

# Satellites, DVB and the Internet

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# Overview

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- Satellite - Internet issues
- DVB Databroadcasting technology
- Convergence with DTV

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# Satellite - Internet Issues

# Fiber is Cheap

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New York to London or Paris over the FLAG WDM submarine cable:

- STM-1(155Mbps) between downtown POPs costs \$844K 20yr IRU + \$63K/yr maintenance for a Telco
- Highly reliable self healing Sonnet/SDH ring
- So Fiber between these cities for a Telco costs less than \$100/Mbps/mo!

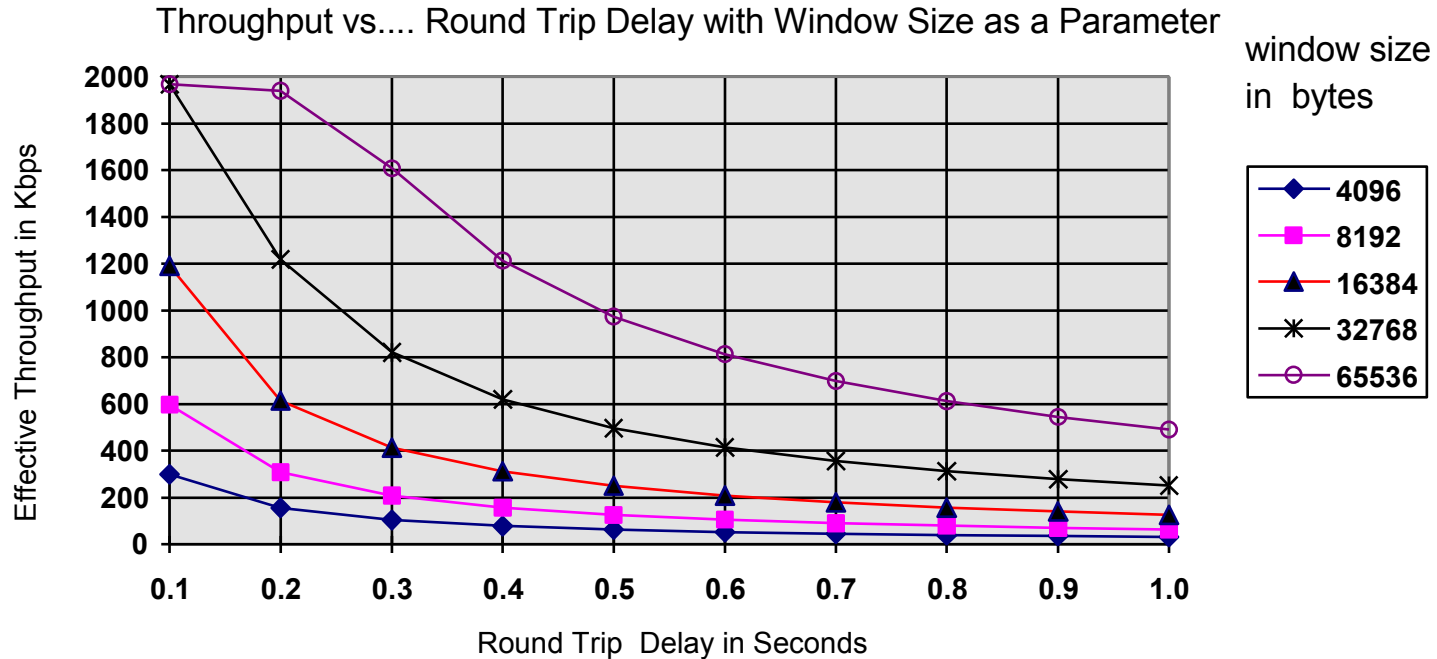
# Point-to-Point Satellite is Expensive

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- Assume:
  - Ku Satellite costs \$300M to build and launch
  - 45 transponders (2GHz total)
  - Life of 15 years, 10 year amortization
  - FEC rate of 3/4 (i.e. 2Gbps useful bandwidth)
  - 50% utilization (ramp up and simplex imbalance)
  - 10%/yr cost of money
- So a 1Gbps satellite costs about \$4M/mo.
- With overhead and profit, that's about \$5K/mo. for 1Mbps simplex pipe.

# TCP Throughput on GEO Satellites



**Satellite delay is about .24 o/w or .48 r/t second**

Note that:

- Delay is not a problem for most IP/UDP multicast applications
- TCP extensions exist to address the problem (window scaling)
- New TCP stacks (W98, W/NT5) are much improved
- ISPs Con - 4/27/99
- Browsers usually open multiple TCP sessions anyway

# GEO Satellites are good for:

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- Broadcast (IP Multicast)
  - An inherent advantage
- Getting to hard to reach places
  - Only alternative at any price (islands, bypass, rural)
- Mobile and Temporary service
  - Quick turn up “instant infrastructure”
  - Extra capacity when and where its needed
- Specialized applications
  - Secure, direct (low hops), high availability systems

ISP Col = 4/2/09 • Hybrid combinations with fiber

# GEO Satellites are not good for:

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- High capacity point to point
  - High cost of spacecraft & support
  - Available spectrum limits capacity
  - Higher return on investment when sold for broadcast
- Two way fixed service to the masses
  - Transmitters must be professionally installed, monitored and maintained (except for specialized low speed systems)
- Byte-at-a-time interactive services
  - Delay can add up to a second or more (o/w 240 ms delay compared to o/w 50 ms typical for transatlantic Internet service)



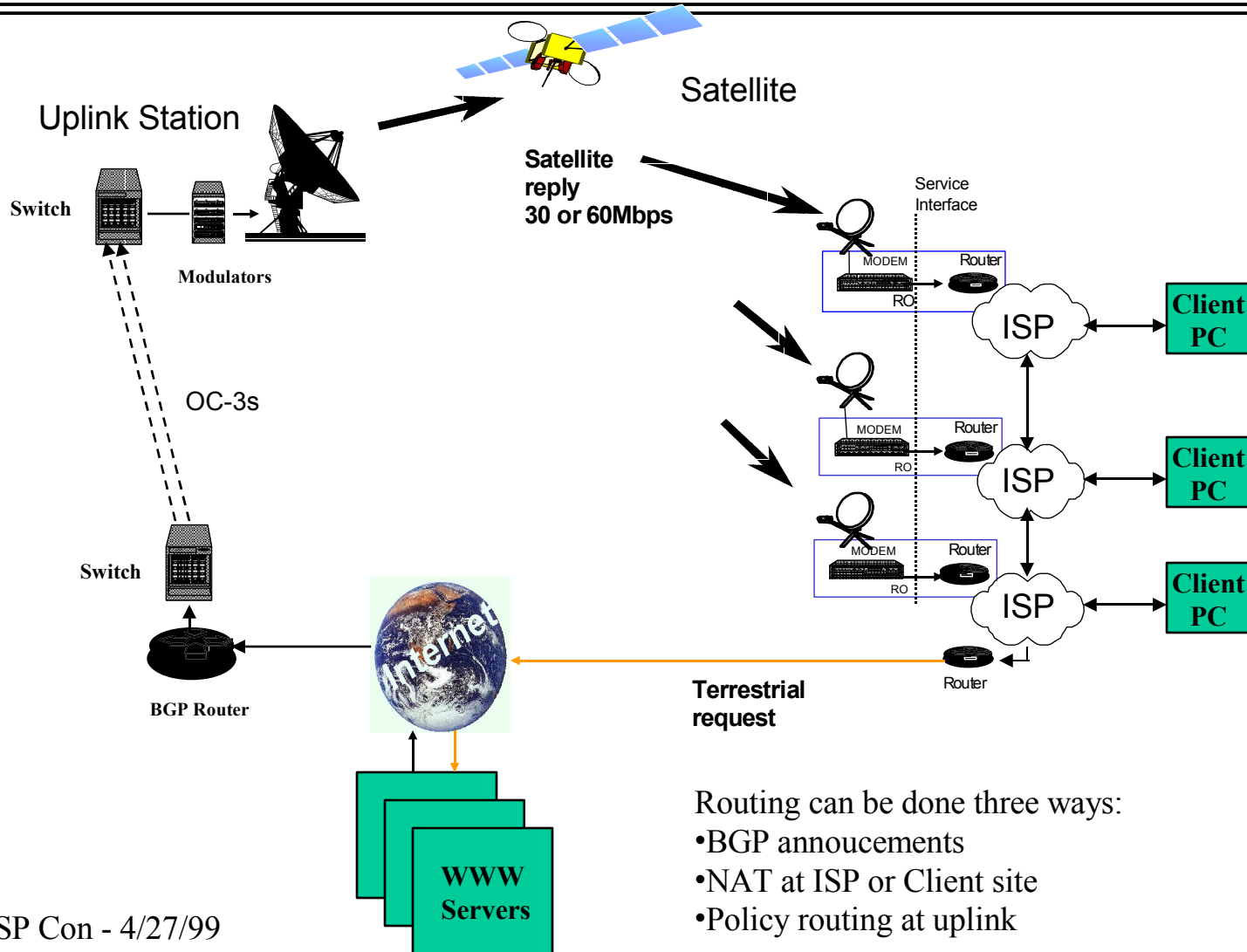
# Two Basic Configurations

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- Asymmetric hybrid with terrestrial Inter/Intranet
  - Turbo Internet service to end user
  - Bypass of national infrastructure through direct reception at ISP POPs.
- IP multicast
  - Best efforts (carousel) file broadcast
  - Reliable multicast file transfer using backchannel

# Hybrid Internet

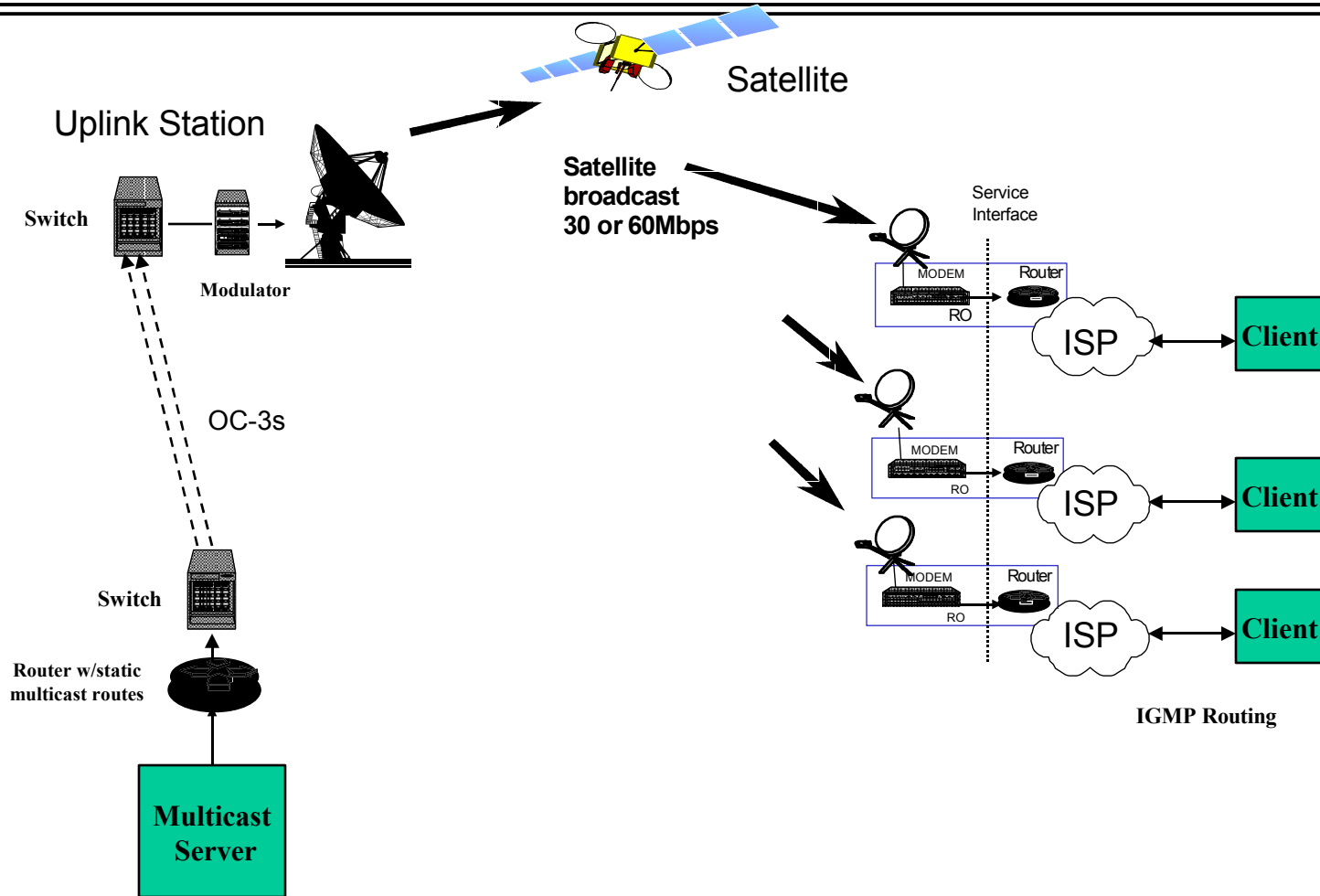


ISP Con - 4/27/99

Routing can be done three ways:

- BGP announcements
- NAT at ISP or Client site
- Policy routing at uplink

# IP Multicast



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# Digital Video Broadcasting (DVB)

# What is DVB

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- Global standard for one-way digital television (actually any data)
- Based on ISO 13818 MPEG-2 coding and multiplexing specifications (i.e. 188 byte packets)
- Consumer orientation yields low cost high performance design and components
- Cousin to US ATSC digital TV standard as well as DVD, IEEE 1394, etc.

# DVB-S Benefits

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- High performance digital carrier (30 to 58Mbps)
  - Better statistical overbooking gains
  - Bigger committed rates
- Low cost receivers
- Control of what customer can receive
- Privacy via encryption
- Smaller antennas w/no power backoff
- Multimedia support (real time TV, Audio..)

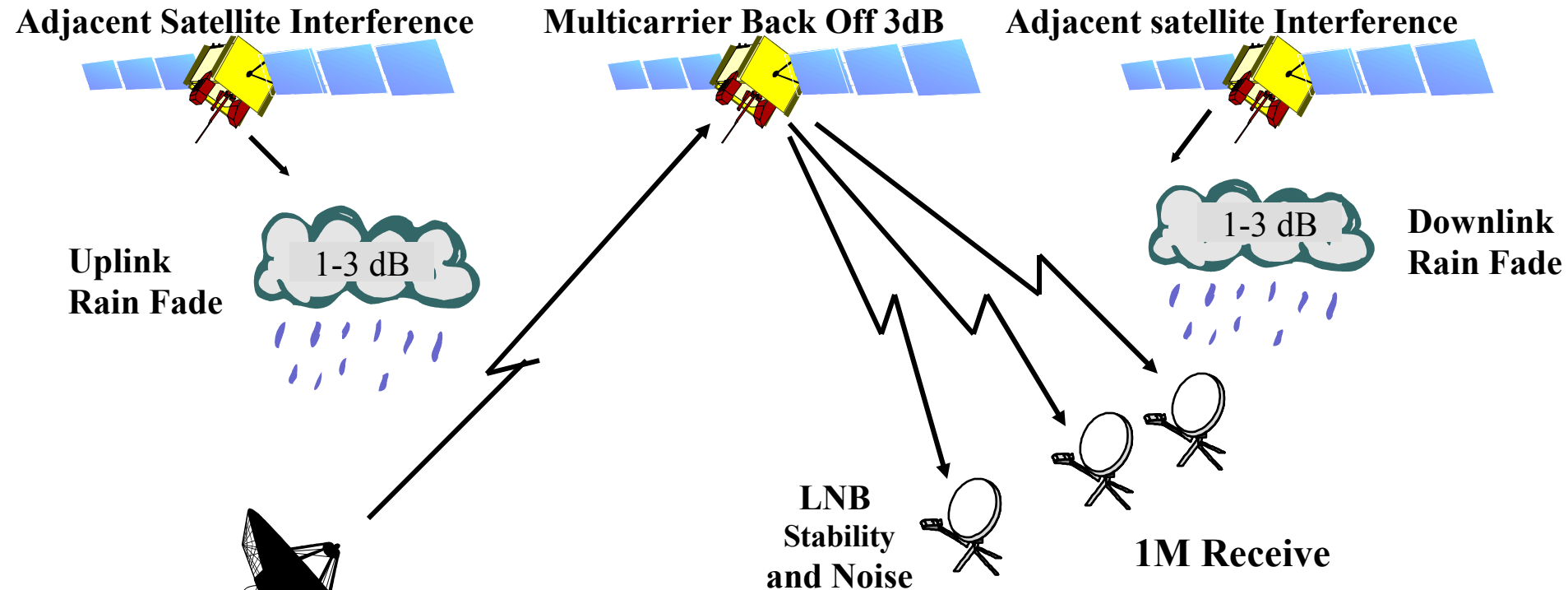
# Other DVB benefits

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- Easy to install
- 1Meter antennas = no zoning delays
- Simple receiver interface (Ethernet or PCI bus), does not require costly router to support high multicast rates (no HSSI)
- Multiple services simultaneously
- Up to 8192 data streams
- Spooks world wide understand and accept  
DVB common scrambling system

# DVB RF Advantage

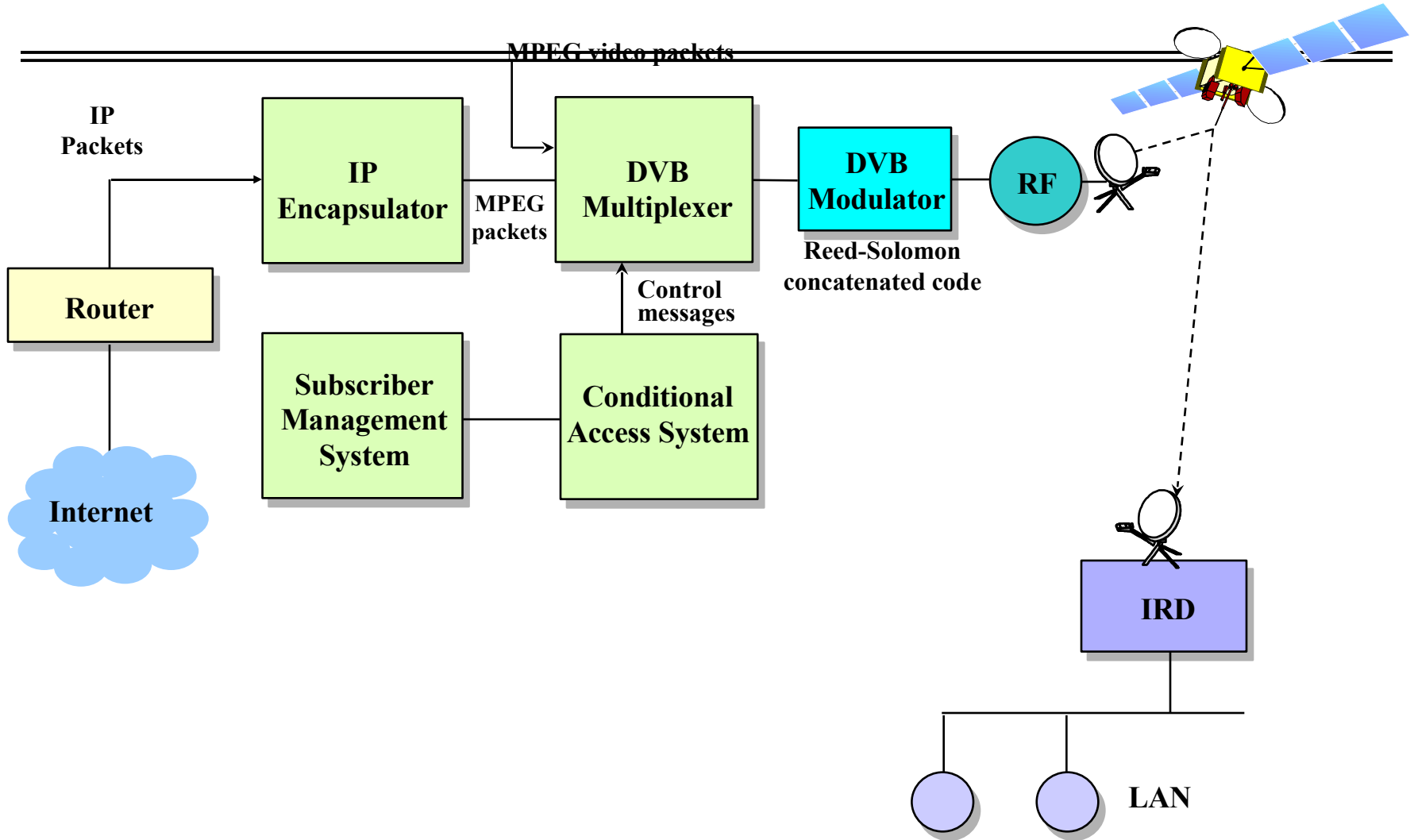


Possible gains:

- Saturated transponder (no backoff) +3dB
- High uplink availability (onboard ALC or UPC) +3 to 6 dB over rain
- Reed Solomon FEC +3dB
- System variable Viterbi FEC +1 to 3dB in case of interference
- Better LNBS +1dB



# DVB Components



# DVB Functions

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- ~~IP Encapsulator~~

- Converts IP packets to MPEG packets
- Routes packets into separate DVB service streams

- DVB Multiplexer

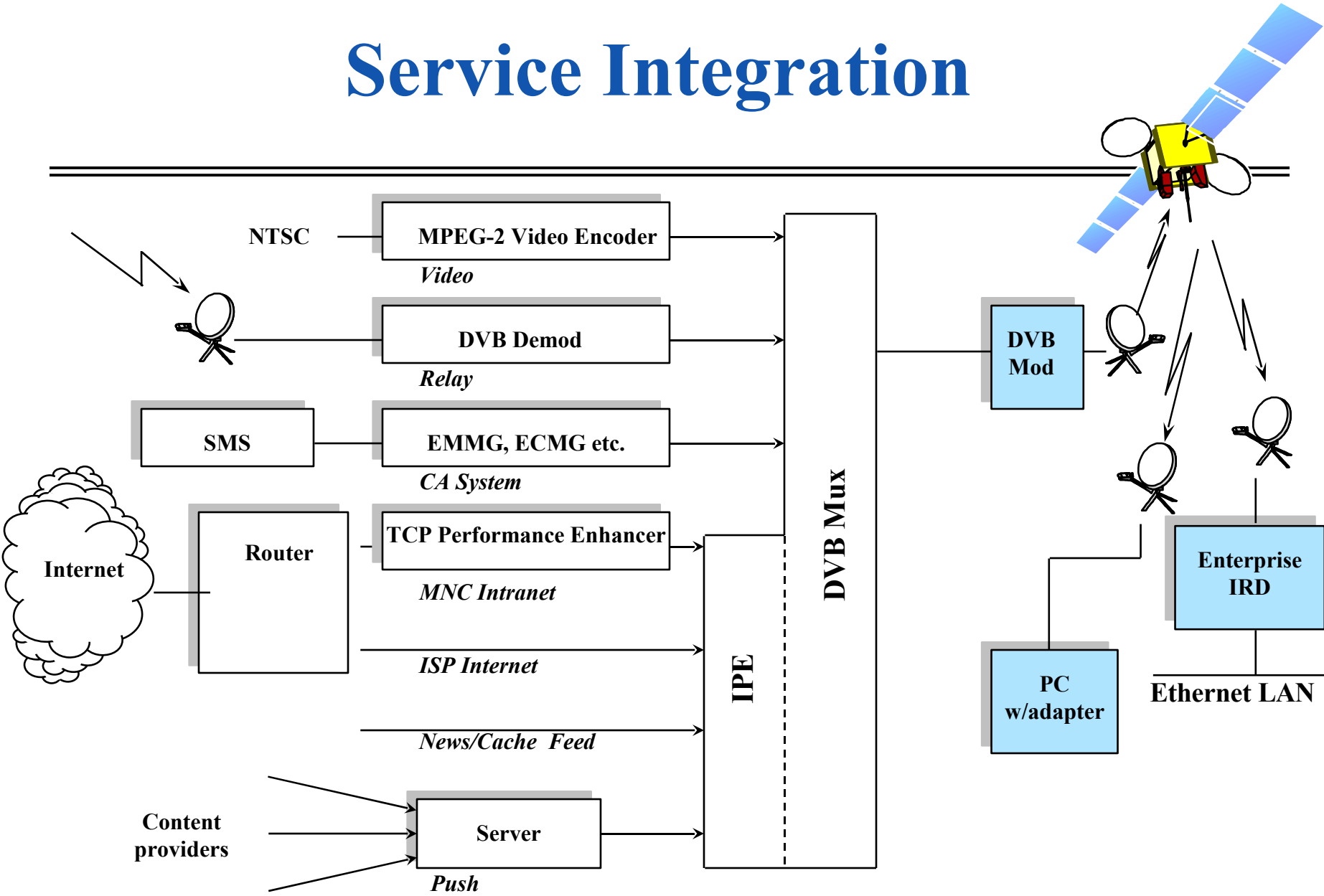
- Multiplexes streams from multiple MPEG sources - e.g. IP encapsulators, video generators
- Injects conditional access controls
- Scrambles (encrypts) the data

- DVB Modulator

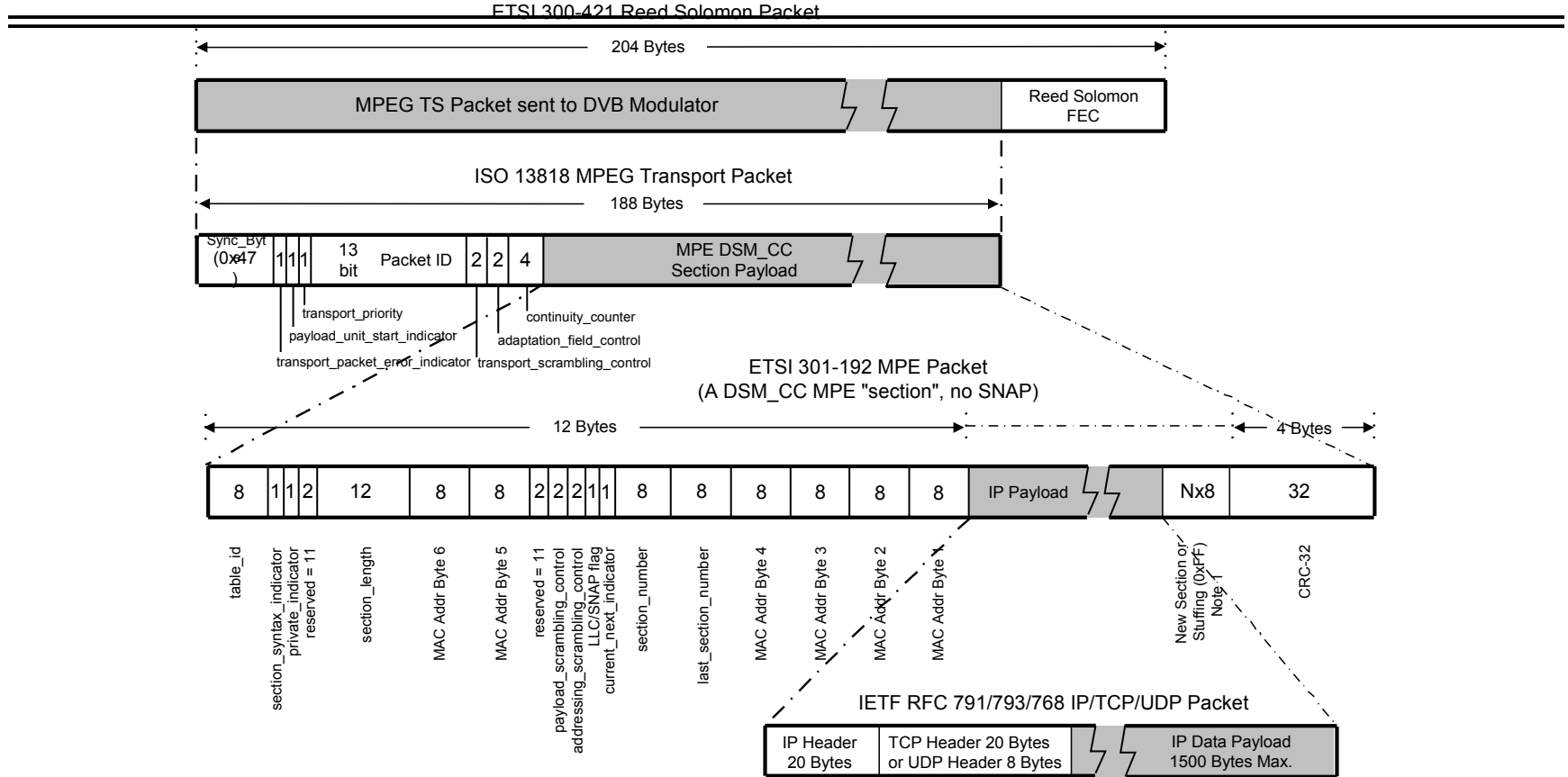
- Converts baseband to IF frequencies
- Adds Reed-Solomon and Viterbi FEC coding

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- Integrated Receiver/Decoder (IRD)
    - Receives IF carrier
    - Converts to baseband
    - Filters out relevant PIDs
    - Decrypts and reassembles IP packet
    - Optional filtering, routing on IP or MAC address
  - IRD comes in two forms
    - Set top box
    - PC bus card

# Service Integration



# MPEG - IP Relationship

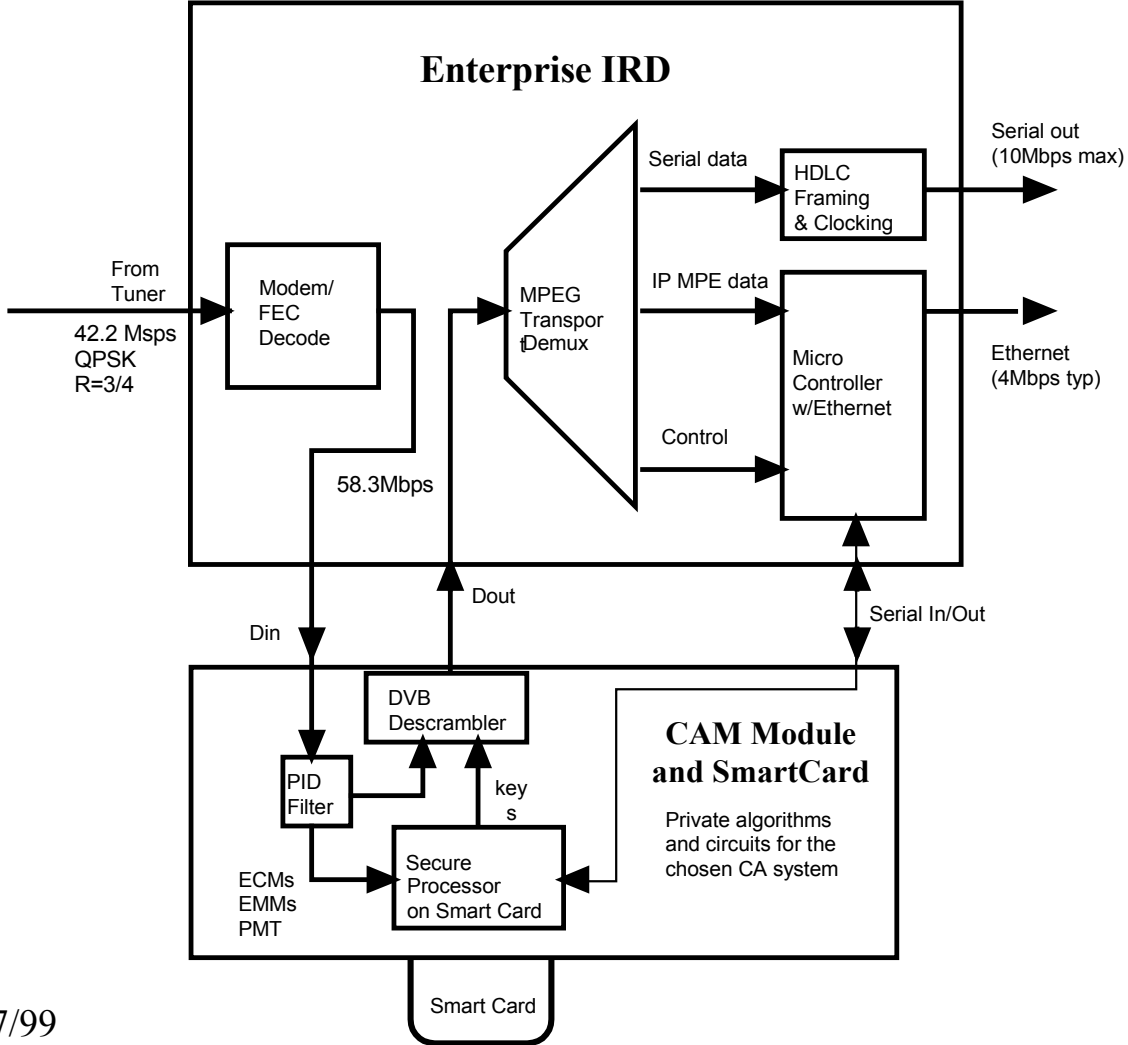


Note 1: It is possible to pack up to 3 minimum size IP/TCP sections, or 4 minimum size IP/UDP sections in one MPEG TS packet, and/or any single section can be up to 4K bytes spanning multiple MPEG TS packets with no additional MPE headers.

Not to scale

## Orion Data Broadcasting System (ODBS) DVB/IP Packet Structure

# Data IRD



# 9 Meter DVB Transmit



ISF

# 1Meter Receive



ISP Con - 4/2/99



# DVB IRD

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# DVB PC Card

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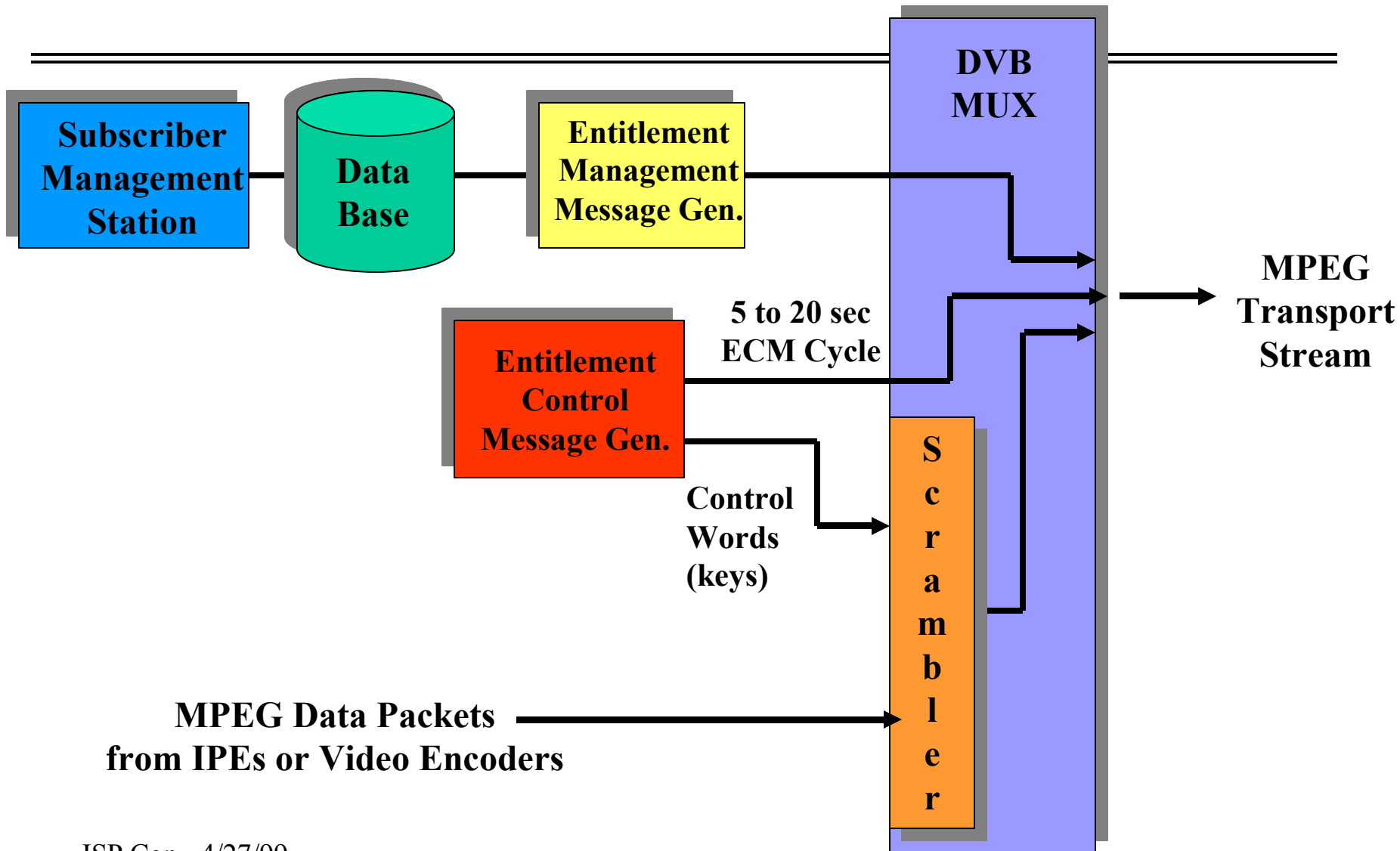
# CAM Module w/ Smart Card

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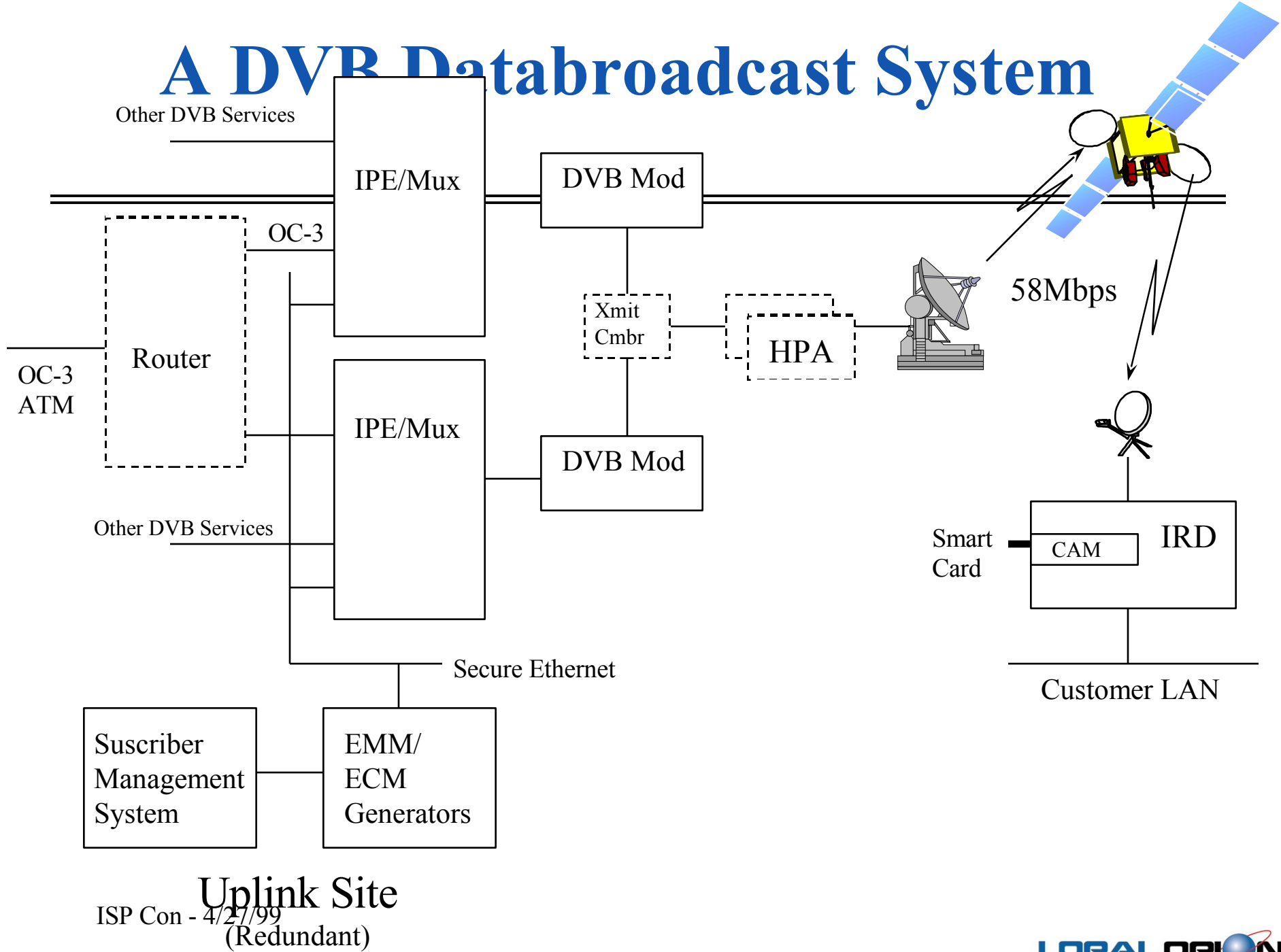
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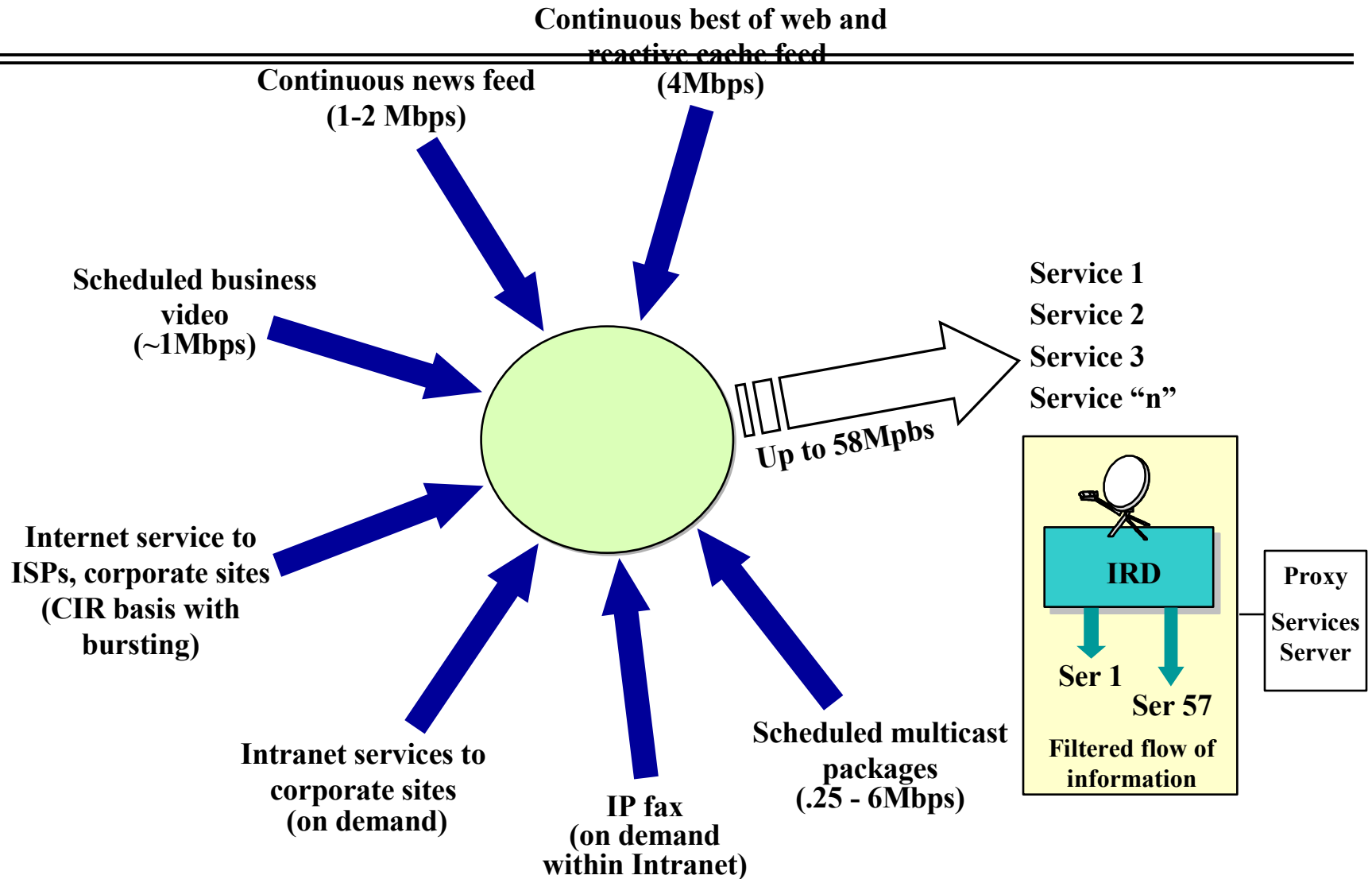
# DVB Conditional Access



# A DVB Databroadcast System



# Integrated Approach



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# Convergence with DTV

# More on DVB

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- DVB-S is for Satellite
- DVB-C is for Cable
- DVB-T is for Terrestrial UHF
- Most systems include an Electronic Program Guide (EPG)
- Overall system is Internet friendly (uses TCP/IP and UDP in many ways such as SimulCrypt head end interface and SNMP management)



# ATSC

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- Advanced Television Systems Committee
- US Cousin to DVB, uses same basic MPEG 188/204 byte packet
- Today targeted at terrestrial UHF
- Several hundred TV stations implementing
- Read: Defining Vision, Joel Brinkley

# Convergence

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- Standard method for encapsulating IP packets in DVB and ATSC defined (see ETSI 301-192)
- DVB and ATSC designers now considering abandoning custom EPGs in favor of Web based systems.
- Many set-top-box vendors developing hybrid Web TV like systems often using Java and Jini...
- New commercial paradigms such as demographically targeted advertising are enabled
- Problem: Extending the CA system to the individual LAN attached PC.

# Thank You

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Questions?

See:

[www.atsc.org](http://www.atsc.org)

[www.dvb.org](http://www.dvb.org)

[www.skystream.com](http://www.skystream.com)

[www.intldata.ca](http://www.intldata.ca)

[www.broadlogic.com](http://www.broadlogic.com)

[www.nagra-kudelski.ch](http://www.nagra-kudelski.ch)

[www.m4.com](http://www.m4.com)

[www.telemann.com](http://www.telemann.com)

[www.ndsworld.com](http://www.ndsworld.com)

[www.broadcast.philips.com](http://www.broadcast.philips.com)

[www.nmc.com](http://www.nmc.com)

[www.newtec.be](http://www.newtec.be)

[www.tektronix.com](http://www.tektronix.com)