

# S a t e l l i t e s

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# What Follows

- ITU frequency assignments
- Markets
- Applications
- Hong Kong and Digital TV
- Conclusion

# Satellite Services 1

- **Fixed Satellite Services (FSS)** - provide satellite links between stations at specified terrestrial locations, including feeder links between other services provided by terrestrially-located stations, such as mobile-satellite and broadcast-satellite.
- **Broadcasting satellite service (BSS)** - emissions for distribution for general public reception.
- **Inter-satellite service (ISS)** - Direct links between satellites where the frequency bands allocated in most cases can be used regardless of the service.

# Satellite Services 2

- **Mobile satellite service (MSS)** - links with mobile radio stations or the stations at fixed locations that communicate directly with them
- **Maritime mobile-satellite service (MMSS)** – two special categories are port operations service and ship movement service.
- **Aeronautical mobile-satellite service (AMSS)** - includes civil air 'Route' (R) and non-civil air 'Off-Route' (OR) frequencies for traffic control AMS(R) and AMS(OR) and safety messages AMS (R)S and AMS(OR)S
- **Land mobile-satellite service (LMSS)**

# Fixed Satellite Services

- **Fixed Satellite Services (FSS)** - provide satellite links between stations at specified terrestrial locations, including feeder links between other services provided by terrestrially-located stations, such as mobile-satellite and broadcast-satellite.
- **FSS** occupy around 55 per cent of WRC allocations of spectrum between 2.5 and 31 GHz. The major services include commercial C, Ku and Ka band Geostationary Earth Orbit (GEO) satellite networks , non-GEO satellite networks , feeder links for BBS and MSS, etc

# Broadcasting Satellite Services 1

- **BSS** emissions for distribution for general public reception.
- Sometimes known as direct broadcasting satellite (**DBS**) - needs to be distinguished from direct-to-home satellite television (**DTH**) which comes under **FSS** and is probably today the dominant activity of **FSS**.
- Some countries allow **DTH** broadcasting as it can be required to confine service to the domestic market, but not **DBS**
- Only one ITU allocation around 12 GHz for **BSS**, with feeder links at 14 GHz and 17 GHz, although by 2007 additional spectrum around 17 to 22 GHz should be available.

# Broadcasting Satellite Service 2

- Compared with BS terrestrial television broadcasts using around 700 MHz bandwidth, BSS television broadcasts use around 2.5 to 2.6 GHz.
- One application of growing importance is the feed of satellite television and broadband Internet streamed video signals to the head-end of terrestrial cable and fixed wireless broadband distribution systems.
- By contrast, satellite radio digital audio broadcast (S-DAB) uses around 1.4 GHz, and this is becoming increasingly popular as a means of providing radio signals to moving vehicles.

# Mobile Satellite Services 1

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# Mobile Satellite Service 2

- 6 groups of spectrum allocations for MSS + FSS feeder links to MSS + direct links between MEOs and LEOs to connect (a) subscribers across regions; (b) terrestrial mobile switching centres or Internet eXchanges.
- Inter-satellite links (ISLs) can also be provided by Inter-satellite service (ISS) frequencies.
- The six groups are bands for:
  1. Commercial GEOs, embracing MSS, MMSS, AMSS and LMSS, using bands from UHF and above.
  2. Government, including military, networks, using bands from UHF and above.

# Mobile Satellite Service 3

3. Non-GEO systems below 1 GHz using narrow bands, mainly so-called 'Little LEOs'.
4. Systems using major band systems below 3 GHz in UHF, mostly for global mobile personal communications by satellite (GMPCS), including GEOs, MEOs and 'Big LEOs'
5. Nine bands above 40 GHz, offering 'millimetre-wave' MSS allocations, but they are not much used at present.
6. Distress and safety communications in the VHF and UHF bands.

Note: MSS feeder links from stationary earth stations to satellite are assigned as part of FSS.



# Economics of Satellite Services

- Satellites start “dying” immediately the enter orbit, so they must maximize revenues for the lifespan, and ...
- Sunk costs high, but incremental costs of very long reach low, so....
- It pays to offer prices which just cover variable costs, and
- Technological advances increase efficiency/lifespan and offer greater service capability - eg. spot beams, two-way terminal technology
- But limitations, eg latency, security, interference (especially tropical weather patterns), plus costs of Earth Stations and terminal equipment, etc = particular markets

# Markets

- Equipment - World satellite equipment markets generated > US\$100m in 1999  
- forecast for 2000 = US\$198m  
([www.frost.com](http://www.frost.com)) - this seems modest!
- Services
- Applications

# Services

- Wholesale
- Carrier
- Corporate business
- Residential business
- Other

# Wholesale

- Lease transponders to carriers for redundancy, thin routes, incremental capacity, resale (eg to ISPs) customers, data networks, etc
- Lease to ISPs: (a) avoid two-way costs of IPLCs to USA; (b) regional traffic avoids USA; (c) by-pass local carrier charges or PSTN congestion

# Carrier

- Internet backbone traffic - broadband especially!
- Fast “Internet-in-the-Sky” (DTH)
- Broadcasting content: (a) DTH; (b) DBS - BSS; (c) to cable headends; (d) multi-platform content
- E-Marketplace web-based traffic

# Carrier Business in Asia

- Frost & Sullivan forecast broadband satellite services market will be worth \$8.6 billion by 2006
- 2001 = year of the first “next generation” satellites
- Asia-Pacific had about 32% of world’s leased capacity in 1999 - mostly due to corporate demand from Japan - Internet traffic fastest growing in world
- US:Asia Internet traffic: up to 10:1 for LDCs, but closer to 2:1 for DCs

# Corporate Business

- Web-based e-business traffic
- Vsat market for regional corporate networks:  
LAN/WAN
- *Complementary* to fibre: Enterprises with small fibre networks who see satellite as cost-effective way to grow their business
- *Substitute*: corporate intranets slow to grow in Asia because of lack of cable capacity to handle large applications?

# Residential Business

- Satellite DTH and DBS TV
- Digital TV will enhance demand for multi-platform content
- IP multicasting = point-to-multipoint broadcast of web content, “push” applications e.g. software
- Fast Internet (broadband) = downlink DTH; uplink via PSTN or Vsat
- Mobile phone (GMPCS) - *see NEXT SLIDE*

Oops!

“We are highly confident of the long-term demand for mobile satellite service operators such as Iridium, Globalstar, IC O and AC es.” Merrill Lynch, *Global Satellite Marketplace* 99 (p.10)

(Sorry guys, couldn't resist)

# Other Services

*Other services may or may not be independently commercial - egs*

- Environmental survey and monitoring
- Military, espionage and intelligence
- Rural services
- Telemedicine
- Distance Learning

# Satellite Broadband Revenues

## Percentage Broadband Revenues Market (Frost & Sullivan)

	1999	2006
N. America	09	24
Europe	37	30
Asia Pacific	32	29
Latin America	14	12
Africa/Middle East	09	05

# Satellite Broadband Traffic

## Percentage of Traffic in Broadband Satellite Services Market (Frost & Sullivan)

Year	ISP	Network	Corporate	Consumer
1998	64%	25%	8%	3%
2001	30%	38%	25%	7%
2004	4%	44%	39%	13%

# GEOs

- GEOs 22,300 miles above the equator
- Telecoms = C-band
- Broadcast = C-band, Ku-band, L-band
- World =  $360^\circ / 2 =$  ideally no more than  $180 \times 2^\circ$  satellite slots; today c.150!!
- Latency c. 0.25 second = two-way real-time conversations a problem

# Satellite TV in USA

- Satellite TV in the US is booming - 12 million subscribers by mid-2000 = nearly 30% increase over 1999
- 60 % of DBS subscribers live in cable TV areas!

# MEOs and Elliptical

- MEOs - inclined to equator, about 6,000 miles up
- Mostly used for surveillance, e.g. weather, military, exploration, mapping, etc
- Fewer required cf LEOs to provide hand-off services, but terminals need more power eg. messaging (Odyssey, ICO??!!)
- Elliptical orbit offers larger footprint

# LEOs

- LEOs between 400 - 1,000 miles up
- Small and cheap to launch, latency not such an issue, but technicalities of handoff complex
- Potential spectrum management issues

# LEOs and MEOs

- Used mainly for data that does not require instant delivery = large onboard storage capacity = store and forward market
- Real time eg. Point-of-sale transactions and near real time eg. SCADA (supervisory, control and data acquisition) market require large constellation deployment of satellites
- Orbcomm is clear LEO market leader ([www.frost.com](http://www.frost.com) lists a further 12 players)
- LEOs still in their infancy - market estimated at > \$900 million 1999-2005

# LEOs and MEOs

- 7 market applications:
  1. Two-way messaging
  2. Hard-to-read meters
  3. SCADA
  4. Tracking and fleet management
  5. Shipping containers
  6. Stolen cars
  7. Point-of-sale transactions

# Applications 1

- Point-to-multipoint = obvious big advantage; Point-to-point and simplex = commercial versatility (eg ISP one-way circuits to US)
- Technology also offers versatility
  - DAMA (Dynamic Assignment Multiple Access) ideal for rural communications
  - Spot beam technology enhances commercial efficiency for delivery mechanism

# Applications 2

- Latency issues:
  - Real-time two-way OK for LEOs - eg video-conferencing
  - Near real-time and store-and-forward is ideal; eg messaging services
- Broadband: ideal for asymmetric broadband applications downstream delivery, but upstream more problematic - eg webcasting
- Locational services: GPS, mobile digital audio radio

# Hong Kong

## Digital TV and Radio

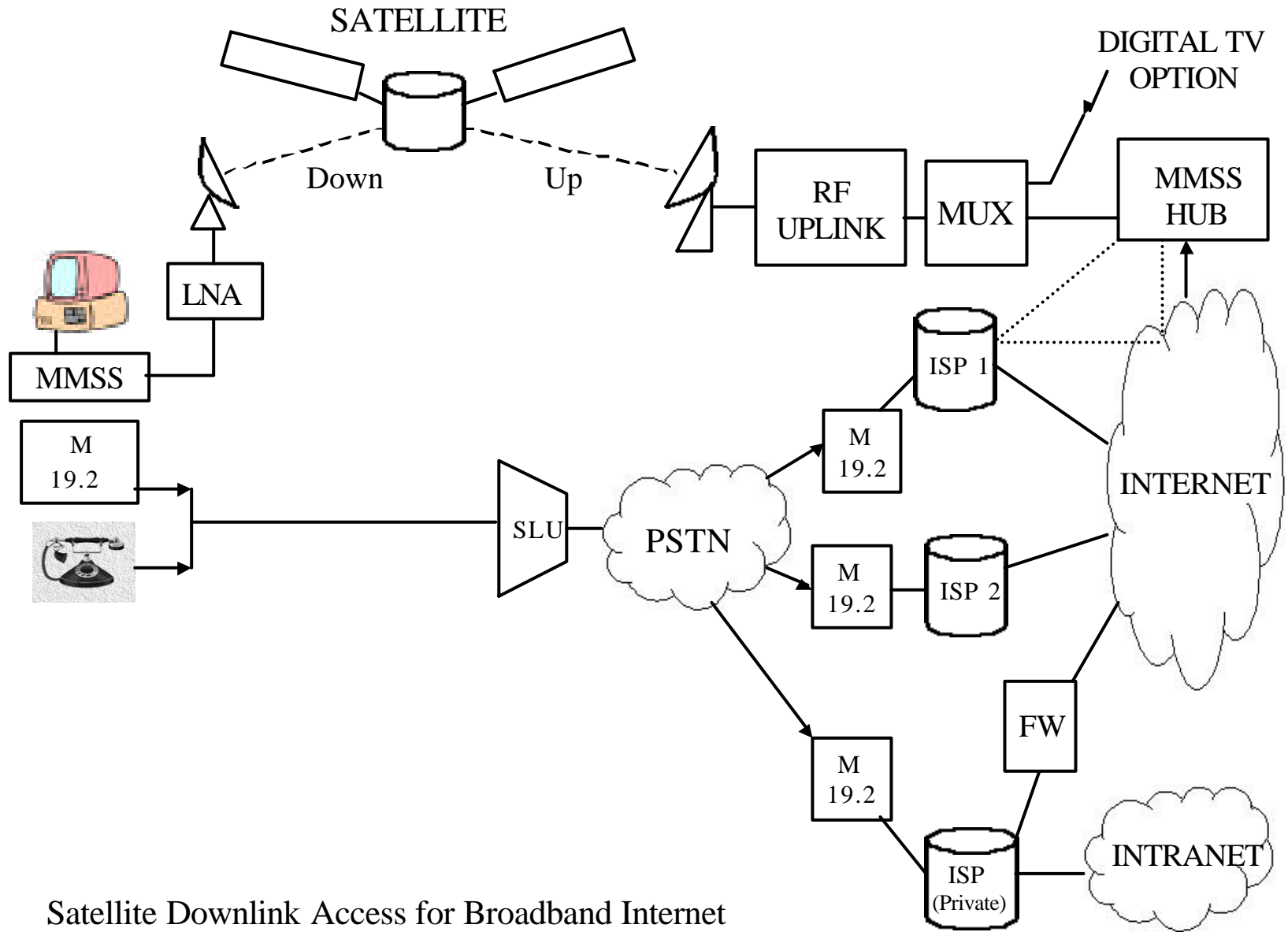
- HK will adopt the European TV standard and award 3-6 licences, each frequency assignment = 5-6 channels?

## Broadcasting Transmission Licences

- **Commercial TV:** ATV, TVB
- **Subscription TV:** (i) *Broadband cable* - Wharf, HK DTV, HK Network TV; (ii) *Satellite* - Galaxy DTV, Pacific Digital
- **Programme Service licence:** HKT VOD
- **Satellite TV Uplink & Downlink:** Hutchvision, Galaxy/TVB, APT

# Digital TV and Radio

- ITU-R *Digital television terrestrial broadcasting* 1997 Recommendation (BT.798-1) guidelines which propose digital systems should fit into one of the existing 6, 7 or 8 MHz analogue channels.
- Digital broadcasts may also migrate to cables systems, or to BSS systems, which would free up yet more spectrum in the VHF and UHF bands.
- But satellite digital audio broadcasting (S-DAB) for reception by vehicles and mobile handsets is finding a market. The 1452 – 1492 MHz band has been allocated for BSS for S-DAB outside the USA and one or two other countries, but it is shared with FS and other services. The ITU has also proposed reserving part of the corresponding frequencies of the BS band for terrestrial digital audio broadcasting (T-DAB).



Satellite Downlink Access for Broadband Internet

# Conclusion

- “Satellite and wireless will never be a serious contender where broadband wireline technology proves in.” Lawrence Gassman, President, CIR ([www.cir-inc.com](http://www.cir-inc.com))
- Fast Internet + broadband content + commercial data + messaging + SCADA + thin route traffic + locational services + .....etc = lots of demand ?
- Local regulations can restrict markets; economics of ‘versatility’ can grow markets

**THE END!**

**THANK YOU**