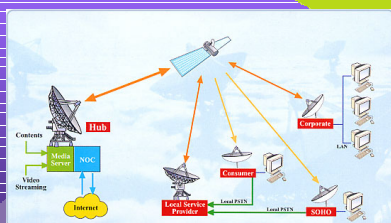


Digital Video Broadcast Technology Applied to the Delivery of IP Services



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Impact of New Technologies

- In the last part of the twentieth century, the almost simultaneous arrival of two major innovations — mobile phones and the Internet — not only changed the face of communications, but also gave the impetus to dramatic economic growth.

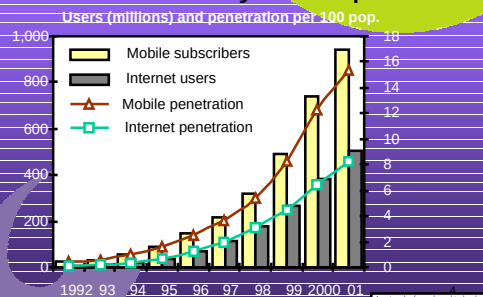
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Impact of New Technologies

- This historical pattern has been repeated in the development of every new communications network technology:
 - 1840's: telegraph
 - 1870's: telephone
 - 1890's: radio telegraphy or "wireless"
 - 1920's: radio broadcasting
 - 1950's: television broadcasting
 - 1960's: geostationary satellite communications
 - 1970's: computer communications
 - 1980's: optical communications
 - 1990's: Internet and mobile communications

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Mobile and Internet: identical twins born two years apart?



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Digital Video Broadcast The Satellite Milestone

(every corner of Africa today has Satellite coverage)

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What is Digital Video Broadcast (DVB) ?

- European standard for transmission of digital TV via satellite (S), cable (C) or terrestrial (T).
- Utilizes MPEG-2 compression and packet standard
- Supports data as well as video transmissions.
- Supports multiple program streams, each of which can be encrypted (DSTV)
- Supports sub-multiplexing within a program stream
- Provides for high degree of forward error correction

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DVB Facilitates Delivery of IP Services Over Satellite

- Satellite delivery of IP services is growing because of Satellite's ability to:
 - reach regions of the world where terrestrial infrastructure is expensive or does not exist
 - multicast broadband data more effectively than can be done by terrestrial circuits
- DVB is a standards based delivery approach for satellite. Its use will:
 - decrease receiver and bandwidth costs
 - foster development of broadband applications

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DVB Delivers Multiple IP Services Over a Shared Satellite Link

In A Shared Link:

The satellite carrier is shared by multiple users;

User packets are interleaved;

Each site filters out its own packets.

There are many ways to do this, but DVB has several advantages.

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Shared Satellite Links Support Bundled, Value-Added Services

- Basic Internet Delivery of Web Pages, Email, File Transfers etc.
 - fixed bandwidth
 - bursting services
- Same for Intranet and Extranet Delivery
- MPEG Video Streams
- Voice Over IP
- Specialized Multicast Data Services

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Multicast Is Expected To Be A Major Growth Area

SOME MULTICAST APPLICATIONS

- Radio & TV Networks-distribute commercials, audio & video objects to affiliates
- Specialized Wire Services
- Financial Data Feeds
- Distance learning
- Corporate Training Video
- Caching Feeds for ISP's and Corporate Intranets
 - School web with Uconnect
- Remote Publishing and Printing

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CHARACTERISTICS OF MULTICAST APPLICATIONS

- large files, could contain voice/data/video
- requires management of entitlements and protection of proprietary content
- bandwidth driven by application or customer need for rapid delivery (usually broadband)
- there could be major scheduling issues; deliver
 - at specific time(s)
 - as soon as possible
- different quality of service and reliability requirements for streaming or package delivery

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Quality of Service Issues for Multicast Applications

- Streaming Applications, such as voice and video, require strict timing delivery of packets; must insure bandwidth and jitter characteristics
- Data Package Delivery could be supported by a range of QoS capabilities:
 - Guaranteed bandwidth
 - Guaranteed delay
 - Available bandwidth
 - Guaranteed bandwidth with potential for bursting beyond the guarantee

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Reliability Issues for Multicast Applications

APPLICATION

Streaming Video, Audio
(return path does not help)

Best Effort Package Delivery
(no return path available)

Reliable Package Delivery
(return path available and does help)

CLASS OF RELIABILITY

Best effort (i.e. will attempt to deliver each packet but if packet is lost no way to recover)

Best effort: uses heavy forward error correction, striping, packet replications to maximize probability that all packets are delivered correctly.

Guaranteed packet delivery: uses FEC plus packet retransmission based on ACK, NACKS: significant issue on "NACK Implosion" for large number of receivers

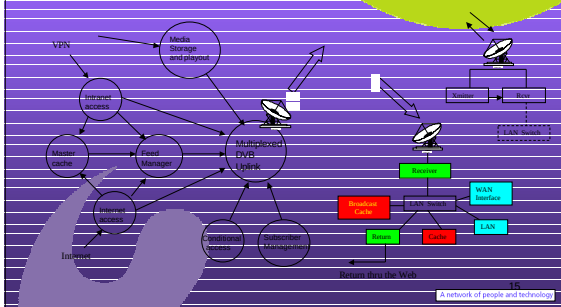
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Multiplexed, Multicast Technology Needs Supported/Facilitated By DVB

- High speed multiplexed (shared) satellite uplink
- Secure delivery of services to entitled users
- Low cost, one and two-way customer terminals
- Quality of Service (QoS) management
- Servers to receive, store and reliably play out streaming data, and data packages
- Network management, billing, accounting, and customer support services

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INTEGRATED UPLINK AND DOWNLINK OPTIONS USING DVB



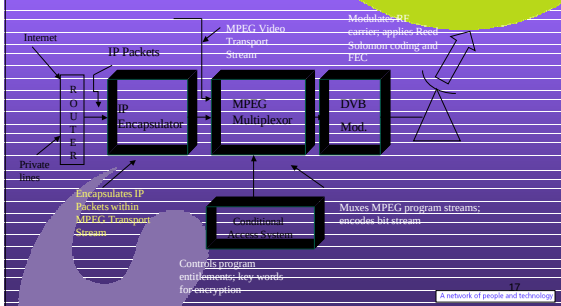
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A Closer Look at DVB Features

- DVB uses a 188 byte packet format for transmission of all services
- DVB can multiplex multiple services on the same carrier
- DVB provides conditional access for security, privacy, and program selectivity
- For satellites, DVB provides:
 - QPSK Modulation
 - Reed-Solomon coding
 - Forward error correction rates: 1/2, 2/3, 3/4, 5/6, 7/8
 - potential to saturate the carrier, leading to more efficient bandwidth utilization and smaller receive antennas

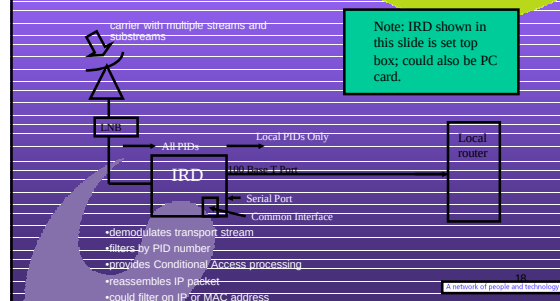
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DVB Uplink Data Flow



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DVB Integrated Receiver Decoder (IRD) Structure



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An Example Multiplexed Carrier

- PID 1 Internet Access - in the clear, submultiplexed by MAC addresses
- PID 2 News feed multicast - shared by all ISPs on the carrier (encrypted)
- PID 3 Caching feed for selected ISPs (encrypted)
- PID 4 Intranet for Corporation "A" (encrypted)
- PID 5 Intranet for Corporation "B" (encrypted)
- PID "n" Intranet for Corporation "C" (encrypted)

NOTE: Each PID has guaranteed bandwidth, but could burst for more, if bw is available

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Summary Of DVB Benefits

- Low-cost receivers (\$100-300 cards; \$1000 set-top boxes)
- Tightly controlled filtering/encryption
- Can mix services on large carriers
 - statistical multiplexing reduces bandwidth costs
 - saturated transponder operation leads to small antennas and more efficient bandwidth utilization
- Standards base encourages application and enhancement development

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There are Some Tradeoffs to Consider

- Cost of DVB uplink
 - Could be in \$100-500K range per carrier
- Packetizing Overhead and Delay
 - 5 - 20% depending upon how packets are stuffed
 - could be delay if packets are stuffed
- Throughput limitations
 - not all products can support larger transponders
 - IRDs differ in ability to support high throughputs

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More Tradeoffs to Consider

- Potential resource optimization conflicts between applications sharing the same carrier
 - large bandwidth, unicast users such as ISPs, might need bandwidth optimization more than antenna size reduction
 - for small bandwidth users, home users, multicast users, small antenna size might be more important than bandwidth optimization
- Possible incompatibilities between vendor equipment, especially for Conditional Access

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Near-Future Technology

- 8PSK modulation for more efficient bandwidth utilization: will be able to get 2 bits per hertz (might need larger antennas).
- Lower cost Two-way VSATs
 - terrestrial return
 - SCPC return
 - Aloha return
 - TDMA/DAMA return (DVB-RCS)

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Near-Future Technology - (continued)

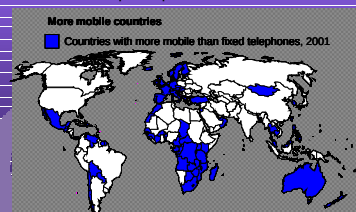
- More powerful IRDs can now support more program streams and higher data rates.
- More processing at IRD's, look more and more like a router.
- More options are available for Common Interface (CI) and thus increasing flexibility of CA (Conditional Access)
- DVB has become an on-board processing standard for satellites; and integrates with Ka-band satellites.

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The Return Channel

Mobile Overtakes Fixed

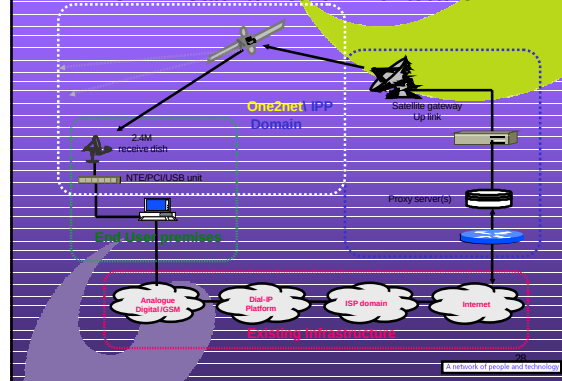
- No single causal effects: phenomenon has taken place across geographic criteria such as countries, regions, and continents and across socio-demographic criteria such as gender, income, or age and across economic criteria such as price premium for mobile or GDP per capita



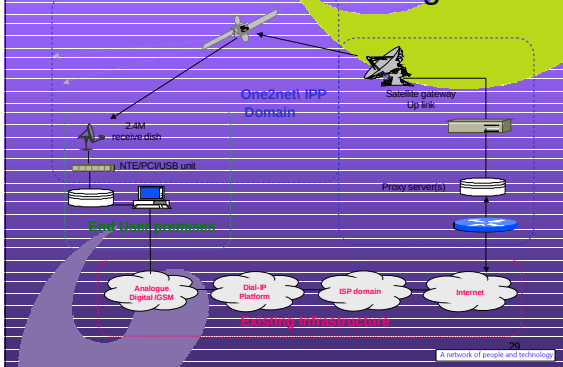
Mobile and Developing Countries

- Developing countries have seen the greatest impact of mobile communications on access to basic telecommunication services
- Cellular networks can be built faster than fixed-lines networks and can cover geographically challenging areas
- Mobile services have served to boost competition, and prepaid models have opened access to mobile cellular for those who would otherwise not qualify for telephone subscription plans

G-DVB Satellite Network Architecture



Add Static Cacheing



G-DVB\DAB\DVb-T

- GSM provides an existing platform for
 - Billing
 - Roaming
 - Return channel
- Portable DVB-T Terminals offer an unique platform for subscribing, delivering, consuming and billing for digital content
 - They offer an access to Digital content that is not dependent on time and place
- GPRS makes GSM an even more attractive return channel
 - The customer is involved for transferred data, not connection time
- GSM is the only way to create a return channel for a mobile terminal

Conclusions

- DVB is and will play a major role in the future of IP networking in Africa
- We are seeing incorporation of DVB in low cost 2 way VSATS (DVB-RCS, iDirect, etc)
- We are seeing multiplexed services made possible by large DVB carriers; antenna sizes are dropping
- DVB has integrated well with new generation of Ku-band satellites (weather permitting)
- Licensing and install issues will become gating items as cost diminishes

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In Summary

- Let's open our minds to the possibilities share our ideas and use the one tool which does not need Donor support, Our Knowledge.
- X-DVB is not the answer to our problems but will be a Milestone in Bridging the Digital Divide

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