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DVB-S2 Technical Presentation

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A Basic Satellite Theory course

Content:

- Higher modulation schemes (DVB-DSNG & S-2)
  - Differences & Advantages
- Related Advantech Wireless Products
- IF versus IF-L: Why
- Nyquist roll-off factors: Advantages

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The BIG MOVE

- **Why DVB-S2:**

  New market demands:

A. HDTV/3DTV (large BW) & IPTV (large traffic) spreading rapidly: Market driver!

B. Need for higher / better compression algorithms (MPEG4)

C. Need for more efficient transportation (DVB-S2)

= 3 master pillars supporting each other

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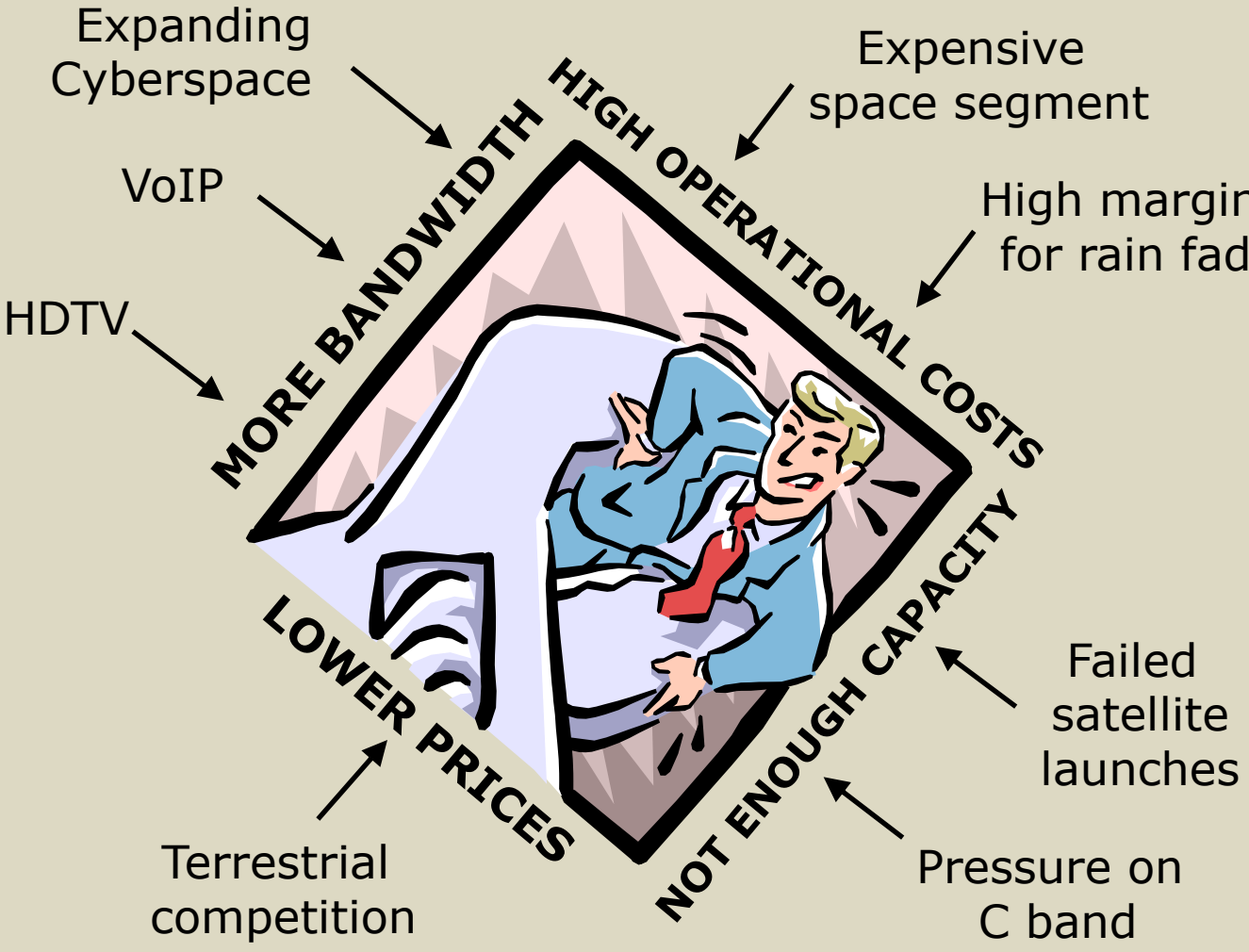
The squeeze of the poor satellite service provider:



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What is DVB-S2 ?

- **New DVB standard for digitial satellite communications**
- **Meant to replace DVB-S & DVB-DSNG**
- **Much better spectral efficiency**
  - –Up to 30% bandwidth saving
  - –Up to 2.5 dB margin gain
  - New features such as
    - –Variable and Adaptive Coding and Modulation
    - –Generic Mode (no transport stream overhead)
    - –Support of multiple streams on a single carrier
  - So close to the Shannon limit that it could be the last DVB-S standard!

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More BANDWIDTH

More MARGIN

More FLEXIBILITY

Less SATELLITE COST

Less AMPLIFIER POWER

Less ANTENNA SIZE

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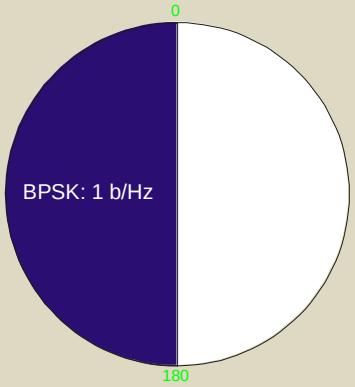
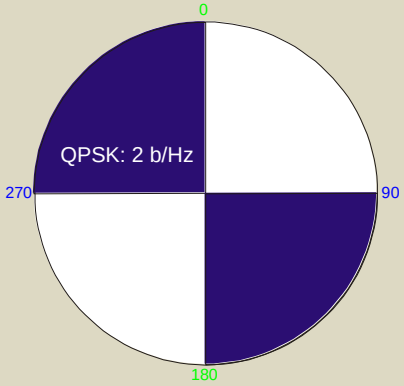
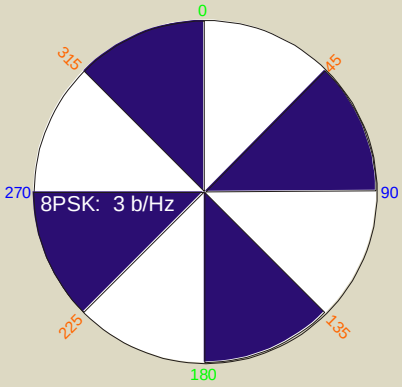
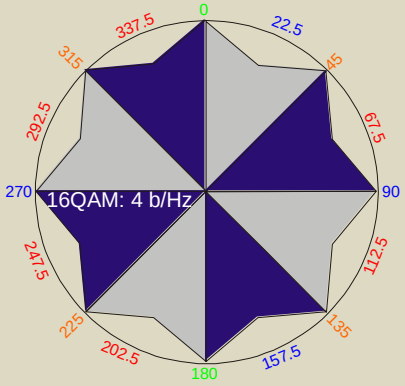
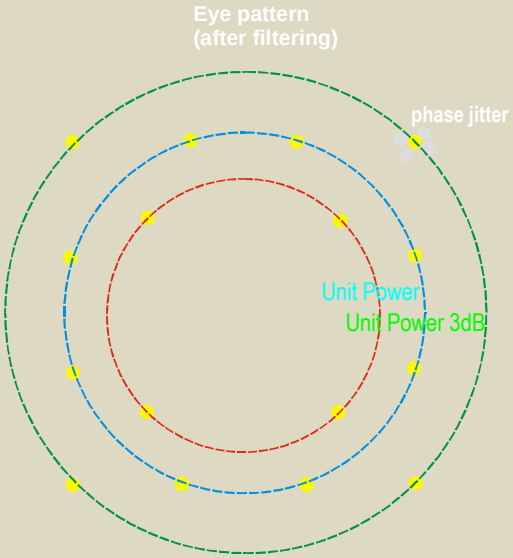
QPSK - 8PSK - 16QAM modulation schemes used in DVB-S/DSNG standards











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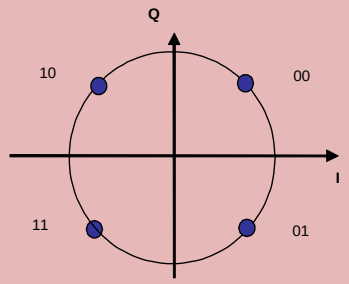
What is different in S2 ?

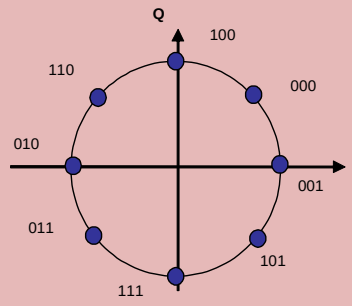
New error correction codes (BCH + LDPC)

New Roll-Off factors (20%, 25% and 35%)

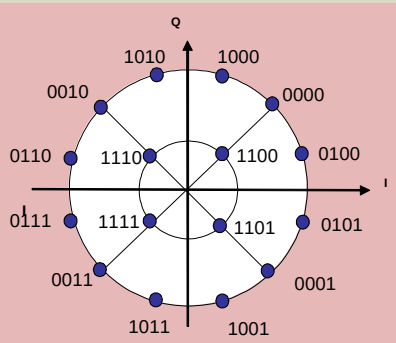
4 TWTA-friendly modulation schemes:



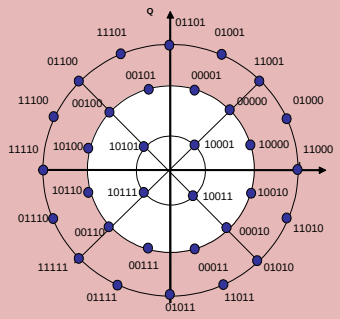
QPSK
2 bits/symbol



8PSK
3 bits/symbol



16APSK
4 bits/symbol



32APSK
5 bits/symbol

Best case: up to 40% more capacity!

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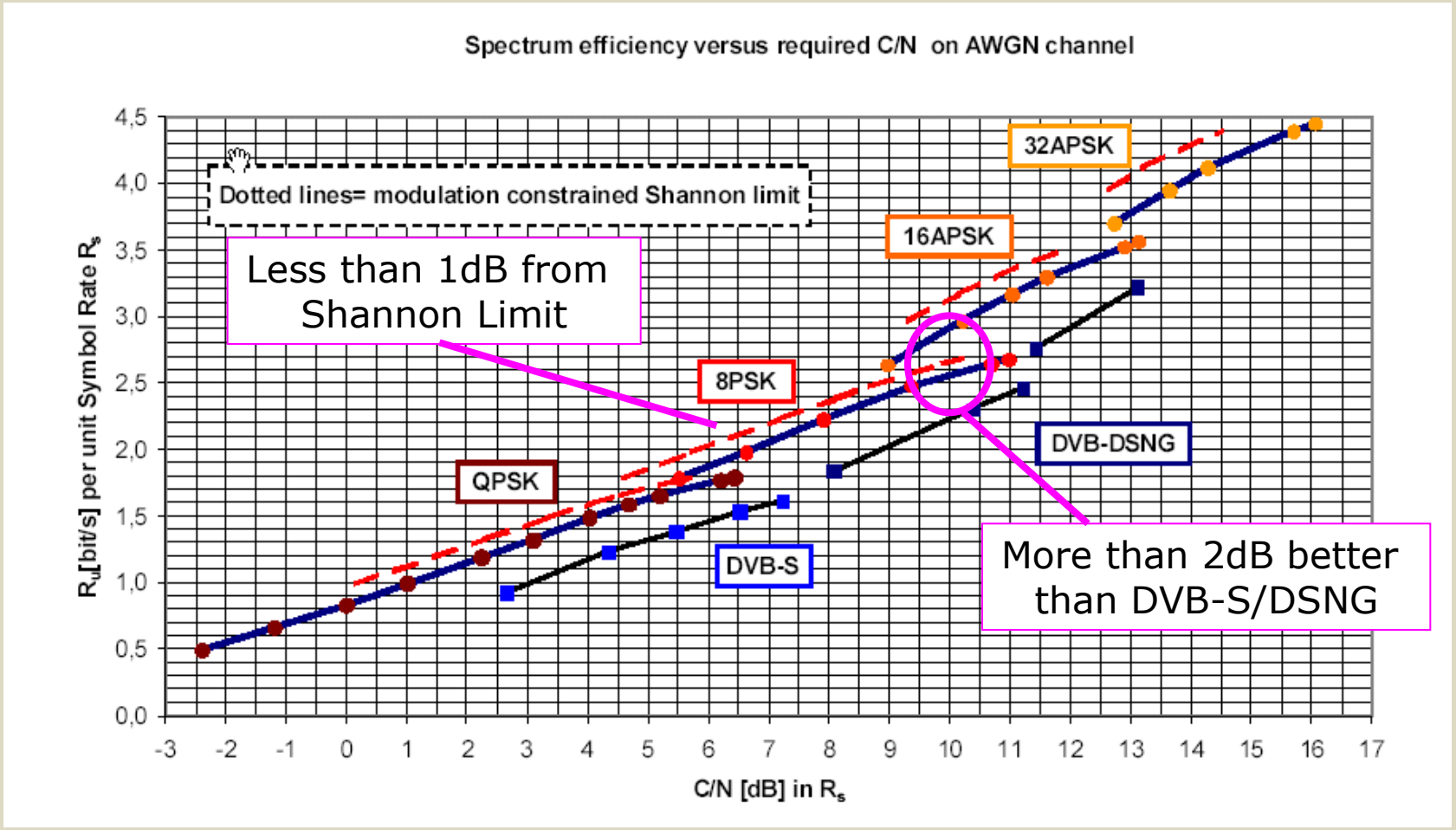
Performance:



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Spectral efficiency:

- **New Forward Error Correction codes:**
  (More powerful, less overhead)

  –BCH (Bose-Chaudhuri-Hocquenghem)
  replaces Reed Solomon outer coding

  –LDPC (Low Density Parity Check)
  replaces Viterbi inner coding

- More inner code rates:
  1/4, 1/3, 2/5, 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10

- New Modulation schemes
  QPSK, 8PSK, 16APSK, 32APSK

- 3 spectrum shaping factors:
  0.2, 0.25, 0.35 %

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Main differences between DVB-S/DSNG and DVB-S2

DVB-S/DSNG

- Meant for broadcast only
- Fixed 188 byte/packets
- One TS / carrier
- RS and Viterbi coding
- Need of high Rx margin
- QPSK /QPSK-8PSK-16QAM
- 35% 25% Roll-off carrier
- Consumer LNB's work in QPSK only

DVB-S2

- Fully transparent to all data
- Baseband in 16 or 64 kb/s
- CCM/MultiStream-VCM-ACM
- LDPC and BCH coding
- Can work within noise floor
- QPSK-8PSK-16APSK-32APSK
- 20% Roll-off carrier
- Pilot tones for extra synch in 8PSK

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Two major worlds in DVB-S2:
Distribution vs. Contribution

- QPSK & 8PSK
- Normal frames only (64 kB)
- Pilots on/off (8PSK: always On)

- QPSK, 8PSK, 16APSK, 32APSK
- Short & Normal frames
- Pilots on/off

Why Pilots:

Replacement of consumer set-top boxes is easy, but LNB's is major obstacle => Pilots

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Generic Mode

- In DVB-S the data format was exclusively the MPEG Transport Stream (TS)
- The size of the MPEG transport stream packet (188 bytes) was optimised for the Reed Solomon error correction code, which is no longer used by DVB-S2
- For IP data, the overhead due to TS and MPE was typically 4 to 15%

- -> **DVB-S2 includes a new Generic Mode for**
- **continuous or packetized data**

- **Advantages:**
- Compatible with any type of data (IP, ATM,…)
- No Transport Stream overhead (2%)
- For IP, the efficiency gain could be more than 4%

- DVB-S2 does not define an encapsulation mechanism for IP data such as MPE, but it is being studied by another standardisation group (TM-GBS)

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Variable coding and modulation:

Each frame can be encoded and modulated with different parameters on the same carrier

3 modes of operation

- **CCM Constant Coding and Modulation (Single or MultiStream)**

  All frames use the same (fixed) parameters

- **VCM Variable Coding and Modulation**

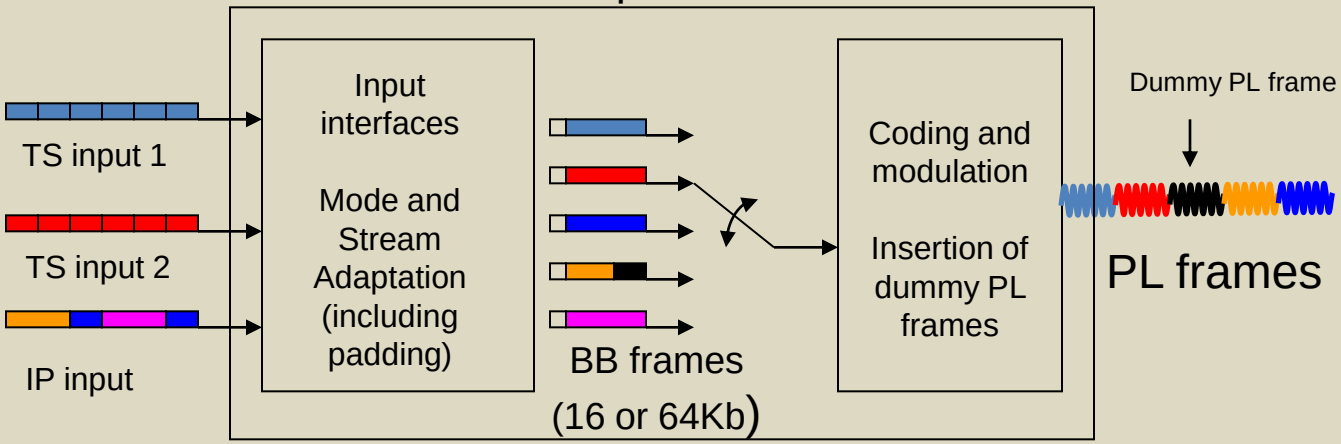
  Different streams/services are coded with different (fixed) parameters on the same carrier

- **ACM Adaptive Coding and Modulation**

  Each frame is coded with its own set of parameters. Parameters are modified dynamically according to the reception conditions for each receiver

Multiple streams on single carrier (CCM-VCM-ACM)

- A DVB-S2 modulator can have several physical or logical inputs:



- The data of each each input is processed in separated Base Band frames.
- The BB frames are time-multiplexed at the Physical Layer on the same carrier (no TS multiplexing)
- When no data is present the modulator can pad incomplete BB frames or insert dummy PL frames
- Demodulators can receive and decode individual streams independently from the other streams

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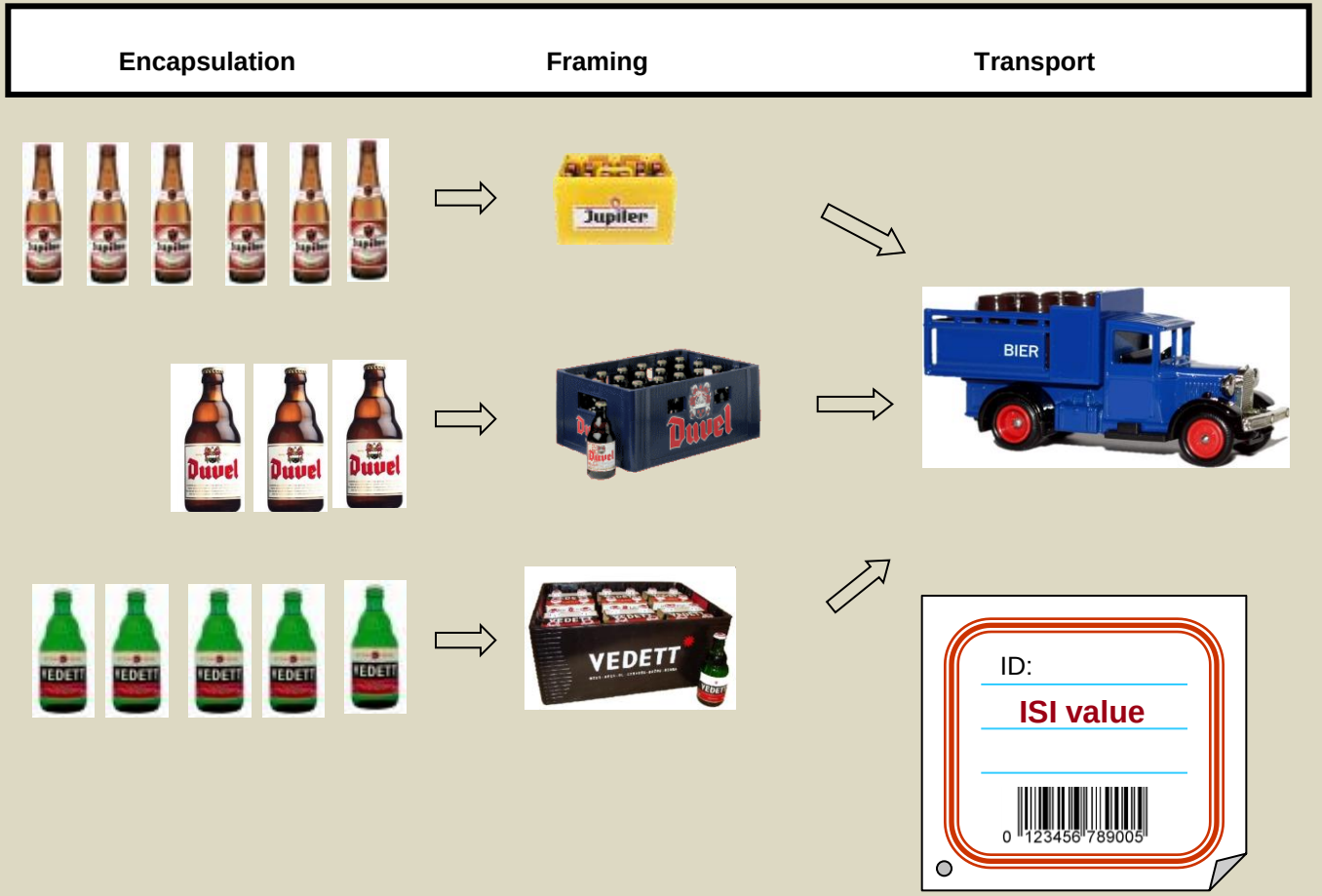
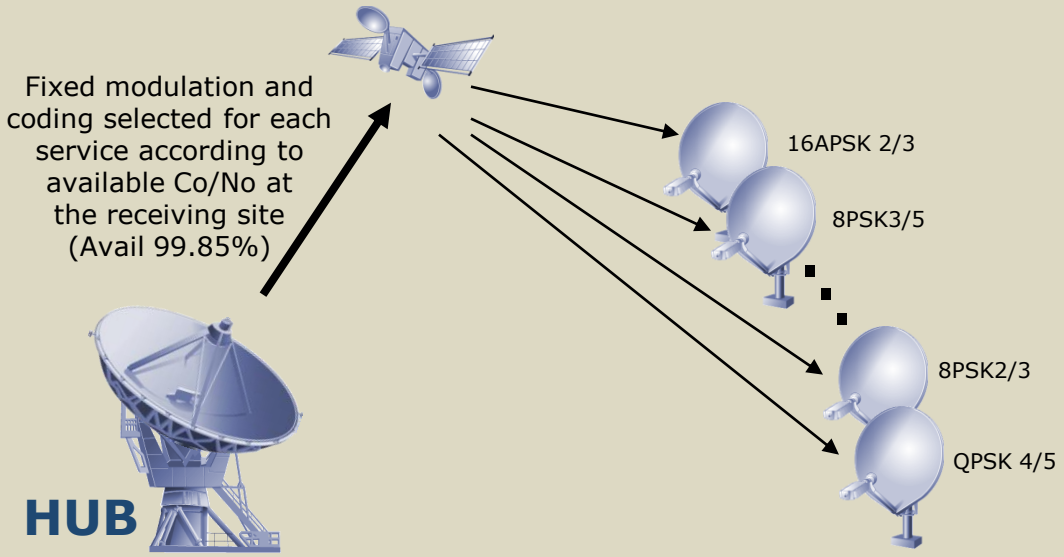
The Belgian DVB-S2 point of view, even tastier



Applications: IP Trunking - VCM

Example: 30MHz used for Unicast IP trunking to 20 sites with rain margin varying from 2.5 to 5.5 dB depending on location:



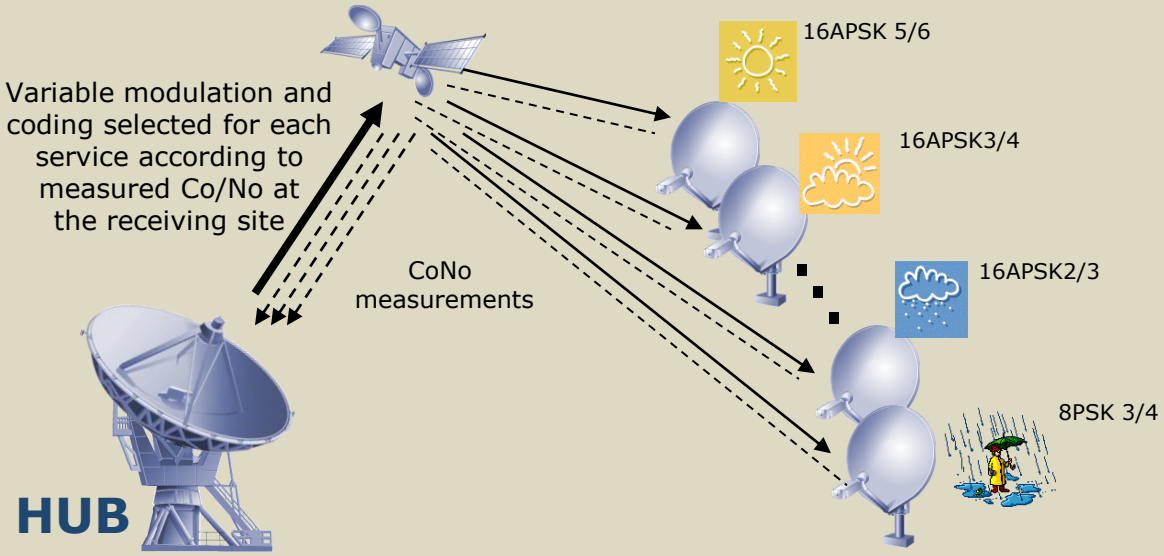
With **DVB-S**: fixed QPSK 2/3 => total bit rate = **36.87 Mbps** (1.84Mbps per site)

With **DVB-S2 CCM**: all sites with QSPK 4/5
=> total bit rate = **47.61 Mbps** (2.38Mbps per site) + 29.1%

With **DVB-S2 VCM**: between QPSK 4/5 and 16APSK 2/3
=> between 2.38 and 3.96 Mbits/sec per site
=> total bit rate > **61 Mbps** > +65 %

Applications: IP Trunking - ACM

Example: 30MHz used for Unicast IP trunking to 20 sites with rain margin varying from 2.5 to 5.5 dB depending on location:



With **DVB-S2 ACM**: between 8PSK 3/4 and 16APSK 5/6

=> between 3.34 and 4.95 Mbits/sec per site

=> total bit rate > **85 Mbps** **> +131 %**

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Applications: DSNG-Contribution

HDTV:

- When combining DVB-S2 with MPEG4 AVC (H.264 Layer 10) technology, it will be possible to transmit contribution quality HDTV in less bandwidth than SDTV with DVB-S and MPEG2

example:

DVB-S 8PSK 5/6: SD MPEG2 4:2:2@ML at 21.5Mbits/sec (video 19Mbits/sec)

in **11.7MHz**

DVB-S2 16APSK 4/5: HD MPEG4/AVC MP@L4.0 at 27.5Mbits/sec (video 25Mbits/sec)

in **10.5 MHz**

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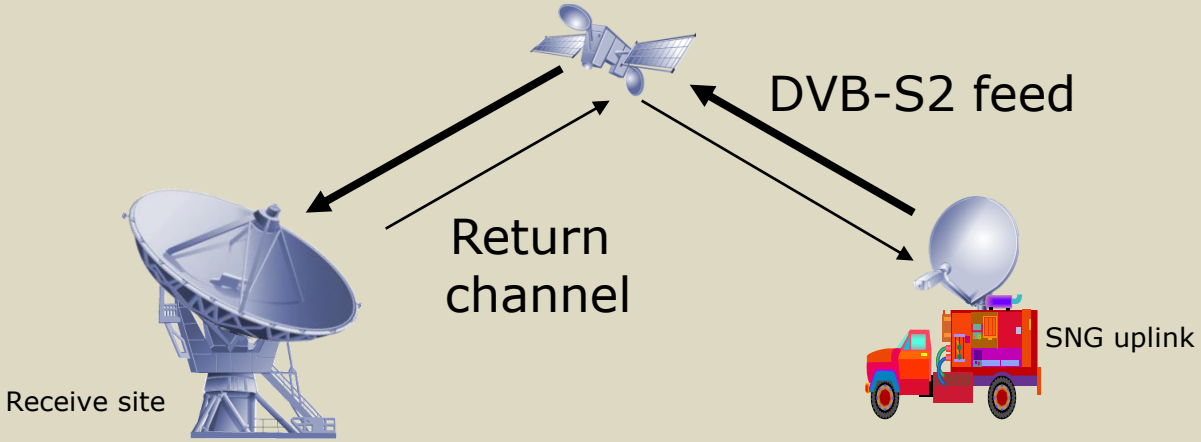
Applications: DSNG – Contribution in ACM (cont'd)

If a return channel is available from the receiving site to the uplink, ACM can be used to convert the rain margin in additional video quality (with variable rate video encoder):



Example: carrier at 7.5 Msymbols
Co/No varying between 4 and 10dB

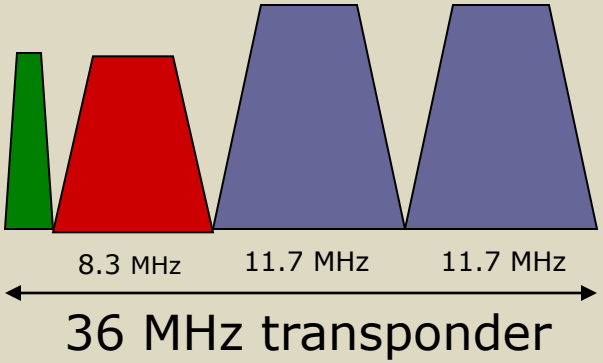
DVB-S: fixed QPSK 1/2 -> 5.5 Mbits/sec

DVB-S2:  QPSK 2/3 -> 8.3 Mbits/sec

 8PSK 3/4 -> 13.9 Mbits/sec

Applications: DSNG - Contribution

Typical DVB-S transponder usage:

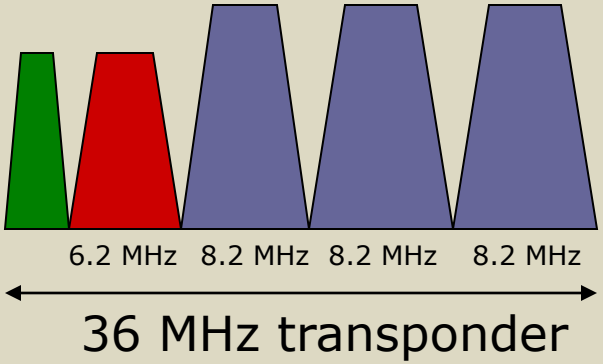


Large channels:
Data rate = 21.5 Mbits/sec
8PSK 5/6, ROF = 25 %, BW = 11.7 MHz
Co/No> 8.3+3.63= 11.9 dB,

Narrow channels:
Data rate = 8.445 Mbits/sec
QPSK 3/4, ROF = 35%, BW = 8.5 MHz
Co/No> 4.9+1.41= 6.3 dB BW = 8.5 MHz

Spare capacity (VSAT, coordination channel,…): 4.3 MHz

With DVB-S2 and the same channel conditions:



Large channels:
Data rate = 21.5 Mbits/sec
16APSK 4/5, ROF = 20 %
Co/No> 12.2 dB, BW = 8.2MHz

Narrow channels:
Data rate = 8.445 Mbits/sec
QPSK 5/6, ROF = 20%
Co/No> 6.2 dB BW = 6.2 MHz

Spare capacity (VSAT, coordination channel,…): 5.2 MHz

There is room for 1 additional large channel AND almost 1MHz of extra spare capacity!

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DVB-S2 and Broadcast applications (DTH)

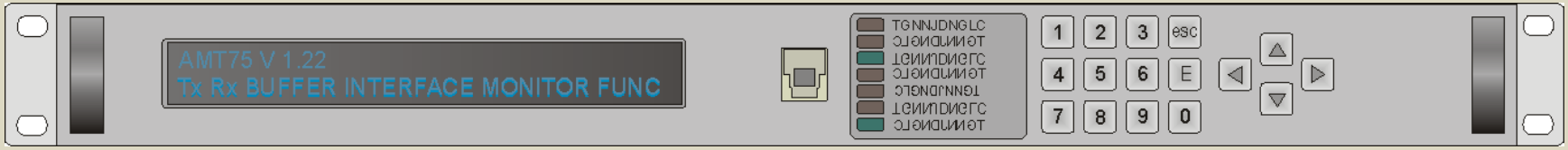
Typical 36MHz transponder usage with DVB-S and DVB-S2:

	SATELLITE EIRP 51 dBW		SATELLITE EIRP 53.7 dBW	
	DVB-S	**DVB-S2**	**DVB-S**	**DVB-S2**
Symbol Rate Roll-Off factor	27.5 Mbauds (ROF 0.35)	30.9 Mbauds (ROF 0.20)	27.5 Mbauds (ROF 0.35)	29.7 Mbauds (ROF 0.25)
Modulation	QPSK 2/3	QPSK 3/4	QPSK 7/8	8PSK 23
Bit rate	33.8 Mbps	46 Mbps (+36%)	44.4 Mbps	58.8 Mbps (+32%)
Number of SD channels	7 SDTV MPEG2 15 SDTV h.264	10 SDTV MPEG2 21 SDTV h.264	10 SDTV MPEG2 20 SDTV h.264	13 SDTV MPEG2 26 SDTV h.264
Number of HD channels	1 HD MPEG2 3 HD h.264	2 HD MPEG2 5 HD h.264	2 HD MPEG2 5 HD h.264	3 HD MPEG2 6 HD h.264

With identical Transmit / Receive link budget & conditions !

Advantech DVB-S2 products (1)

- **SBM75e Modulator**
  - DVB-S/DSNG/S2 w. CCM SS/MS, VCM & ACM
  - Up to 45 MBaud in QPSK, 8PSK, 16APSK, 32 APSK and 64QAM
  - Fully compliant to all DVB-stds.
  - Aggregates up to 8 ASI inputs
  - IP GSE, routing, bridging, encapsulation etc.
  - IF/IFL outp., etc.

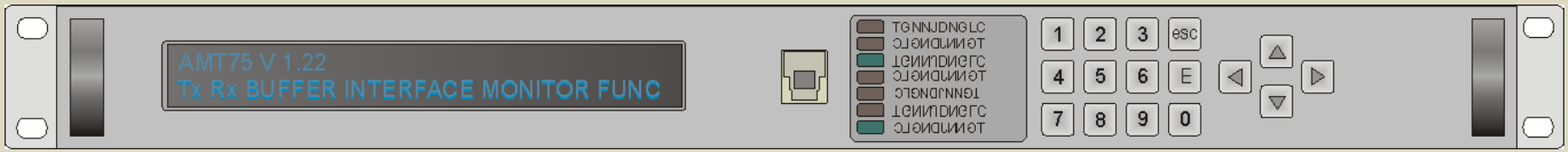


Advantech DVB-S2 products (2)

- **SBD75e Demodulator**
  - DVB-S/DSNG/S2 w. CCM SS/MS, VCM & ACM
  - Up to 45 MBaud in QPSK, 8PSK, 16APSK, 32 APSK and 64QAM
  - Fully compliant to DVB-stds.
  - Restitutes up to 6 ASI outputs
  - IP outputs, decapsulation, etc.
  - Single or dual versions
  - Active or passive 19” front panel
  - IF/IFL inputs

Advantech DVB-S2 products (3)

- **AMT75e MoDem**
  - Combines SMB75e and SBD75ein one chassis
  - Accommodates all types of interfaces (Telco, Brdc, IP)
  - Best value for price in Market
  - Proven reliability



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A few other Nice-to-knows

- Why L-band vs. IF on Tx
- Carrier Roll-off factors
- Hierarchical mode in DVB-S2

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70-140 MHz versus L-band over IF cables

Why is L-band preferred?

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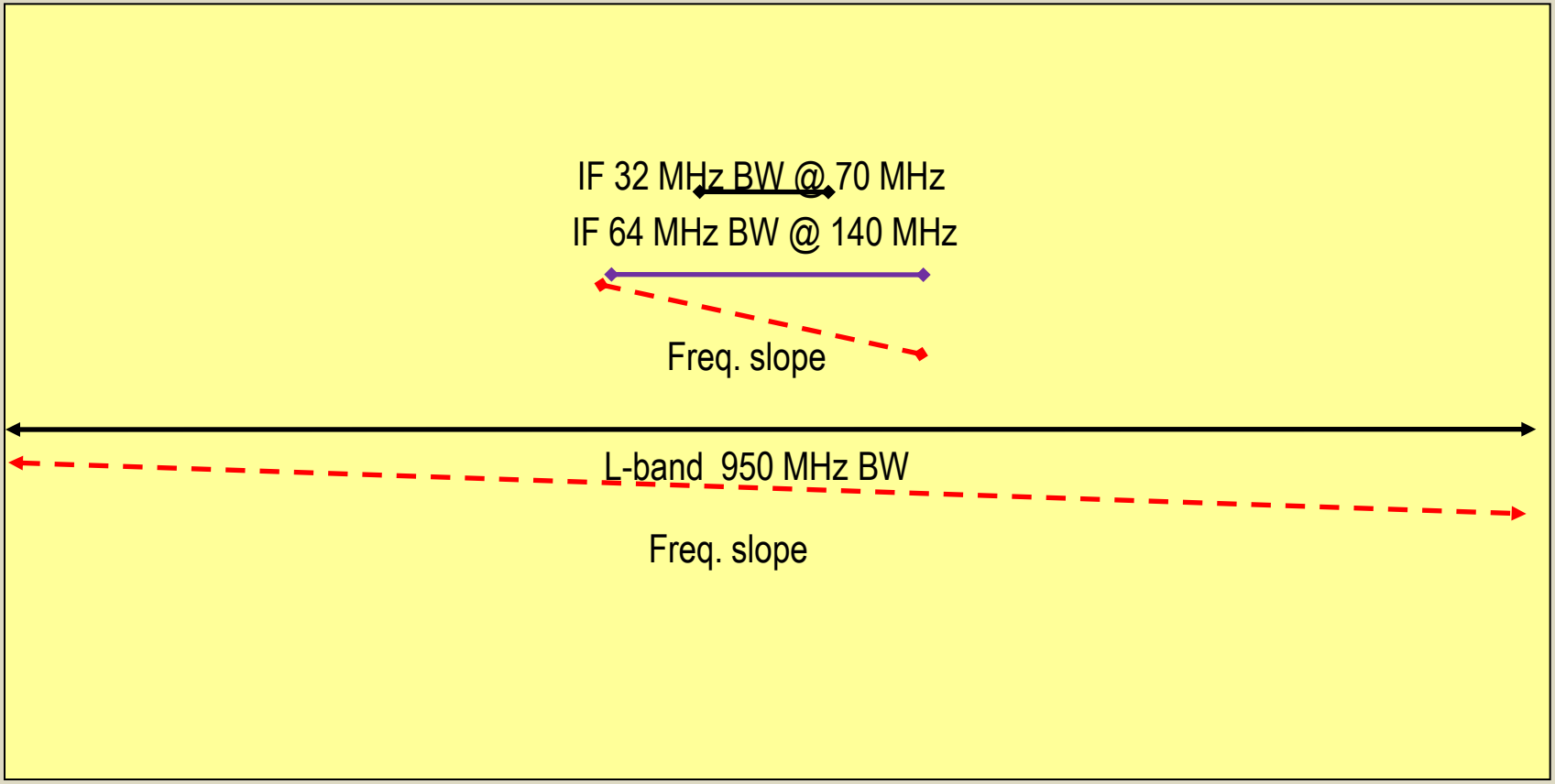
IF vs. IF-L:
Frequency Slope & BandWidth



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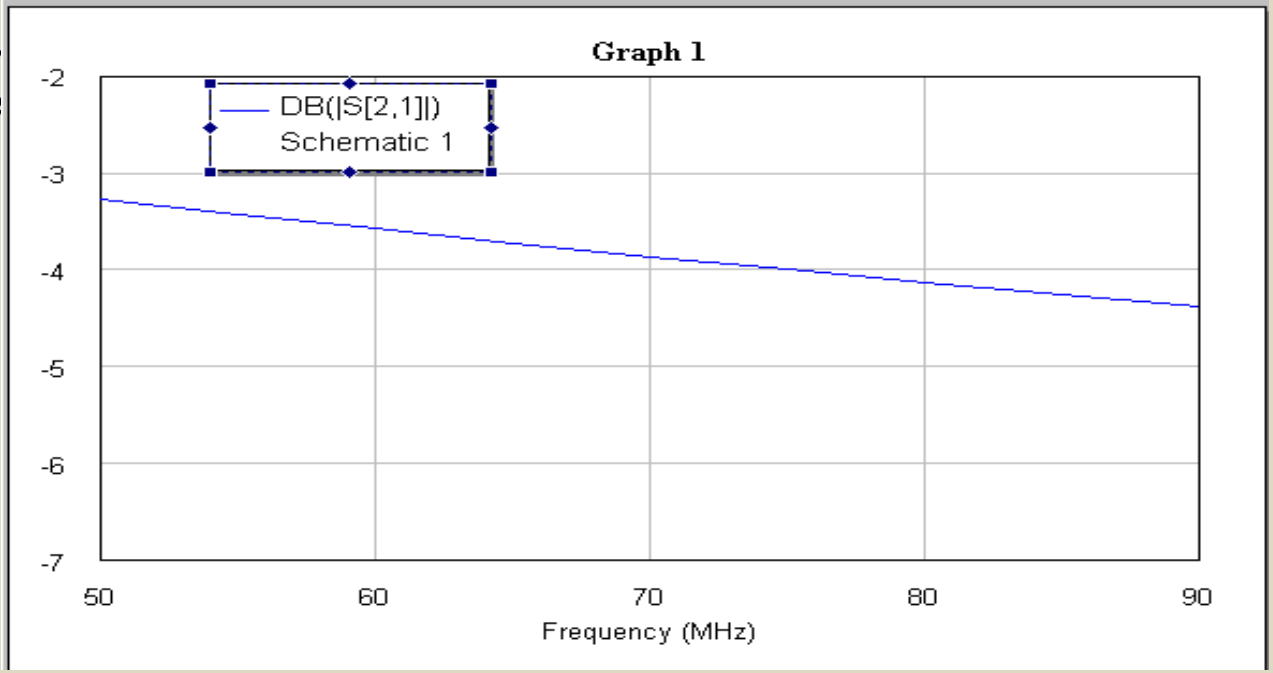
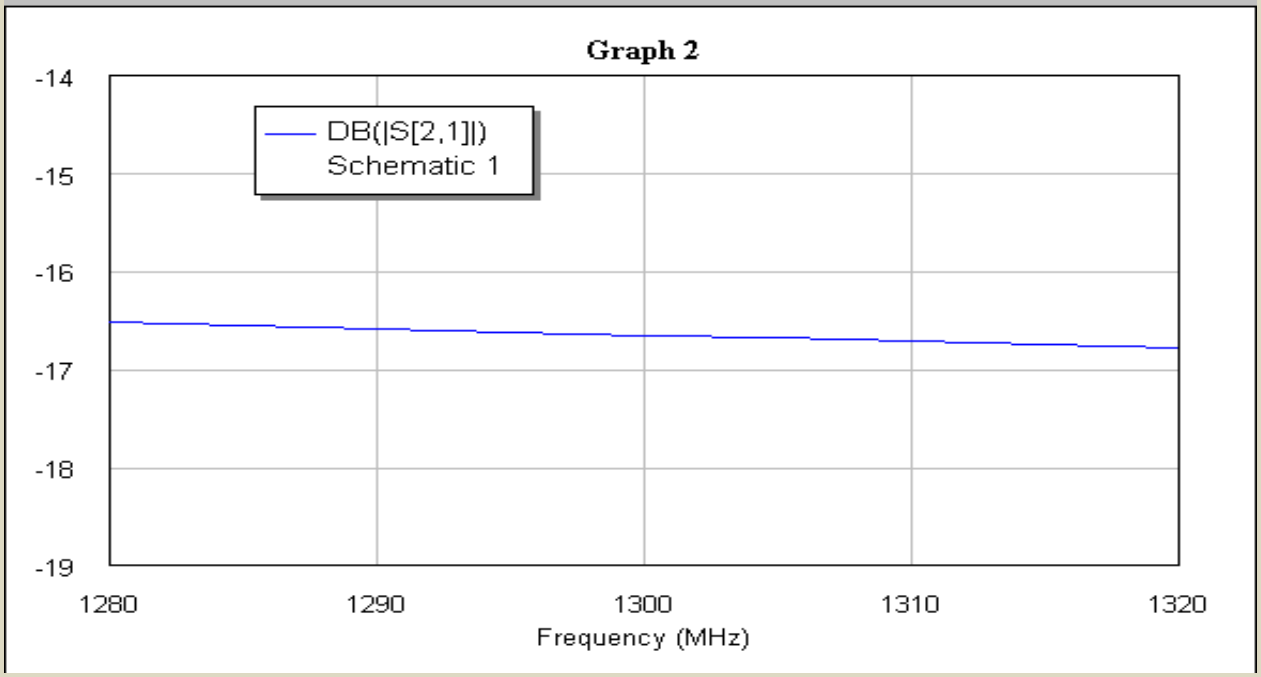
Same 40 MHz BW over IF and L-band: more degradation @ IF





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Roll-Off factors (Nyquist filters) in DVB-DSNG & DVB-S2

DVB-S: 35%

DVB-DSNG: 25% & 35%

DVB-S2: 20%

Remark: ADV equipment allows the use of all roll-off factors in all modulation schemes

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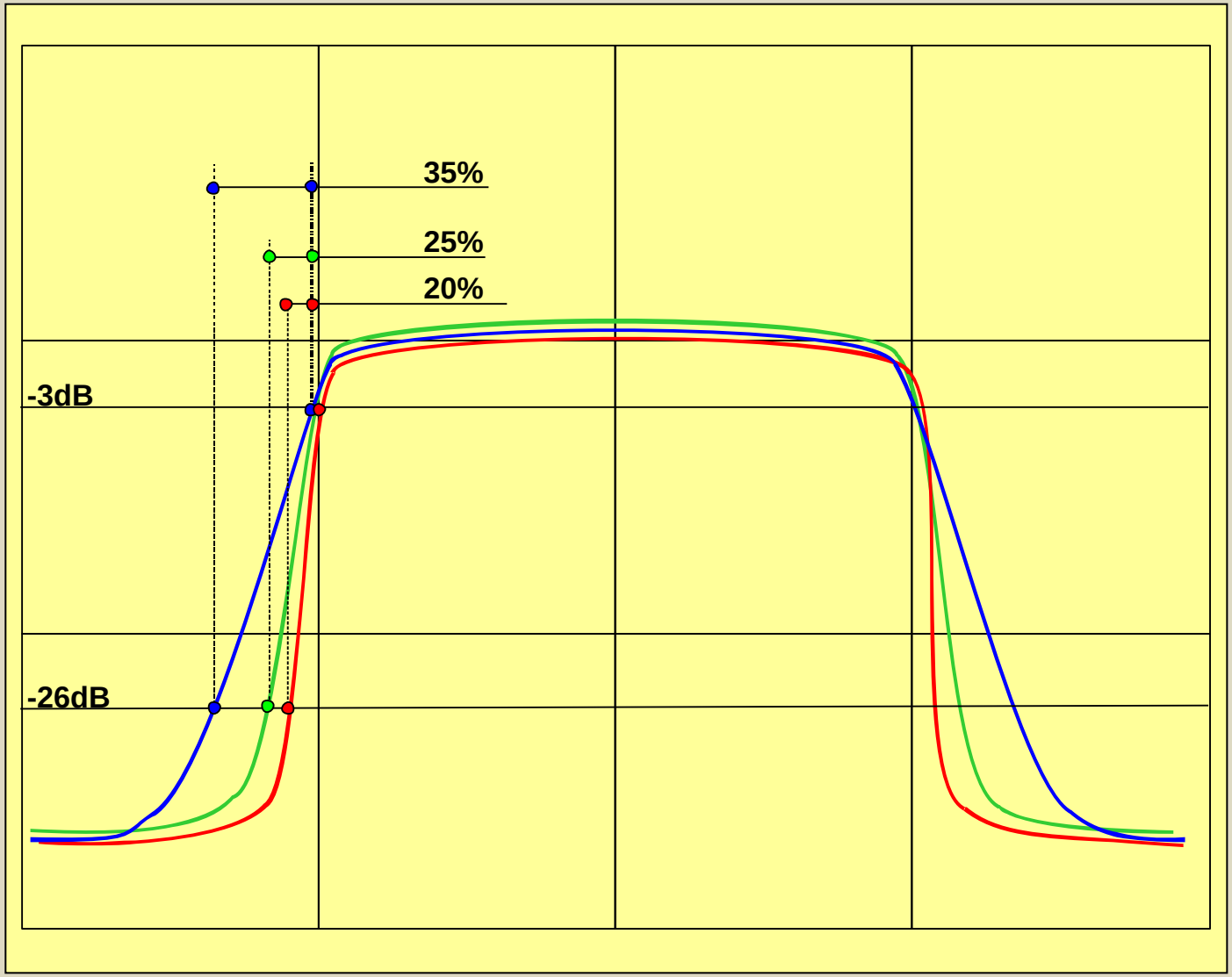
20% vs 25% vs 35% roll-off shaping



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What about existing DVB-S receivers?

DVB-S2 signals are not compatible with DVB-S receivers

DVB-S2 has a special mode called **hierarchical modulation**, but

Hierarchical modulation is not used in practice because:

high complexity
low gain
degradation of DVB-S performance
Market obstacle (still no HD,...)

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Our mess in Space: Profile view LEO/MEO & GEO

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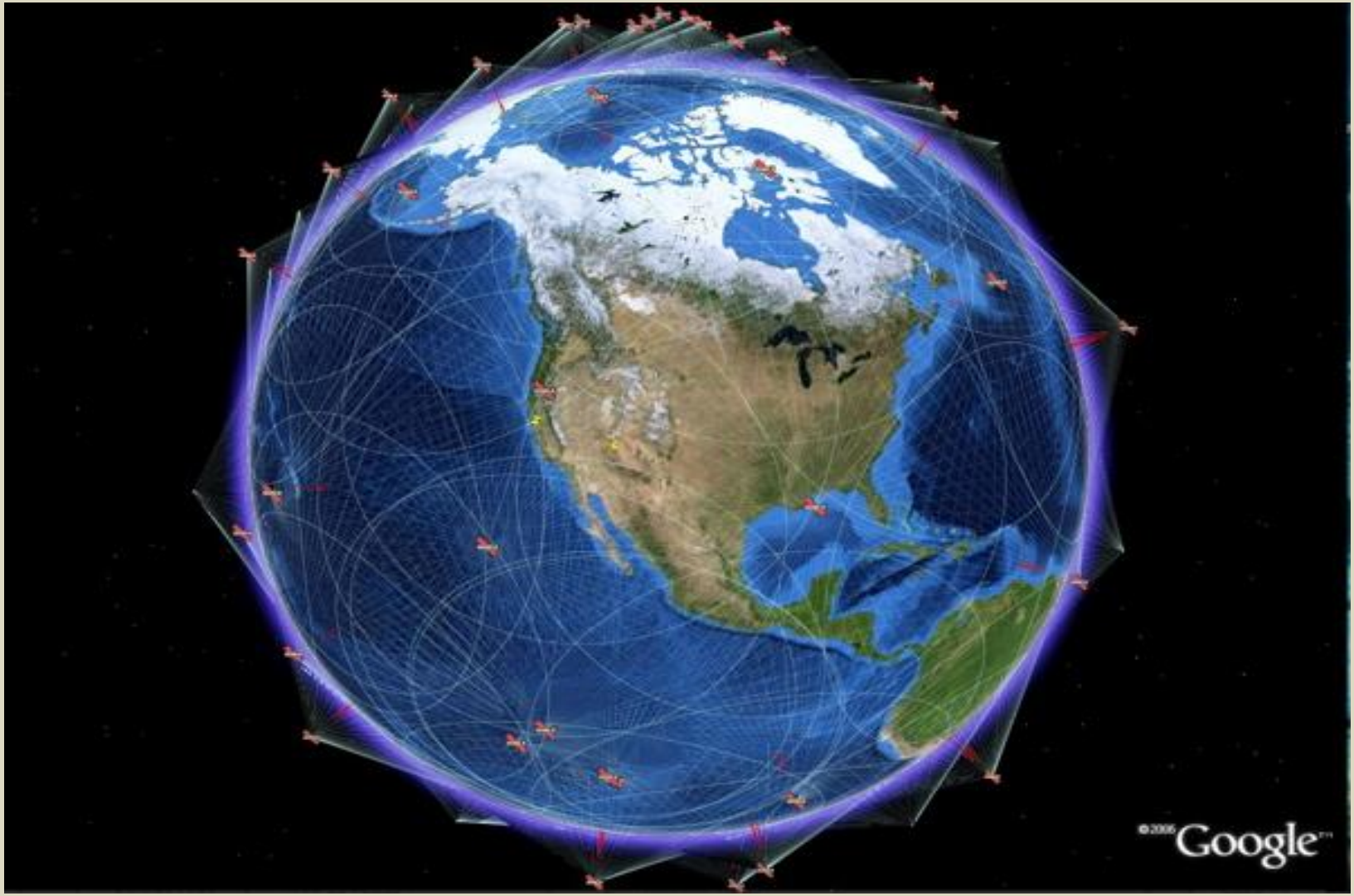
Q & A



Thanks for listening