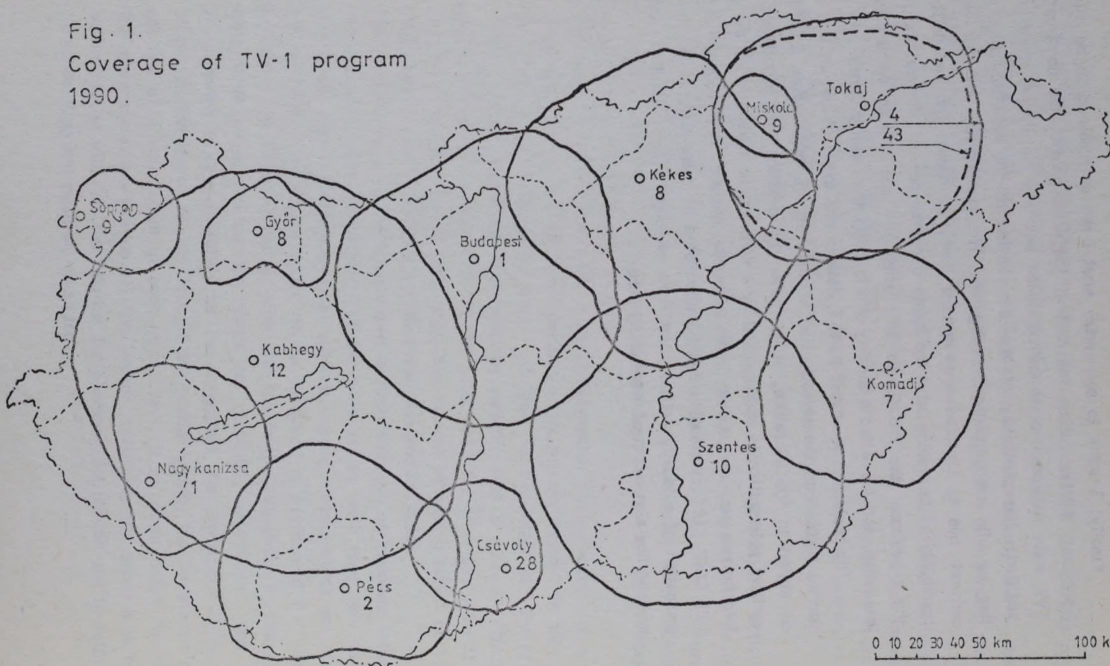


Fig. 2.
Coverage of TV-1 program
1995.

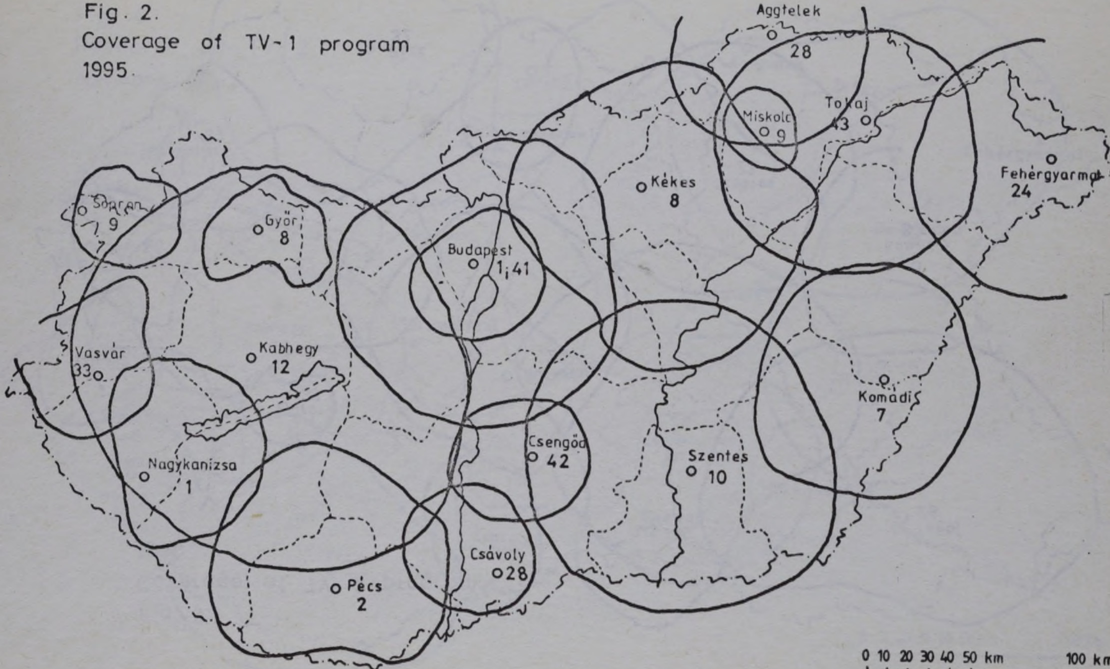


Fig. 3.
Coverage of TV-2 program
1990.

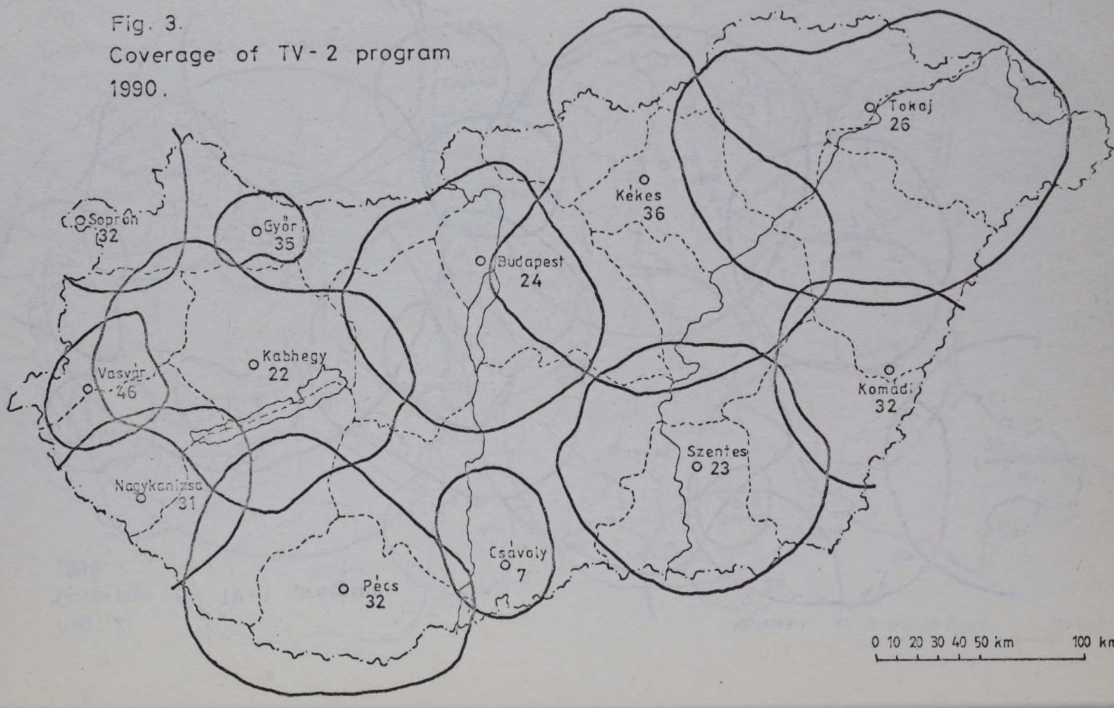


Fig. 4.
Research of TV-2
Network

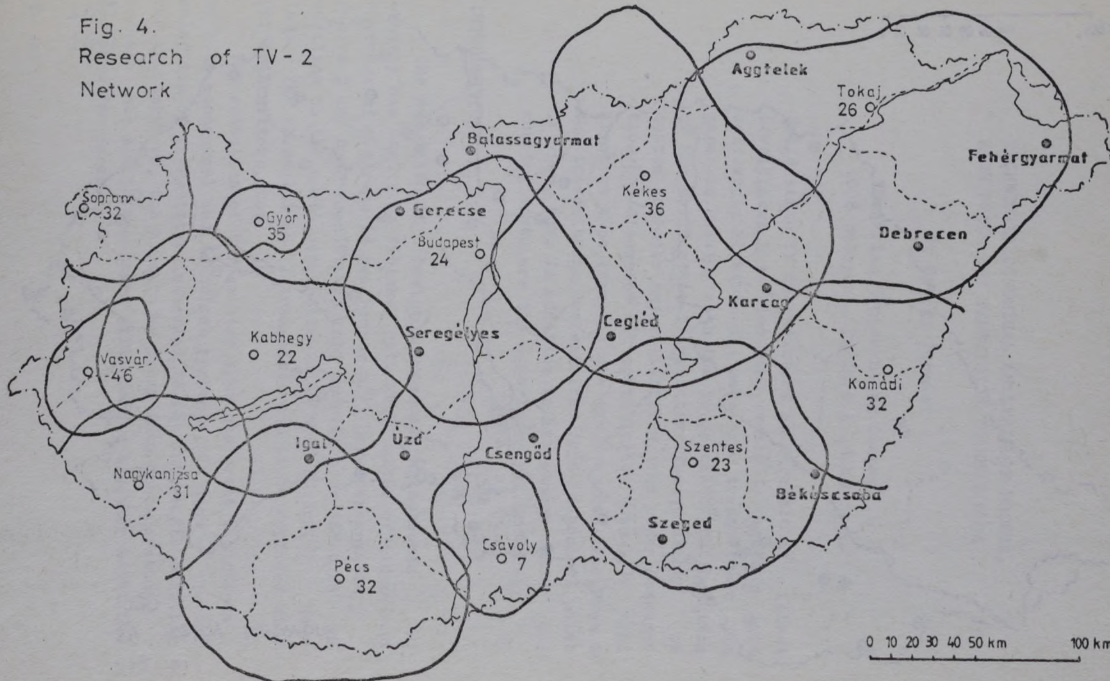


Fig. 5.
TV Relay Network
1990.

TECHNICAL-ECONOMICAL ANALYSIS OF MODERN, HIGH POWER UHF TELEVISION TRANSMITTERS

Dr György Tormási

Hungarian Broadcasting Company
1008 Budapest, Trefort 2. Hungary

Solid state TV transmitters as a result of latest development have also been available together with well-known klystron and tube type transmitters. The paper is dealing with the technical characteristics of the solid state transmitters.The questions of system engineering, reliability, and power consumption are discussed and solid state- tube- and klystron type transmitters are compared. Features of the transmitters are examined from economical point of view, too. In addition to investment costs the running costs are the more important factors.

INTRODUCTION

The extention of television broadcasting networks in Hungary has not been finished yet. Realisation of widespread coverage of programs is reached by high power transmitters /above 5 kW/ have to be taken into operation in UHF band in addition to the small power television transposers. Near future VHF channel 1 and 2 transmitters will be replaced with UHF transmitters, too.

The selection of transmitter type has great importance of both economical and technical respects. In case of selection of transmitter installed in the future the existing UHF transmitters, too have to be taken into consideration, because this old transmitters will operate together with the new ones for years.

Before studying of recently available transmitters we look back on recent past and examine the present situation, too.

HISTORY OF UHF TRANSMITTERS

First UHF television transmitter, was put in operation with the power of 4 kW at Budapest. This transmitter was called "colour transmitter" because it was started nearly the same time when in Hungary the colour television began. The transmitter had klyston power amplifier working in common vision-sound mode of operation. In accordance with the idea of that time the broadcast of second television program has been started in UHF band. After a long competition the multiplex mode of operation transmitters manufactured by NEC have been put in operation. The multiplex mode of operation means separated amplification of vision and sound and in case of emergency either of final stages of transmitters are able to amplify vision and sound together, but with half output power only. In order to increase the reliability the exciter has been doubled. The high frequency switches necessary to switch over in multiplex mode and the stand by exciter make the increase of reliability doubtful. In spite of this the experiences are very good because 9 transmitters have operated with very low time of breakdown. The develop - ment of the transmitters wants to reach over the application of modern element increasing reliability the increases of efficienc , too. In accordance with experiences the re- liability is good, we don't utilize the advantages of multiplex stand-by. Performances of the transmitters are good and unchanging.

Efficiency of klystron type transmitter isn't good and on several occasions klystrons have problems due to unknown reasons. As a result of development of klystron type trans- mitters there exist five generations of transmitters. Parallel with fourth and fifth generations the all solid state transmitters have been developed.

OUTLINE OF SOLID STATE TRANSMITTERS

The power amplifier of high power UHF television transmitter has been used by
- tube
- klystron
- transistor
- klystrode

for amplification. The tetrode tube and klystron type power amplifiers are wellknown. The klystrode is a relative new element coming from the object of development: combine the high amplification and the high reliability of klystron with good efficiency of tubes /1/. This device is the subject of another paper.

UHF transistor power amplifier is manufactured by some companies only. Conception of designe had two tendencies. One of them /this is handed over a result quickly/ is represented by NEC Corporation /2/. The power amplifier is prepared for one channel using broadband elements, too. European factories - Thomson-LGT is first of them - follow another direction. In this case only three types of power amplifiers are needed to cover all the UHF band /3/.

Figure 1 shows a conceptual diagram of solid state 10 kW vision and 1 kW sound power transmitter. This is a single stand-alone transmitter but has dual exciter and dual blowers with automatic changeover function.

UHF 6 kW transistor power amplifier has eight modules of 800 W output. Two sets of 800 W power amplifiers are fed by one regulated power supply. Figure 2 shows the diagram of 6 kW power amplifier. Input signal is 8 way divided, then individually amplified by an 800 W module and combined by an 8 way combiner to obtain an output of 6 kW.

Figure 3 shows the block diagram of 800 W UHF power amplifier unit, which has 12 final power transistors and employs circulators. Active elements of the amplifier are transistors. Figures show that the output power of transistors are integrated as a result of 10 kW output power of transmitter.

Compared solid state and klystron type transmitters, the following points should be taken into consideration:

1. A klystron or tube type television transmitter is furnished with no redundancy in itself, so that in order to continue the broadcasting service without interruption, it is necessary to provide a stand-by system using two sets of transmitter.

2. A solid-state transmitter is furnished with full redundancy in itself and requires no stand-by transmitter in combination.

High redundancy and high reliability are achieved by using the final amplifier stages in parallel. The solid-state transmitter employs the final power amplifier using multiple power amplifiers; service interruption will not occour by the failure of one amplifier,it only produces reduction of transmitter output power. In case of solid-state transmitter a new definition of MTBF /meantime between failure/ is necessary: for example failure means 1 dB decrease of transmitter output power.

The transmitter output will become as follows:

$$P_{/n-k/} = P_n \left(\frac{n-k}{n}\right)^2$$

P_n operating output power

$P_{/n-k/}$ the power obtained when k amplifier fails

n number of amplifiers in use

k number of amplifiers fail

For example, the 20 kW transmitter employs for visual amplification 32 pcs 800 W module. Therefore, when one of the visual modules fails we have:

$$P_{/n-1/} = 20\ kW \left(\frac{32-1}{32}\right)^2 = 18{,}8\ kW$$

Output power is decreased 0,3 dB. Supposing 2 pcs of moduls fail output power is reduced 17,6 kW ÷ 0,56 dB.

Let we examine the case, when 4 pcs 800 W modules fail; we obtain output power 15,3 kW /1,15 dB/ which is out of 1 dB limit. In practice this value is reduced to 18 kW output power /o,45 dB/ by automatic gain control /AGC/ of transmitter so that all specifications of transmitter have been fulfilled.

TECHNICAL-ECONOMICAL COMPARING OF TRANSMITTER TYPES

Question is: which of the optimum high power transmitter types is suitable for extention of television broadcasting networks in Hungary. Shall we use in future multiplex stand-by system or select another type and which of them.

Selection was done step by step. First of all in case of selection klystron type transmitter the multiplex mode of operation as a stand-by system was refused. The decision was based on the above mentioned experiences of last years.

Next step was the comparison among vision and sound transmission specifications of various type transmitters. It is proved that there is no difference among specifications of different type transmitters.

This information wasn't enough for selection therfore the following other features were taken into consideration:

1. Reliability /MTBF/
2. Investment costs
3. Power consumption /efficiency/
4. Maintenance costs.
5. Safety
6. Installation
7. Other standpoints

Table 1. shows features of transmitters using various types of power amplifiers. Investment costs are given in relative value and we have no price of klystrode transmitter.

We have to know that data of table suitable for getting trends only.

Features of various types of transmitters were studied by two different points of view. Team making decision consisted of experts working for operation and for investment. It means two points of view were represented during the decision. Reliability, power consumption, maintenance costs and safety are important for maintenance field. People working for investment worry about investment costs and easy installation.

Other standpoints /air cooling, no warmup time, no mechanical tuning are also important for operation. Delivery time is a common standpoint but 6-8 months time promising by supplier makes no difference among transmitters.

Economical features give another standpoint for consideration. Types of transmitter shoud be selected by installation and operational costs. Higher efficiency, lower maintenance and sparepart costs are against higher installation costs. During 10-20 years of operation solid state transmitter get the money back. As a final result of economical study team had to decide between higher present expenditure and small one for 10-20 years time.

Taking into consideration all above mentioned respects team was coming to the decision which has given solid state transmitter preferencies over other types of transmitter and 3 pcs 20 kW and 1 pc 10 kW solid state transmitters have been ordered.

REFERENCES

1.N.S. Ostroff/A. Korn, Klystrode equipped UHF transmitters for full time broadcast service. 16th International Television Symposium and Technical Exhibition. June 1989, Montreux, Switzerland

2.General description on solid-state VHF/UHF television transmitters. NEC Corporation, Tokyo, Japan

3. 5 kW-10 kW UHF solid state transmitters. Thomson LGT 6/89

BLOCK DIAGRAM 10 kW UHF TV TRANSMITTER

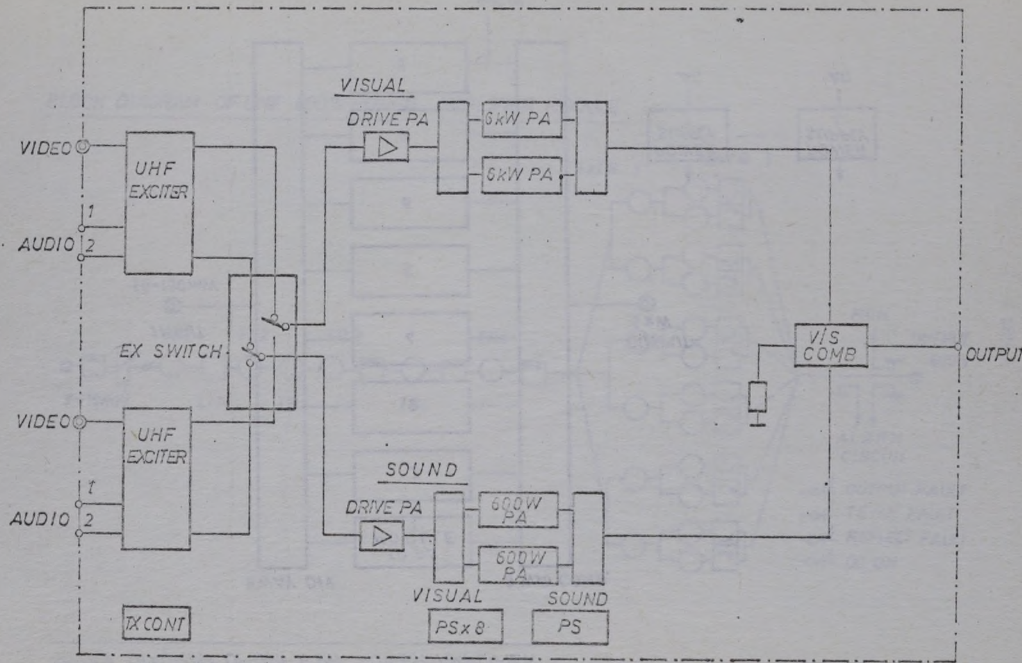


FIG. 1.

BLOCK DIAGRAM OF UHF 6 kW POWER AMPLIFIER

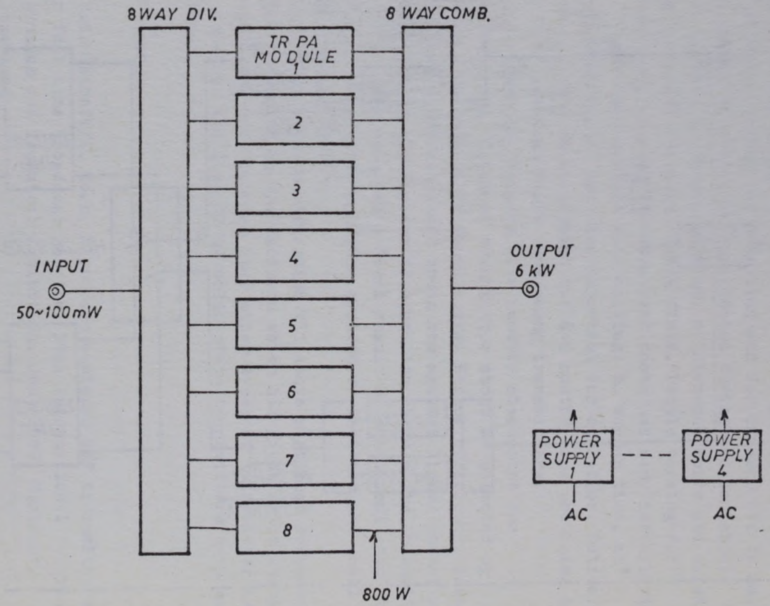


FIG. 2.

BLOCK DIAGRAM OF UHF 800W POWER AMPLIFIER MODULE

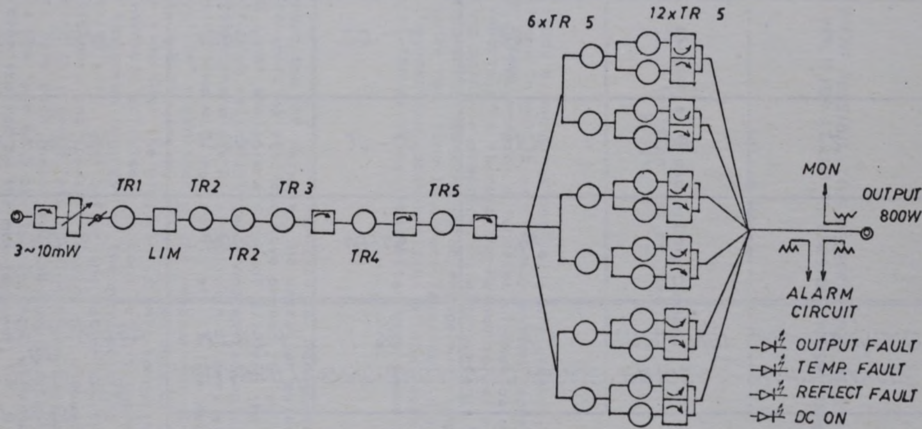


FIG. 3.

POWER AMPLIFIER OF TRANSMITTER	ITEM				
	RELIABILITY (MTBF)	EFFICIENCY (%)	USED VOLTAGE (V)	PRICE (RELATIVE)	MAINTENANCE (MAN X DAY/YEAR)
TETRODE	7000	40-45	7k	95	12
KLYSTRON	12000	30-40	25k	100	12
SOLID-STATE	42000	20-40	28	110	2
KLYSTRODE	10 000	50-60	30k	?	12

TABLE 1.

THE IMPROVEMENT POSSIBILITIES OF EFFICIENCY IN KLYSTRON POWER AMPLIFIER AT UHF TELEVISION TRANSMITTERS

István Rózsa

Hungarian Broadcasting Company
Television Station Tokaj
H-3910. Pf. 2.

The study examines an optimally efficient setting of klystrons in multiplex stand-by systems operating in SOUND NORMAL mode as a function of beam parameters, and reports of a calculating method to define the working point in practice. It also presents the development of working point change with constant perveance resulting in a more favourable efficiency and the practical possibilities of the reconstruction of the existing transmitter beam power supply.

INTRODUCTION

Since the beginning of the seventies our Management has gradually extended the UHF network. The operation experiences of the first transmitting stations have proved the advantages of the klystron power amplifiers first of all from the point of view of their high reliability and long operating time. In the national system there are klystrons with as many as 40.000 hours of operating time with no trouble at all. The debate "tetrode or klystron" - considering the present ever-increasing prices of energy and the trends as well - can only be decided if one keeps in view that the klystron is only competitive if its not too favourable efficiency is considerably improved. That is why it is common interest of the manufacturing firm and the operator as well, that better and better klystrons should be manufactured and operated keeping all unquestionable advantages. Taking this trend into consideration the following UHF transmitters have been installed: Kabhegy, Budapest, Szentes and Kékes, a new type of 5-cavity klystron, with higher efficiency has been applied by the manufacturer.

Let us figure the useful power calculated for 1 kW DC beam power as an efficiency measuring number - separately for the vision and the sound power amplifiers - then as station characteristics for the total useful power (Table 1.)

$$\eta_V = \frac{P_{VP}}{P_{VB}}$$ - vision power amplifier

$$\eta_A = \frac{P_{Aeff}}{P_{AB}}$$ - sound power amplifier

$$\eta_T = \frac{P_{VP}+P_{Aeff}}{P_{VB}+P_{AB}}$$ - total efficiency

P_{VP} - vision peak power

P_{Aeff} - sound effective power

$P_{VB};P_{AB}$ - DC beam power

Having a look at the comparative table shown below it is immediately obvious that there is practically no change in the total efficiency of the stations in spite of the fact that there is an increase by cca. 15-35 % of the efficiency of the vision klystrons, the reason for which is the firm decrease of the efficiency of the sound klystrons.
An extreme example of the sound power amplifiers at the stations of Kabhegy and Pécs

Pécs (1972)	1AV60 4-cavity	$P_{out\ sound}$ = 4 kW	P_{AB} = 26,5 kW
Kabhegy (1979)	1AV97 5-cavity	$P_{out\ sound}$ = 4 kW	P_{AB} = 73,5 kW !

WORKING POINT ANALYSIS OF UHF POWER KLYSTRONS

A study prepared in 1980 serves as the theoretical basis for the improvement of efficiency [1].

This study provided suitable relations in operation practice analysing the klystron beam characteristics, deducting the - for the practice - well approaching funtion of beam parameters and gain, and verifying the approximate working point independency of the DC-RF conversion.

It also examines the possibilities of working point changes in special view of a case when a multiplex stand-by system SOUND MPX mode - when the sound klystron has the same beam parameters as the VISUAL klystron - changes into SOUND-NORMAL mode with decreased beam power.

The study gives a detailed analysis of the relation in the course of the working point change brought about by <u>varied</u> or <u>constant</u> perveance, and suggests introducing a more efficient changing method (constant perveance) that helps to save a lot of power.

Let $U_o - I_o$ and $U_1 - I_1$ be two independent points of the klystron beam characteristics for which the following hold good:

Voltage	$U_o > U_1$	Gain	$A_o > A_1$
Current	$I_o > I_1$	Beam power	$P_o > P_{10}$
Perveance	$p_o > p_1$		

The most essential relations for practice in case of working point changes at varied or constant perveance (without mathematical details):

	with constant perveance	with varied perveance
	$p = c$ $U_{MA} = c$ $U_B \neq c$	$p \neq c$ $U_{MA} \neq c$ $U_B = U_o$
Current	$I_1 = I_o\left(\frac{U_1}{U_o}\right)^{1,5}$	$I_1' = I_o \frac{p_1}{p_o}$
Voltage	$U_1 = U_o\left(\frac{I_1}{I_o}\right)^{0,67}$	$U_1' = U_o$
Beam power	$P_{10} = P_o\left(\frac{U_1}{U_o}\right)^{2,5}$	$P_{10}' = P_o \frac{I_1'}{I_o}$
Gain	x $A_1 = A_o\left(\frac{U_1}{U_o}\right)^{2(n-1)}$	$A_1' = A_o\left(\frac{I_1'}{I_o}\right)^{2(n-1)}$
4-cavity	xx $A_1^{(4)} = A_o\left(\frac{U_1}{U_o}\right)^{6}$	$A_1'^{(4)} = A_o\left(\frac{I_1'}{I_o}\right)^{6}$

Notes: x n-the number of cavities participating in gain

xx checked by linear regression

$b = 6,06$ (power)

$r^2 = 0,97$ (korrelation)

COMPARING THE TWO WORKING POINT CHANGE METHODS

The changing of the working point can be

1. with constant perveance - with a beam voltage change
2. with varied perveance - with modulating anod voltage change

The comparison can be drawn

If a/ saturated or beam power ratios are the same $\frac{P_1}{P_t} = \frac{P'_{10}}{P_o} = \frac{P_{10}}{P_o} = a_e$

b/ current ratios are the same $\frac{I_1}{I_o} = \frac{I'_1}{I_o} = i$

c/ gain ratios are the same $\frac{A_1}{A_o} = \frac{A'_1}{A_o} = g$

The relations are shown in Fig. 2. and Fig. 3.
On the basis of the comparison one can state that considering all cases - the beam power and the gain are more favourable with constant perveance.

CONCLUSIONS

1. In case of the multiplex stand - by klystron power amplifiers output power needed for the sound function - with a view to an essential decrease of the working point should be realized with a constant perveance by decreasing the beam voltage.

2. The sound function klystrons should also be applied to have an optimum efficiency near saturation.
   So, if possible

   $P_{SAT} \leq 1,2\ P_{NOMINAL}$

3. The lower efficiency of our national UHF network with klystron power amplifiers is not basically due to the lower efficiency of the klystrons, but to the unfavourable setting of the sound amplifiers.
   Sound klystron in NORMAL mode - because of the varied perveance changing method - operate at an efficiency of 5 % while the klystron efficiency is 38 %.
   But constant perveance changing method sound power amplifiers are not all set to an optimum of 1/10 sound-visual power ratio.

THE STEPS OF CALCULATING THE SOUND NORMAL WORKING POINT

The starting data:

SOUND MPX

- U_o - beam voltage
- I_o - beam current
- A_o - gain
- a - sound-vision power ratio <1

The calculation:

SOUND NORMAL

1. $U_1 = U_o(a_e)^{0,4}$ - beam voltage
2. $I_1 = I_o(a_e)^{0,6}$ - beam current

x 3. $A_1 = A_o(a_e)^{2,4}$ - gain

a_e: sound effective - vision average max. power ratio <1 (all black, without synchron)

$a_e \cong 2a$ - the effective power ratio

If $a = \frac{1}{10}$ then $a_e = 0,2$

If $a = \frac{1}{5}$ then $a_e = 0,4$

After calculating U_1 the same U_1 must be experimentally set and then the values of I_1, A_1, P_{out}, P_{SAT} must be checked.

REALISATION

The general power supply can be seen in Fig. 3.
After calculating U_1 the original beam voltage must be divided

$$U_1 + U_{SUPPLEMENT} = U_o$$

i.e. U_o is the sum of the voltages of two independent rectifiers.

When calculating secondary voltage of the beam transformers the following must be taken into consideration

1. AC-DC conversion of the rectifier

$$U_{DC} = U_{AC}\frac{3\sqrt{2}}{\pi}$$

2. Short circuit impedance (for reason of protection) cca. the original

$\varepsilon \approx 8-10$ %

Notes: x The approached gain of the 5-cavity klystrons tuned to high efficiency is similar to that of the 4-cavity klystrons.

REFERENCES

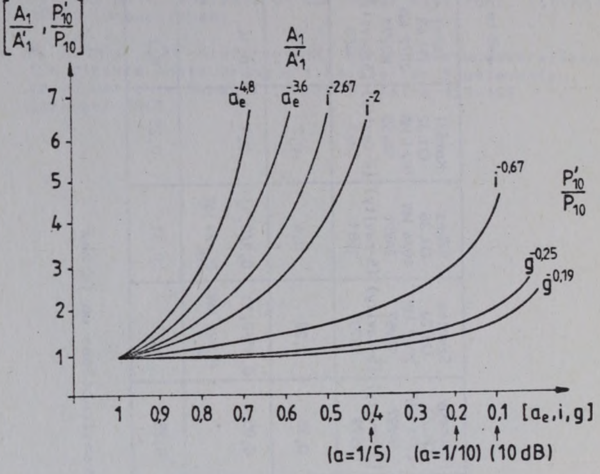
[1] Working point analysis of UHF power klystrons. István Rózsa 1980. (Unpublished)

[2] W. Schmidt, UHF Klystrons mit hoher Leistungsverstärkung für direkte Ansteuerung mit halbleiter Bauelementen. Valvo Berichte Band XII. Heft 5. Seite 129-153. Dezember 1966.

Table 1.

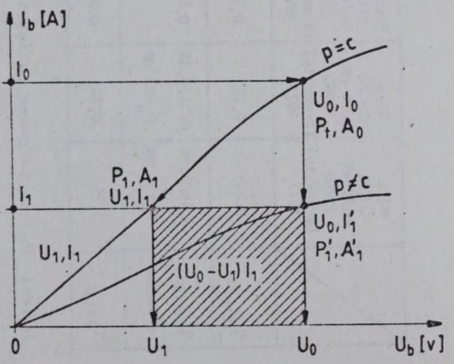
	Pécs CH.32 20/4 kW 1AV60 (4-cavity) 1972	Tokaj CH.26 20/4 kW 1AV60 (4-cavity) 1974	Budapest CH.24 40/4 kW 1AV97 (5-cavity) 1979	Kabhegy CH.22 40/4 kW 1AV97 (5-cavity) 1979	Szentes CH.23 20/2 kW 1AV67 (5-cavity) 1979	Kékes CH.36 40/4 kW 1AV98 (5-cavity) 1981	Komádi CH.32 10/1 kW 1AV58 (4-cavity) 1983	Tokaj CH.43 20/2 kW K3271 (4-cavity) 1988
η_{vision}	0,29	0,28	0,39	0,38	0,33	0,4	0,3	0,34
η_{sound} old/new	0,14/0,14 P_d=13 kW	0,14/0,14 P_d=13 kW	0,06	0,05	0,05/0,11 P_d=22 kW	0,1/0,1 P_d=21 kW	0,1	0,14
η_{total}	0,25	0,24	0,26	0,25	0,22	0,31	0,25	0,3

Notes: P_d: saved power during the rekonstructions up to now



A1/A'1 , P'10/P10
A1/A'1
ae^-4,8
ae^-3,6
i^-2,67
i^-2
i^-0,67
P'10/P10
g^-0,25
g^-0,19
7
6
5
4
3
2
1
1
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
[ae, i, g]
(a=1/5)
(a=1/10)
(10 dB)

Fig. 1.



Ib [A]
I0
p=c
U0, I0
Pt, A0
P1, A1
U1, I1
I1
p≠c
U0, I'1
P'1, A'1
U1, I1
(U0 - U1) I1
0
U1
U0
Ub [v]

Fig. 2.

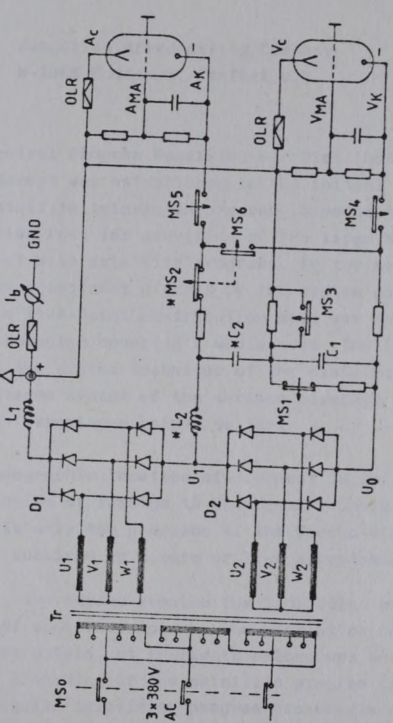

MSo
3×380V
AC
Tr
U1
V1
W1
U2
V2
W2
D1
D2
U1
U0
L1
*L2
OLR
Ib
GND
MS1
*MS2
MS3
MS4
MS5
MS6
*C2
C1
OLR
Ac
AMA
AK
OLR
Vc
VMA
VK

Fig. 3.

THE MICROWAVE PROGRAM DISTRIBUTION SYSTEM OF BUDAPEST

Gabor Jász

Hungarian Broadcasting Company
H-1088 Budapest, Trefort u.2.

The Central Program Receiving and Distributing System of Budapest was established in the initial period of the satellite television program broadcasting by the Hungarian Post for provision of the large hotels in Budapest with satellite programs. In the meantime, the program assortment offered by the system got expanded and the star-point distribution mode was changed for a transmission covering a whole area. The lecture discusses the system technique of the distributor system, the antenna system of the surface coverage and the reception experience gained so far.

As known, the geographic location of Budapest is unfavourable in respect of reception of foreign tv broadcasts. Besides the Hungarian boradcasts only two programs of the Czecho-Slovakian Television can be received in a more or less acceptable quality.

For this reason, the demand arousen for facilities of reception of tv programs of western origin by the population and tourists of large and busy hotels, at realistic prices was not satisfiable prior to the launching of the satellite program transmission. In 1984, when regular television program broadcasts were started by the ECS I-FI satellite came the idea: let us establish a central program reception station at a suitable point of Budapest where the statellite and earth tv and radio (sound) program signals are received and prepared for distribution, wherefrom the program signals are transferred by means of a suitable transmission device to discrete groups of the viewers, i.e. to the citizen's CATv systems and to the internal cable networks of the hotels. For the distribution, due to the transmission paths of 5-10 (15) km length, as well as to the endowments of the infrastructure, the coaxial cable technique could not be taken into account. Requirements set in relation to the transmission device are:

- the terminal equipment should be as simple as possible, at both the transmitter and the receiver sides;
- preferably no modulation exchange should take place at the receive end;
- the input and output frequency spectrum should be in compliance with the internal frequency distribution of the cable networks;
- the transfer parameters of the system on the receive end should facilitate signal forwarding on an adequately long cable section (of possibley several kilometres length);
- the transfer capacity of the system should be large enough (15-2o tv channels);
- the occupied radio-frequency bandwidth should preferably be narrow.

On basis of the abovesaid aspects the amplitude modulated microwave system was selected. This is a compromise, as the above advantages have to be paid by on expense of meeting the more stringent signal- to- noise and linearity requirements of the AM transmission.

Organizing and establishing of the system were fulfilled by the Hungarian Post. The circle of users, due to the mediapolitical guiding principles of the given period, was limited to the hotels. The program assortment was formed by the Sky Channel, Music Box (on recent name: Super Channel) and Tv5 radiated from the ECS-1 F 1 satellite, whose reception was licenced for Hungary free of charge, by the owners of the programs. Later, the list was lengthened by the first program of the Austrian Tv (ORF1) and the MTv Europe (ASTRA).

The equipment was delivered by firm Hirschmann (Rankweil/Austria) and the system is in operation since 1986.

The block diagram of the distribution system is shown in Figure 1. The satellite programs are available in baseband form (Tx/Rx) per channel, on the output of the satellite receiver indoor units. The ORF1 program is received at a place near to the Austrian frontier and it is transferred to Budapest on an FM microwave channel.

Preparation of the program signals for the distribution is made per channel, selectively. The baseband signals are modulated onto a standard TV-IF (picture: AM-VSB; sound: FM). From the IF, the signal is up-converted to a standard VHF channel and this is the actual input signal of the AM microwave channel.

These channels of frequency ranging between 100 and 300 MHz are transposed by an up-converter each, by means of a common local oscillator, to the 12.3-12.5 GHz SHF band. By the up-converters each a travelling-wave tube is driven, on the output of which a 33 dBm SHF power level is available. The system also contains a pilot generator, whose signal facilitates operation of the AGC and AFC circuits on the receive end.

The amplifiers are followed by a combiner network consisting of filters, circulators and 3-dB hybrides, having four output ports (output power per port and per channel: 23 dBm). The signals of the individual outputs are distributed by 3-dB hybrides for the paraboles of the transmission directions. Initially 9 transmission directions were operated in general with parabolic antennas of 0.6 m diameter on the transmit end and 1.2 m diameter on the receive end. The radiation is effected with a vertical polarization and the polarization of the adjacent transmitting directions to each other is orthogonal.

Recently, with an exprimental purpose two sector radiators have also been installed for coverage of a larger area.
At the receive end in the vicinity of the antenna is accommodated the down-converter, on the output of which the program signals appear in the VHF band, in an allocation corresponding to the transmit end input.

The indoor (regulator) unit of the receiver has the function of generating the stable local oscillator basic signal required for down converting as well as attaining stability of the oputput signal.

On the nine needle-beam transmit directions this time 12 receivers are operated, of which 3 are connected to cable distributor (CATv) networks.

The hops of the links range between 3.5 and 8 km. The energy balance of a link is shown in Figure 2.

Since 1989, usage of the microwave distributor system is licenced also for the population, in majority of the cases with connection to smaller community receiver systems (MATv) resp. in form of individual reception. For this purpose a simple and relatively cheap receiver can be produced by a modification of the low noise converters (LNC) of the satellite earth stations (TVRO). In the course of this modification the frequency of the local oscilator (LO) is varied; by a re-tuning of the band of the Sat. IF I amplifier the SHF signals are converted into the UHF band, which is already processable by the customary Tv receivers.
In case of a simple converter-type reception of this kind in general problems are caused by the relatively high gain (typically) 50 dB of the converter, its insufficient linearity and, occassionally by the improper stability of the local oscillator (LO) frequency.

In the initial star-centre transmitter system good reception could be reckoned with only along the transmitting directions and for this reason as first step, for experimental purpose, a sector radiator was put into operation and for the time of the preparation of this conference; in the first half of 1990, the radiation will be changed for an area coverage system, with installation of antennas of cosecant radiation pattern.

By an antenna of cosecant vertical radiation pattern a uniform field strength is ensured within its coverage area, independently of the distance from the transmitter. (Figures 3 and 4).

The area to be provided with programs in Budapest will be covered by 3 sector radators of 7o beam width, where the polarization of the successive antennas is alternately vertical resp. horizontal.

According to our tests carried out on the experimental sector radiation and on parabolic antennas interworking with the same no essential interference could be detected between the transmissions of near identical dierection and deviating (orthogonal) polarization.

In addition to the above mentioned coverage area, expansion of the program assortment of the distribution system is also planned up to a 16-20 tv program ultimate capacity and, starting of the VHF-FM sound programs is also in progress.

The experience gained from the AM distributor system so far is favourable: the equipment reliably operates and no failure occured in the link either for equipment fault or propagation problems.

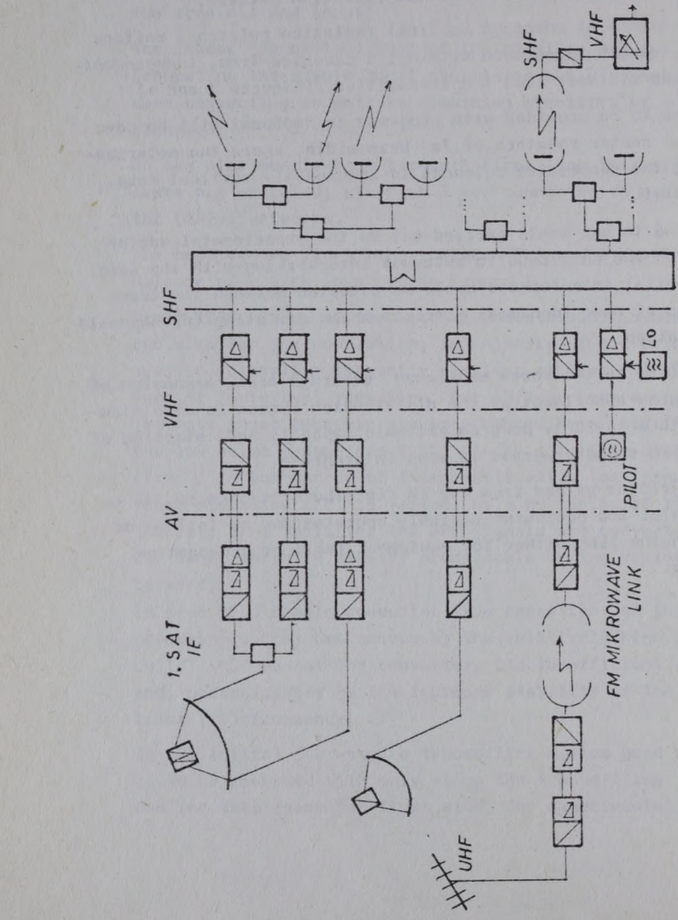


FIGURE 1. BLOCK DIAGRAM OF THE SYSTEM

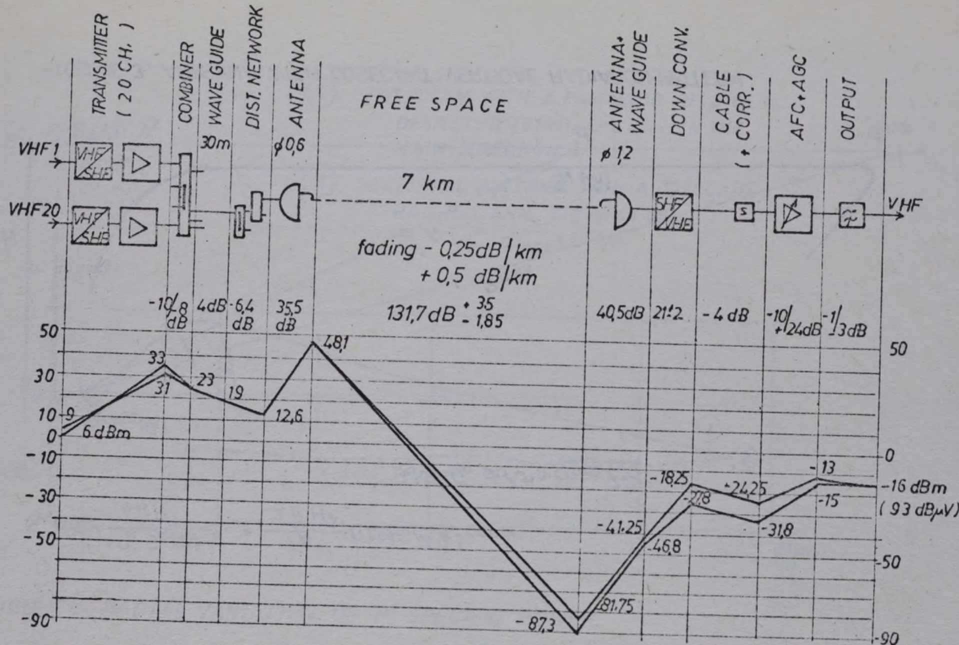


FIGURE 2. LEVEL DIAGRAM OF A POINT-TO-POINT LINK

$$S_V(\vartheta) = \frac{P_A\, G_A(\vartheta)}{4\pi R^2} = \frac{P_A}{4\pi H^2} G(\vartheta) \sin^2\vartheta \stackrel{!}{=} const$$

$$G_A(\vartheta) = G_0 \sin^2\vartheta_0 \cdot \underline{\underline{cosec^2\vartheta}}$$

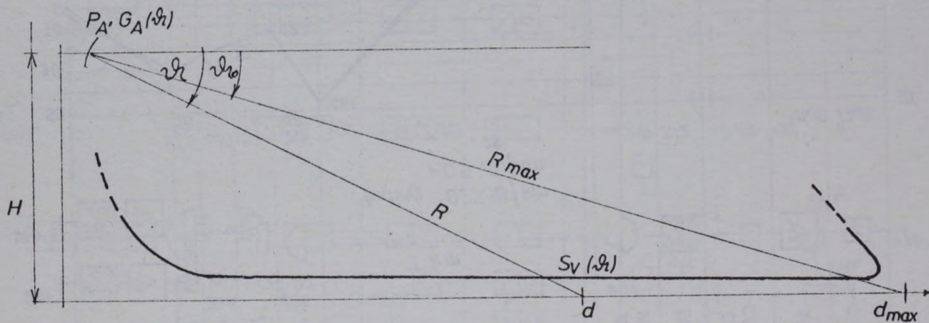


FIGURE 3. ANTENNA WITH COSECANT VERTICAL RADIATION PATTERN

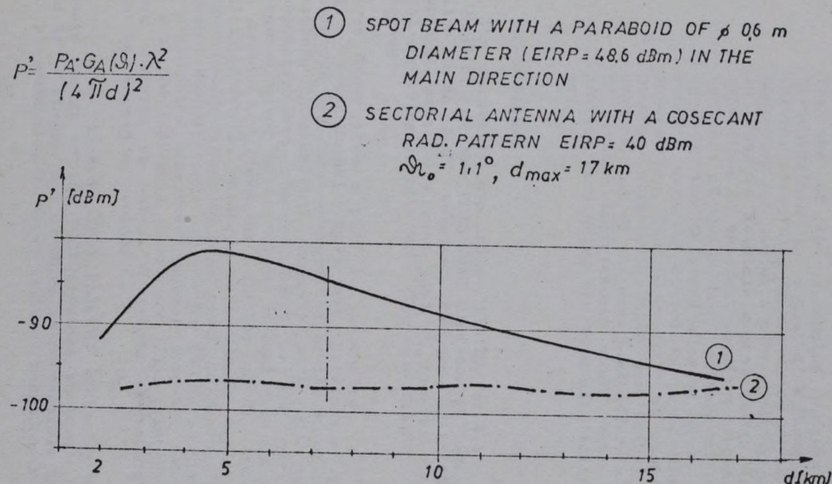


FIGURE 4. RADIAL VARIATION OF P' SPECIFIC POWER

A NEW STRATEGY TO CONTROL THE ECCT TELETEXT DECODER IC

P. Ferenczy

Technical University of Budapest
Institute of Telecommunications
Sztoczek u. 2. BUDAPEST, Hungary
H-1111

The use of the extension packets in teletext transmissions is becoming a usual practice in Europe, especially in countries where the national character set contains many accentuated characters. In order to maintain compatibility with the first generation of teletext decoders special care should be taken of the control software of the decoder IC to keep the teletext display free of flickering accents normally caused by processing X26 packet information. The paper gives an overview of a new program strategy, which not only solves this problem, but at the same time offers a whole series of further improvements which serve the viewers' comfort when using the teletext facility of the tv set.

Introduction

The currently available "SPAND9/ver.4.0" software for the MAB8401, or the PCF84C00B microcontrollers to drive the Philips made ECCT teletext decoder (SAA5243) has some drawbacks, especially when used to receive a teletext data signal employing packets #26. The main disadvantages are the following:

-- Every time a page is re-acquired, all the special [e.g. accentuated] characters previously displayed by packets #26 are first overwritten by the so called fall-back characters (transmitted normally with odd parity), then subsequently are changed back to the correct special characters using the information contained in packets #26. This causes a "flickering" display of all the accents, or diacritical marks, which is periodically repeated each time the previously requested page comes in again. The effect is the same, when the page arrives for the first time too, since the accentuated characters appear somewhat later, than the text with the fall-back characters. This flickering effect is rather annoying to watch, distracts the attention of the viewer and should be avoided.

-- In a "linked page" mode of operation the original firmware design of the ECCT provides maximum 4 simultaneous pages to be stored, one of which is necessarily the displayed one. The remaining 3 stored (linked) pages can correspond to only 3 dedicated colored keys on the remote control: e.g. the RED, GREEN and the YELLOW. If the viewer wishes to see the page corresponding to the fourth colored key [CYAN], then -having pressed this key - he or she has to wait for that page to be acquired. This is certainly not in line with the fast action of the RED, GREEN or YELLOW keys, where hitting any of these keys immediately displays the corresponding page. Obviously the CYAN key operation speed should be equivalent with those of the other three.

-- In a "non-linked page" mode of operation the ECCT basic design provides for only 3 more pages to be stored simultaneously and by software these are usually the 3 pages in consecutively increasing page numbers. The viewer however usually wishes to be able to page both upwards and downwards, so besides the [non-linked] displayed page the (n-1), (n+1), (n+2) and (n+3) pages should also be stored for quick viewing, which means, that the (n-1) page should also be available for immediate display.

A completely new strategy has been developed at the Budapest Technical University in 1983 to get rid of all these deficiencies, while maintaining all the good features of the current SPAND9 software. The solution is a pure software one and no modification whatever of the ECCT firmware is needed. This new program is called SMART, which stands for `smooth multipage acquisition and refreshing teletext'. This paper gives a brief outline of the structure of the new software (version 1.6) together with some hints on its use.

Description of the new software

In order to avoid the flickering accents of the characters produced by packet #26, it is essential to have the display and acquisition memories completely separated. The basic idea is to load and process all the data of a requested page in an acquisition memory and only when all the necessary processing had been finished, should its content be copied to a display memory. This scheme inevitably brings about a major restructuring of the 8 K page memory of the ECCT. Originally this 8 K page memory is allocated as follows:

acquisition & display # 1	acquisition & display # 2	acquisition & display # 3	acquisition & display # 4
extension packets # 5	extension packets # 6	extension packets # 7	extension packets # 8

Here memory block #5 contains the extension packets of the page stored in block #1, similarly blocks #2, #3 and #4 are related to blocks #6, #7 and #8 respectively. In order to be able to store four display-ready [i.e. fully processed] pages simultaneously and at the same time to retain at least 2 acquisition memory pairs, blocks #3, #4, #7 and #8 in SMART are designated as display memories only and are never used for acquisition. On the other hand block pairs #1/#5 and #2/#6 are kept for conventional acquisition and for the storing of relevant extension packet informations. It should be noted, however, that block #2 is sometimes used to store a "freezed page" in certain parts of the program execution (i.e. when temporarily no more page acquisition is needed). The new allocations of the memory blocks are as follows:

acquisition only # 1	acquisition (or store) only # 2	display only # 3	display only # 4
extension packets # 5	extension packets # 6	display only # 7	display only # 8

Initially the #1/#5 pair waits for the initial page of the system, while block #3 is displayed on the screen with artificially forced rolling header. [The initial page number is conveyed to the ECCT in packet #30, this is stored in block #5, which is read first, to know which page to request. Content of packet #30 is also used to copy to the display memory any status message.] As soon as the initial page arrives, the processing of packets #26 are started. This is not seen by the viewer, because block #3 is displayed, not block #1! Having finished the processing of the acquired page, it is copied byte-by-byte through the IIC bus into the current display memory, i.e. to block #3. The viewer sees this copying action like a top-to-bottom quick rolling of the text.

Right after this the acquisition of two further pages is started. There are two possibilities:

1. The initially captured page has no linked pages.
2. The initially captured page has linked pages.

1. The captured page has no linked pages.

In this case SMART starts a simultaneous search for the two immediately neighboring pages, that is the (n-1) and the (n+1) page numbers. These pages are requested into the acquisition blocks #1 and #2. The program leaves about 30 seconds for these pages to turn up, which is considered to be sufficiently long for most of the teletext services used in Europe. If successful, then the received pages are first processed, using packets #26 if any, and subsequently they are copied into display memory blocks #4 and #7 resp. During all these actions the viewer is watching the content of block #3, i.e. the initial page.

Having finished the searching, processing and copying of these two "neighboring" pages, the program execution turns to the next two pages: (n+2) and (n+3). They are automatically requested by acquisition blocks #1 and #2, and again leaving approximately 30 seconds for them to appear, the content of block #1 is loaded into block #8, while the content of block #2 remains where it is. By now the (n-1), (n+1), (n+2) and (n+3) pages, if they exist, have all been stored, and by way of using the increment or decrement keys on the remote control keypad [if not available, then the RED and GREEN keys resp. also function to this end in this case], the viewer can display any of them without a waiting time. If the page stored in block #2 is to be displayed, then first its content is loaded into one of the display memories, through the IIC bus, from where a subsequent display is possible.

During this acquisition process the viewer is continuously kept informed about the status of the (automatically) requested pages. In the top left hand corner of the screen there is a pattern like the one below:

< O >>>

The "O" represents the screen and the page currently being displayed, while the sign "<" - if displayed - signals that the (n-1) page is already in the page store, and similarly the signs ">" indicate the presence of the respective "upper" pages. If instead of the "<" and ">" signs a minus sign [-] appears, it means that the page either does not exist, or has not turned up yet. Keeping an eye on this status message, which is constantly being updated, it is always possible to decide which page is worth to choose next. In addition to this there is a further information conveyed by this status message: if it blinks, it means that the acquisition process of all pages has come to an end either because all 4 neighboring pages have already been collected, or because one or more of them didn't turn up within 30 seconds. Every blink of the status message in the top left hand corner indicates, that a fresh reception of the displayed page has taken place. It should be noted here, that in case the displayed page has one or more linked pages (see next subclause), then these have priority, and the number of either the "<", ">", or "-" signs is reduced from 4 to the remaining number of free page memory blocks. Consequently if a full 4 page link exists, then only the screen symbol of the status message remains displayed.

It should be born in mind, however, that as soon as a new page has been selected for viewing, the whole memory map is reorganised, as the search for at least one, but possibly more new pages is started, and this means that the previously stored collection of pages is partially lost, until the new acquisitions provide for the new entries. It is therefore especially advantageous to know in advance if for instance it is worth while to ask for page (n-1), because if it does not exist, the viewer does not get anything, but at the same time the previously stored (n+3) page will be lost. [Luckily this situation cannot arise in case of (four) linked pages (see next subclause), since it is the responsibility of the teletext editors that only existing pages are assigned as linked ones.]

2. The captured page has further linked pages.

If the initial page has linked pages [the numbers of these are contained in packet #27], then these data are saved and the first two of them are requested by acquisition blocks #1 and #2. As these requested pages arrive, they are processed and subsequently copied to the so far empty display blocks #4 and #7, while the viewer still watches block #3. Then the next two linked page numbers are requested by the software to acquisition blocks #1 and #2, and having collected and processed them the content of block #1 is copied to block #8, while the content of block #2 remains where it is, the processed page is freezed and kept there.

Now if the viewer presses any of the colored keys on the remote control, then the corresponding stored page [stored in either block #4, #5 or #6] is immediately displayed. The page in block #2, belonging to one of the colored keys [usually the CYAN key], however needs some further action before it can be displayed: its content must first be copied to one of the 4 display-only memories [either #3, #4, #7 or #8], which takes place rather quickly. The viewer only sees a swift top-to-bottom roll, its speed is determined by the clock frequency of the IIC bus. Since all four linked pages have previously been stored in the memory blocks [the currently displayed one is a fifth page!], there is no waiting time needed to display any of them.

In order to keep the viewer informed about the repeated reception of the displayed page, the picture screen symbol, "O", appearing in the top left hand corner blinks every time the page is re-acquisitioned. If the reception level of the tv program happens to be a poor one, then one can observe the correction of the erroneous characters taking place by every "blinking" of the "O" symbol, thereby improving readability (this error correction will later be treated in detail). It should again be noted, that if the displayed page has less, than 4 linked pages, then the status message in the top left hand corner of the screen will indicate as many "neighboring" pages as SMART can store in the unused memory blocks.

Rotating pages, subtitles, newsflashes, update

Special care has been taken to provide an adequate service in case of receiving rotating pages, subtitle pages or newsflashes. The updated pages also come under this heading, they must also be taken care of. The problem arises from the fact, that since only two simultaneous page acquisition is possible in this new software strategy [this is the price paid for being able to get rid of the flicker effect as well as having altogether 5 pages stored in memory], somewhat longer time is needed for SMART to collect all four extra pages into the memory, than is enough under conventional (e.g. SPAND9) software control. Now if the requested page happens to be a rotating one, then in order not to miss the next possible version of the same page, SMART gives priority to such a page in case it is currently being displayed. This means, that having received the page header, from its control bits C4 (erase) or C8 (update) are evaluated. If either of them is set to 1, then this acquisition block remains in operation, and only the other block begins to search for the still missing pages. In this way any new appearance of this rotating, or updated page will facilitate its new acquisition, which subsequently results in copying it into the current display memory, thereby providing a continuous refreshing of the displayed page.

The same applies to such incoming and currently displayed pages, where the control bits C6 (subtitle) or C7 (newsflash) are set: these also enjoy absolute priority resulting in a prompt display and appropriate updating within the page. As time passes by, of course the other acquisition block collects one by one the still missing pages into the page stores so they become available for immediate display in due time too. It should be noted, however, that none of the stored pages (except the one just being displayed) are refreshed because of the lack of adequate number of acquisition blocks. This means, that there may be a jump in the sequence of the rotations immediately after a previously stored rolling page is called to be displayed.

Re-allocation of the memory blocks

In a continuous operation SMART always keeps track of all the display memory blocks [#3, #4, #7 and #8] and acquisition block pairs [#1/#5 and #2/#6], their instantaneous status is constantly being observed. If a new page is requested either by the linked-page option or by direct choice, or by increment/decrement stepping, then such an action is taken, which involves the least number of program steps. Therefore no unnecessary cross-loading of the page stores takes place: the unaffected memory blocks remain unchanged. This strategy inevitably leads to an ever repeated reshuffling of the memory blocks, which in other words means, that for example memory block #4 is not necessarily the fixed location of the page available by the RED key call, or block #8 is not always associated with the YELLOW key request, etc.

This is especially true for block #2, which -according to the execution of the program - can play the role of a conventional acquisition block together with block #6 for the possible extension packets, but it will be converted to a fixed page store, when the 4th linked page arrives.

The memory bank select bit in the ECCT is also used in a flexible way, depending on the varying demands posed on the program by the viewer as well as the program itself.

Error correcting by multiple reception of a page

It is a regular feature of the fixed format teletext, i.e. the World System Teletext, that by repeated reception of the same page the character errors tend to decrease. This very attractive feature is based on an integration technique, whereby only those characters are written into the page memory, which have correct (odd) parity. Errors characterized by even parity (i.e. parity errors) will either cause the corresponding memory location to be loaded with "space", or - in case a non-space character is already there - have no effect whatever. On the other hand if a previously correctly received character turns up in a repeated reception of the page with a parity error, then it will not overwrite the good one. Obviously a page having several "spaces" or false characters as errors in the text will be corrected in due time by replacing these spaces with correct characters, since the probability of receiving again and again the same character erroneously is very low.

Owing to the fact, that in SMART the acquisition memory block is never the same as the displayed one, special measures had to be taken to ensure the constant error correction of the displayed page. Considering the fact that only two memory blocks are available at any time for acquisition, and taking into consideration the duty of the software to collect four further pages into the memory each time a new page request has been made, it is only by way of a compromise that refreshing of the displayed page can be made. Assuming that the newly requested page is neither a rolling, nor a subtitle page [which always have priority and are constantly updated], then its refreshing can only begin after all its linked or neighboring pages have already been received and processed. This obviously takes some time, and this extra waiting time is the price paid for all the previously mentioned advantages, but this compromise seems to be well acceptable. In any case, the viewer is constantly informed about the execution of the program by the status message displayed in the top left hand corner of the screen. Every time this status message blinks, it means, that the currently displayed page has arrived again and has already been used to "refresh" the page memory content. On the other hand if it does not blink after one cycle time of the magazine has passed, then this is an indication, that the acquisition memory blocks are still busy and memory refreshing unfortunately must wait.

Conclusions.

A completely new software has been developed to control the Philips teletext decoder IC SAA5243 (ECCT). It provides full level one features (FLOF), processes packets #26 too, but without the flickering effect of the displayed accented characters and provides a 5-page storage.

New Developments in World System Teletext

M. C. Roberts

Philips Components Ltd., Southampton, UK

Synopsis: A new range of teletext decoders will be described including their impacts on the market. Also included will be solutions to problems affecting WST and the TV manufacturers. An outline will be given of new market areas for the WST technology.

World System Teletext was first introduced in the UK in 1976 as a commercial service. Since this time there have been over 40 million decoders sold to viewers. This figure is growing at a rate of nearly 10 million per year. Research has shown that this is not an idle investment made by the consumer, in the UK alone more than 7 million people use the system everyday and 10 million use it every week. Average viewing times/day have risen every year to reach between 20 and 25 minutes.

The majority of the decoders now available in the market are based on the Philips device Enhanced Computer Controlled Teletext device ECCT. The introduction of this device to the market in 1985 caused many problems for the setmakers as this was one of the first devices in a television which relied heavily on software. However over a period of 3-4 years most setmakers transferred production over to this device and it is now accepted almost as an industry standard and as such it has been copied by other suppliers.

Recognizing the wide acceptance of the ECCT/VIP2 combination can cause many problems when it comes to introducing a new decoder IC to the market. The most significant of these is will the setmaker change to the new product bearing in mind all the expertise he has built up. To overcome this problem we in Philips have designed a new decoder which is largely software compatible with the ECCT.

In its simplest form you can consider this new device, called IVT (Integrated VIP and Text) a combination of the ECCT and the VIP2 device. The IVT is not just a single device it is a family of ICs and the first of these is the IVT1.0 .

Called the SAA5246, this device started volume production in April this year, It incorporates a digital dataslicer. This has the advantage of reducing the numbers of peripheral components required. The RGB outputs have also changed to push-pull units which means only two external components are required. There are now only 24 peripheral components required compared with the previous norm of 66.

IVT1.0 is designed in CMOS technology and this has had a tremendous effect on the total current consumption, which has dropped from a max. of 375mA to a max. of 120mA and in the process the 12 volt supply has been lost. All the registers of ECCT are still available and are in the same positions. However new registers have been added. There are two of these new registers, one for advanced control and one giving information on the device status.

The increased use of teletext for On-Screen Display of messages means that more attention has to be paid to stabilizing the text display in poor and no signal conditions. Both video and scan related synchronization modes are included as is the option to free-run the PLL. The register which controls this is the first of the new ones. It also includes bits for the direct writing of extension packet 24 to screen memory or to extension packet memory, as well as the selection bit for register 11 or 11B.

The second of these new registers is for device status, 5 bits are allocated to show which decoder is installed in the TV set, this makes it easy for the software to decide which device/ language option is in use. A register bit identifies whether the incoming broadcast signal is 625 lines or 525 lines and finally two bits are used for signal quality and text quality measures.

The second member of the family is the SAA5244, this part has the name IVT1.1 . This device is a 40 pin version of the IVT1.0, but it contains only one acquisition channel and has on-chip RAM (7 bits wide) enough for one page plus its FLOF prompts. This part is important since it is the first Philips teletext part to be truly single chip. It is aimed at the small screen TV which has previously had problems with the device due to space and system cost. The software control for this device is very similar to the ECCT.

The availablility of only one acquisition circuit has meant that we can reduce the numbers of registers but where possible there is compatibility, making software writing easier. It is expected that simple softwares of only 2k bytes will be required for this device. There are 32 special characters included in the device, these are suited to OSD applications and in VCRs.

The third member of the family is a derivative of the IVT1.1, it is called the IVT1.1BMC or SAA5247. It is completely software compatible to the IVT1.1, the difference comes from its ability to have a big memory attached. This memory can contain the entire teletext transmission of the broadcaster (depending on the size of the RAM). When a page is requested then the IVT then scans through the background memory for the page, if it found then the page is displayed, if not then the page will be looked for from normal transmission. Any page in the memory can be found in half a second, making effectively instant access.

As was indicated earlier in my presentation waiting time reduction is the single most often requested improvement by both broadcasters and by the general public. I have already mentioned one solution to this thorny question, this was a very memory intensive answer which can be quite expensive. Another answer is to use less memory but more intelligence in the way the memory is filled.

One such system is based on the SAA9042 from Philips, this device has eight acquisition circuits and will directly address upto 256k4 DRAM memories. The intelligence for the system is supplied both by the broadcaster and by the setmaker. The broadcaster must transmit one or both of the user friendly interfaces which has entered common practise in recent years, namely FLOF or TOP. Interpretation of this data must be carried out by the microprocessor associated with the teletext decoder and assuming the program is well written then the users will find that they never or hardly ever have to wait for a page. The control program for this implementation is not small however, FLOF alone is estimated to be 6-8k of code, TOP is 12-15k of code and combined may be 20-24k.

Another problem which affects WST in some parts of the world, is the way language enhancement via packet 26 processing is carried out. Initial activities for language extension were carried out in Spain and the Arab countries, all areas new to the teletext environment. Therefore there was no existing base of decoders with which to maintain compatibility and permitted the use of even parity transmissions. However in Eastern Europe there were Level 1 decoders so we were forced to use odd parity transmissions to keep them operational. The result involved the overwriting the default level 1 characters with their accented equivalent, this causes much annoyance as it makes the characters 'flicker'. The 'flickering' character problem has been elegantly tackled in software by some people, however we believe that we have found a way to solve the problem in hardware and will introduce an IC in the latter part of this year.

Another developing area for WST components is in the Video Cassette Recorder. The major problem with VCRs is to program it to record a specific program on a certain channel at a given time. Early attempts to simplify this involved simple characters on a black screen, this aided block preparation. With the almost universal acceptance of WST in Europe in now becomes possible to produce a pan-European machine which uses teletext for its programming. On such a machine the user would call in the program schedule, move a cursor to the relevant program to be recorded and press a button labelled 'record this'. The relevant information on the program is extracted from the teletext page and downloaded to the timer. The second stage is for the broadcaster to transmit the start and stop codes for each of the programs, then even if there is a delay in the broadcast timings the correct recording is made. Two standards have been defined in the EBU, these describe the way the broadcaster will send information to the VCR. System A will use the line 16 VPS signal that is currently transmitted in Germany. System B will incorporate this information into the extension packet

8/30. Another advantage for putting the teletext decoder into the VCR is to 'update your TV to teletext', it can act as a dual function set-top adaptor.

Finally teletext is beginning to make inroads into the professional data transmission areas with Data Casting. Teletext is the transmission of data from one point to many points and it is a very cost-effective way of achieving this. There are many instances in this modern world where it is necessary to make this kind of transmission. There are now a growing number of manufacturers who are producing professional decoders based on the WST technology. Of course, much of this information has some value so it is possible to sell to the end user, raising revenue for both the broadcaster who charges for transmission capacity and for the information provider.

From this presentation I hope you can see that WST is alive, that it is adapting to meet new requirements and with the help of IC manufacturers is being brought an even wider audience.

Digital TV-set family of Videoton

Lajos Takács
Tv-set factory of VIDEOTON
Székesfehérvár

Within the scope of an innovation project Videoton has established the technical and technological conditions for digital TV-set development and production on the technical bases of digital system of ITT. Our aim was to construct a kind of TV-set which takes marketing interests and ambitions of Videoton into consideration. A single digit TV-set is going to be developped for the lower classes. For the medium and top classes there is a version with flexible variability available to receive and interprete SVHS signals. The set consists of several modules nevertheless this fact allows to mount all types of sets on the same mother board. The possibility of development of the set is given by new modules.

A new TV-set family of Videoton

From the beginning of 1991 Videoton Co. wishes to produce its TV-sets with digital signal processor units in bulk-series. Within the scope of the innovative project a modern, high level manifacturing system was bought which assures the technological conditions to automatic assembly. Adjustments and testings are made by very flexible computer controlled units. Another field of innovation is the basical reform of developing processes. It means the main fields as follow:

- to establish a software developing department
- to organize a computer system as a support for PCB designing and for other documentation
- to set up IEC bus controlled measuring.

At the very beginning of our development project we assumed the existance of the above mentioned technical environment.

The technical basis of development of our digital TV-set is the improved version of the ITT set, that appeared the first on the market and was adopted by several companies. The results of ambitions for higher quality were also taken into consideration. We intended to adopt the latest development results of ITT even if these results have not been utilized in mass production. We wanted to be up-to-date with our next serial of products. Our aim is to construct a TV-set family with versatile customer service possibilities. The TV-set family will be a brigde between our nowadays production and the full digitalized new products available for new broadcasting norms for the second half of 1990.

Construction of the digital TV-set family

Nowadays a TV factory is only able to achieve an acceptable price on markets of high level if it has a complete family of sets which includes

- a simple version with basic services
- a set with extended services
- top-quality sets.

Taking into consideration all these we have formed our concept and went on with development tasks. We aimed to construct a TV-set family which is able to fulfill very different requirements if we change defined moduls, the necessary component values and the position of the components on the same mother board.

All the elements which define options or norm of the set we set on a module. These parts are the following:

- a high frequency modul (tuner, medium frequency unit)
- video signal processor unit with its controller subprocessor
- stereo audio module
- picture-in picture unit
- SCART switching module
- indoor satellite receiver with D2-MAC encoder.

According to these the mother board includes only the common

parts of every type: as power units (power supply, deflector unit), the analog circuits to switch different functions and the connectors of modules.
Let us say some words about the technology and components. We apply the surface mount technology (SMT) partly because it is required by the miniaturialization and partly because it proved to be good to massproduction in case of our other products. SMD components are as follows: chip components (resistances, capacitances solid state semiconductors), MELF components (resistances, capacitances) and PLCC integrated circuits.

Brief introduction of the TV-set family

Set for basic service
This kind of set is available with medium size (22"-25") CRT, so its services are as follows:
- tuning with voltage syntheser
- automatic channel search and store
- OSD display
- TXT receive
- PAL-SECAM receive
- mono sound

The TVP 2075 type controller microprocessor is able to control the so called simple digit video signal processor unit and the tuner, to OSD display through TXT and with the help of analog adjustable and switchable output it can control sound intensity and is able to normalize as well. The necessary 2 kbits memory is assured not at the usual way with 2 pcs of MDA 2062, but with NVM 3060 (it means 4096 bits as a storage) on the bases of the ITT simple video concept. The digital unit includes the following integrated circuits:
- VCU 2133 A/D and D/A converter
- VSP 2860 video and syncronous processor
- SPU 2220 SECAM processor
- TPU 2735 TXT processor with 64 k DRAM (8 TXT pages).

The input signals of the unit or the MF composite video signals of picture or the SCART connector are external video signals. The output signals are R-G-B signals (with beam current limitation) and the controller signals of horizontal and vertical deflection together with East-West correction. The mono terminal is mounted onto the motherboard. It is driven by the sound demodulator of MF unit. Its power is IOWS (musical).

Set with advanced service

Market expects the advanced services e.g. stereo sound, picture-in-picture, etc. in the class of medium and great size (25"-32") CRT. We have formed the service system of this set by taking the mentioned things into consideration, e.g.:

- tuning with frequency syntheser (channel division is made according to the standards of European countries)
- SVHS receiving possibility
- transient corrector circuit (DTI)
- picture-in-picture display
- II. SCART, CINCH input-output sockets.

The set includes two pieces of microprocessors: one of them (UP) controls the high-frequency unit, the picture and sound processor unit and analogous switches, the other UP controls the picture-in-picture unit and the second tuner as well. The base of both microprocessors is a 2070, its capacity is 16 kbytes. The software was developed in our own software department. The construction and circuitry of video signal processor is very similar to the construction of DIGIT 2000. It consists of the following integrated circuits:

- VCU 2136 A/D, D/A converter
- TEA 2014 analog switching IC
- PVPU 2204 video processor
- DTI 2223 tranzient corrector
- SPU 2243 SECAM processor
- DPU 2553 deflector processor

- MCU 2600 timer marker generator
- TPU 2735 TXT processor with 64 kbyte DRAM.

On the contrary to the former ITT digit system the video bus ensures paralel supply, its power consumption is decreased (5Vs) and its noise radiation level is smaller in conjunction with the inner shieldings.

The picture-in-picture unit is able to gate its own picture, the SCART video signal and as a new hit, all the stored channels from the second tuner MF. We use the following integrated circuits:

- MAX 454 analog switch
- VCU 2133 A/D, D/A converter
- SPU 2220 SECAM processor
- VSP 2860 video and syncronous processor
- PIP 2250 picture-in-picture processor with 2x6 kbyte DRAM.

The stereo sound unit processes the 5.5-5.74 MHz stereo signals with two carriers, the 6.5 MHz signal (or 6 MHz English depending on the processor) and the 32.4 MHz French (L) norm amlitude modulated MF signal. The applied integrated circuits are

- TBA 120U, TDA 2460 FM, AM demodulator
- ADC 2310 A/D converter
- APU 2470 sound processor.

The 2. SCART includes SVHS and CINCH video and sound input-output sockets and the necessary analogous switches. All the sockets are not used at the same time because the relevant standards of the countries are different.

Top-class set

We plan to manufacture this set with great-size (32") CRT. According to our definition a set belong to the top class if it has the possibility to satellite receivment beside all the above mentioned services.

We intend to apply the Videoton design indoor unit which has a tunable sound receiver facility. We plan to add a D2-MAC decoder to this unit if market claims to it.

ISBN 963 8111 38 0 Ö

ISBN 963 8111 39 9 T

MTESZ - egyesületi használatra !

Kiadja: Híradástechnikai Tudományos Egyesület
Készült: 300 példányban
90/502 MTESZ Házinyomda, Budapest.
Felelős vezető: Boncza Gábor