Ingegneria delle Telecomunicazioni

Satellite Communications

10. Make it Better – Satellite ACM

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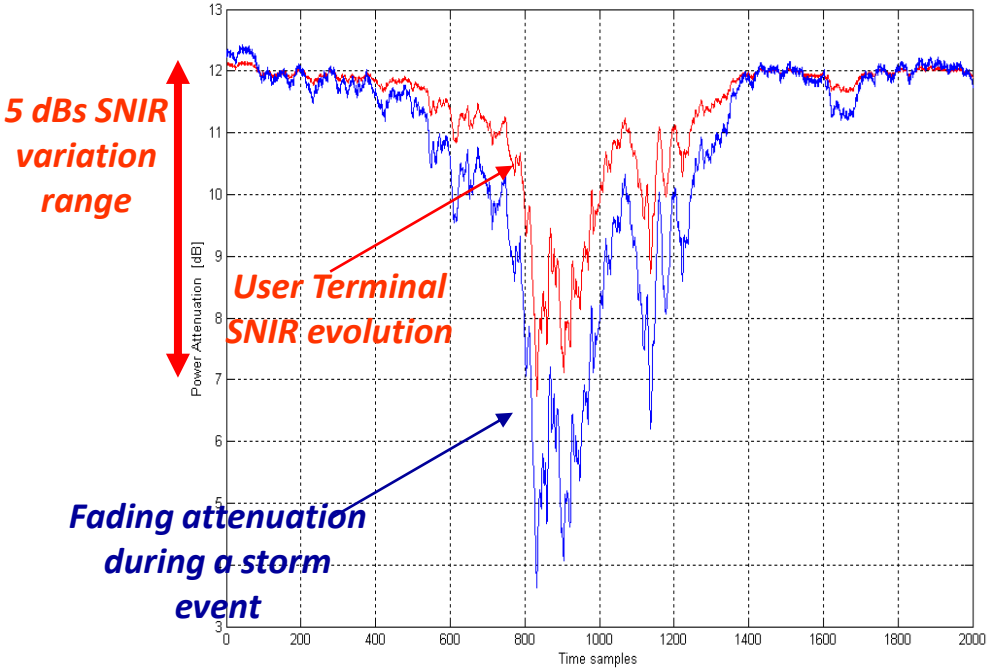
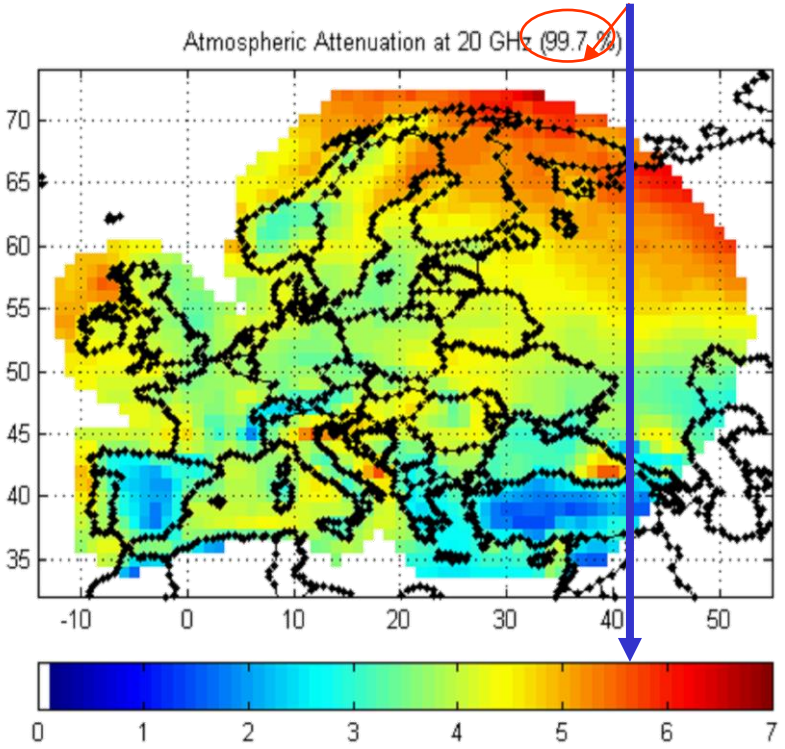
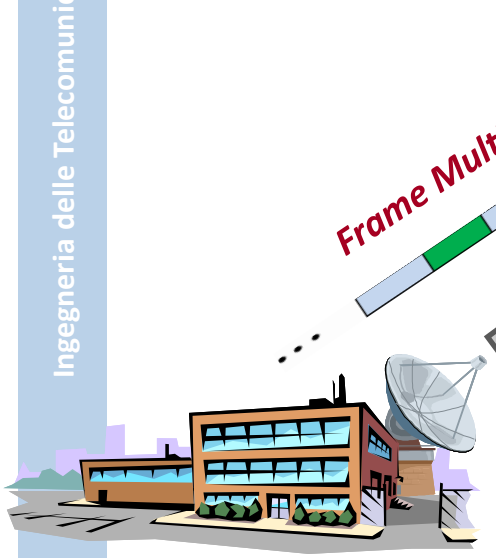
Adverse Propagation Conditions





Adaptive/Variable Coding and Modulation (ACM/VCM)



TX

Bit-rate Control, MODCOD Selection

Highly protected MODCOD, Lower bit rate, Lower required C/N+I

Low-Protected MODCOD

DEM C/N+I Measurement

Feedback Channel -> ACM
No Feedback -> VCM

Feedback

DEM C/N+I Measurement

ACM in a Nutshell

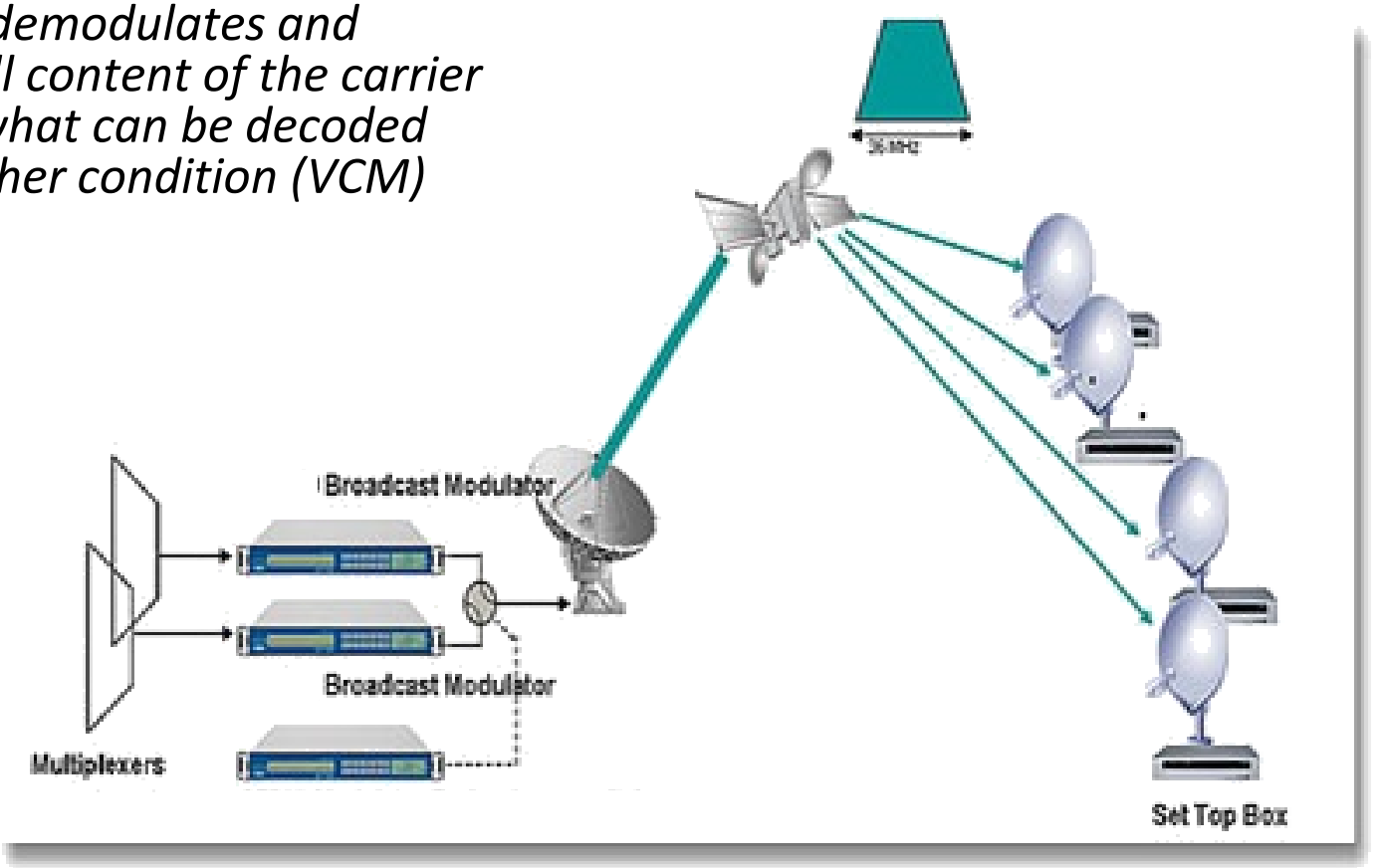
- Broadband interactive satellite systems allow for adapting the link to individual user channel conditions regularly
  - Link Adaptation between GW and user terminal is achieved by **adapting coding and modulation (ACM)** and maintaining the same symbol rate.
- **ACM principle:**
  - Estimate the link quality (SNIR) at user terminals and report to GW.
  - Adapt coding rate and modulation format according to User Terminal (UT) channel conditions
  - Adapt the bit rate assignment to individual links according to the physical layer MODCOD assignment.
- End-to-end Result: data rate maximization for each UT at each time -> overall system capacity maximization

DVB access schemes 1/2

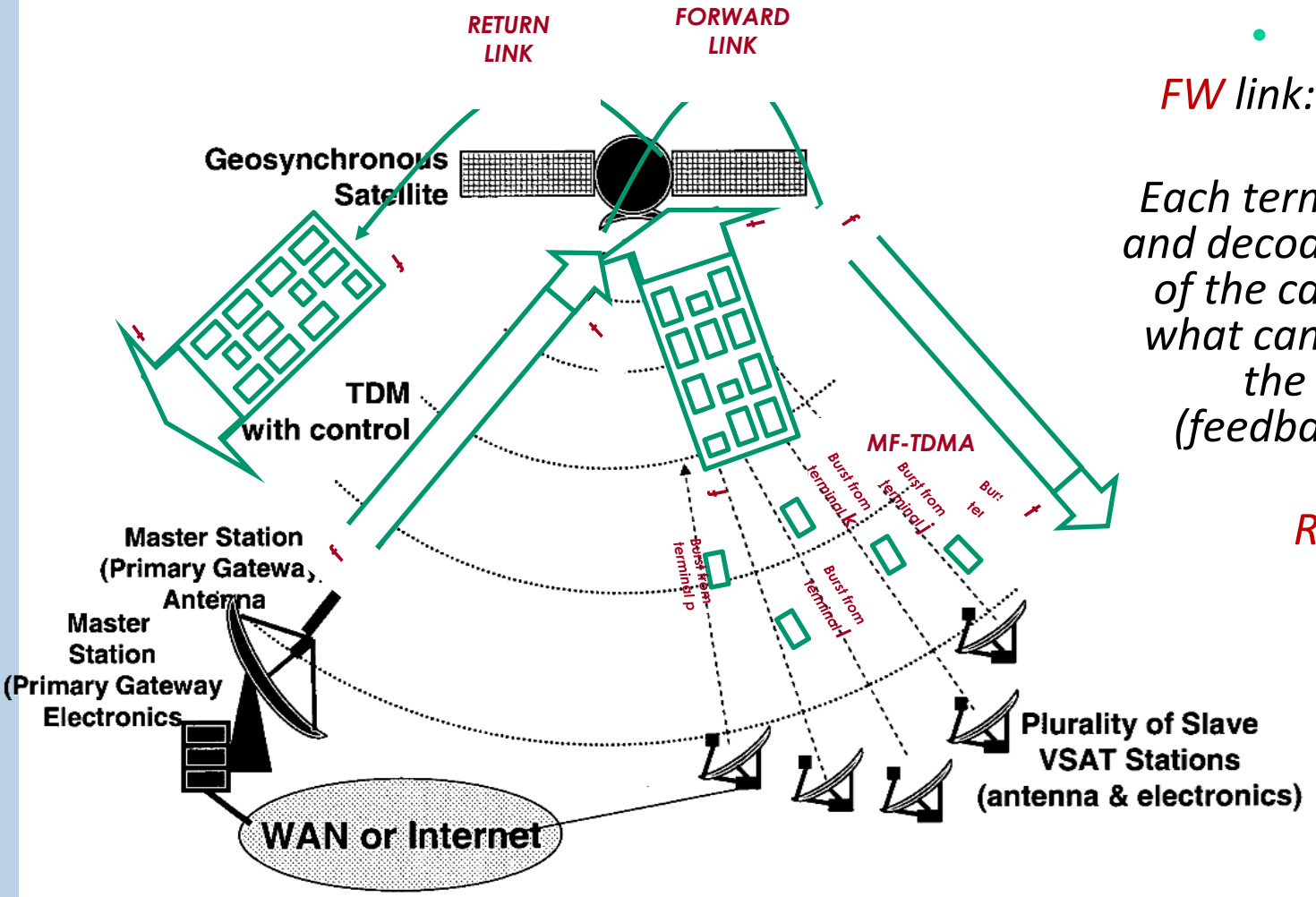
BROADCAST

DVB-S2 in CCM or VCM mode:

Each terminal demodulates and decodes the full content of the carrier (CCM) or just what can be decoded given the weather condition (VCM)



DVB access schemes 1/2



- ***INTERNET ACCESS***

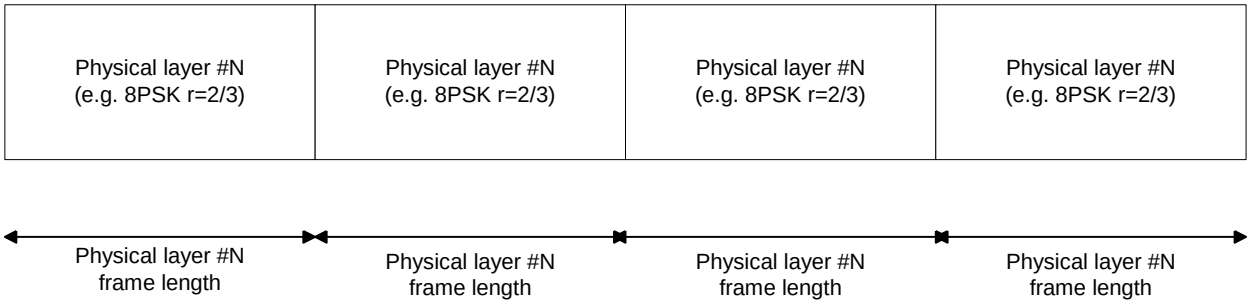
FW link: DVB-S2 in CCM or ACM mode:

Each terminal demodulates and decodes the full content of the carrier (CCM) or just what can be decoded given the weather condition (feedback provided to the GW)

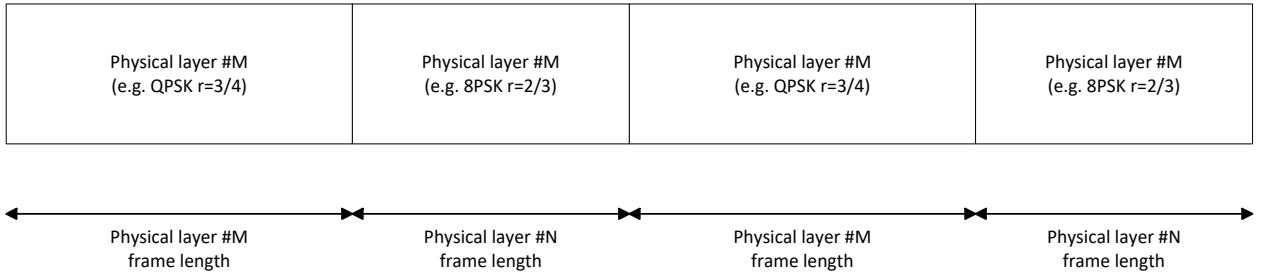
RT link: DVB-RCS(2)

DVB-S2(X) Operation Modes

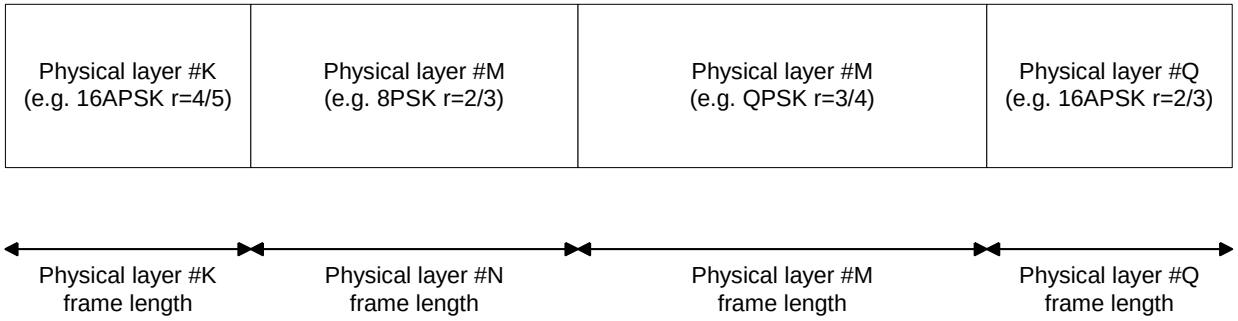
Constant Coding and Modulation (CCM) – repeating frame configuration



Variable Coding and Modulation (VCM) - prediction



Adaptive Coding and Modulation (ACM) – needs feedback

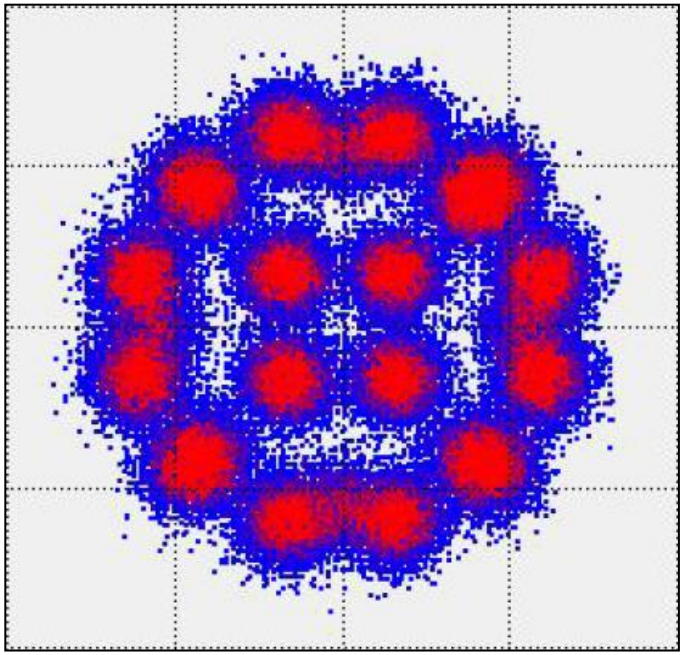


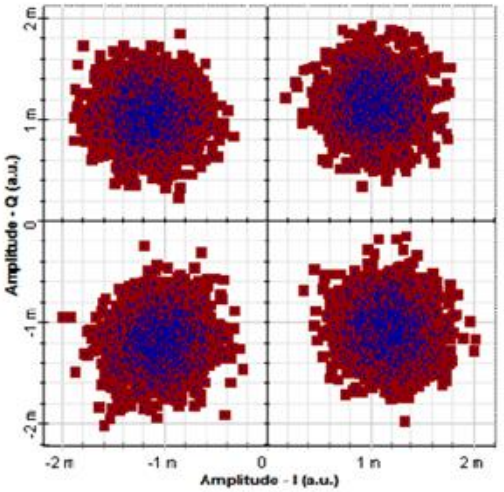
DVB-S2 modulation and coding scheme 1/2

$$E_s/N_0 = (C/N_0) / R_s \Rightarrow E_s/N_0 > (E_s/N_0)_{th}$$

LINK CLOSURE

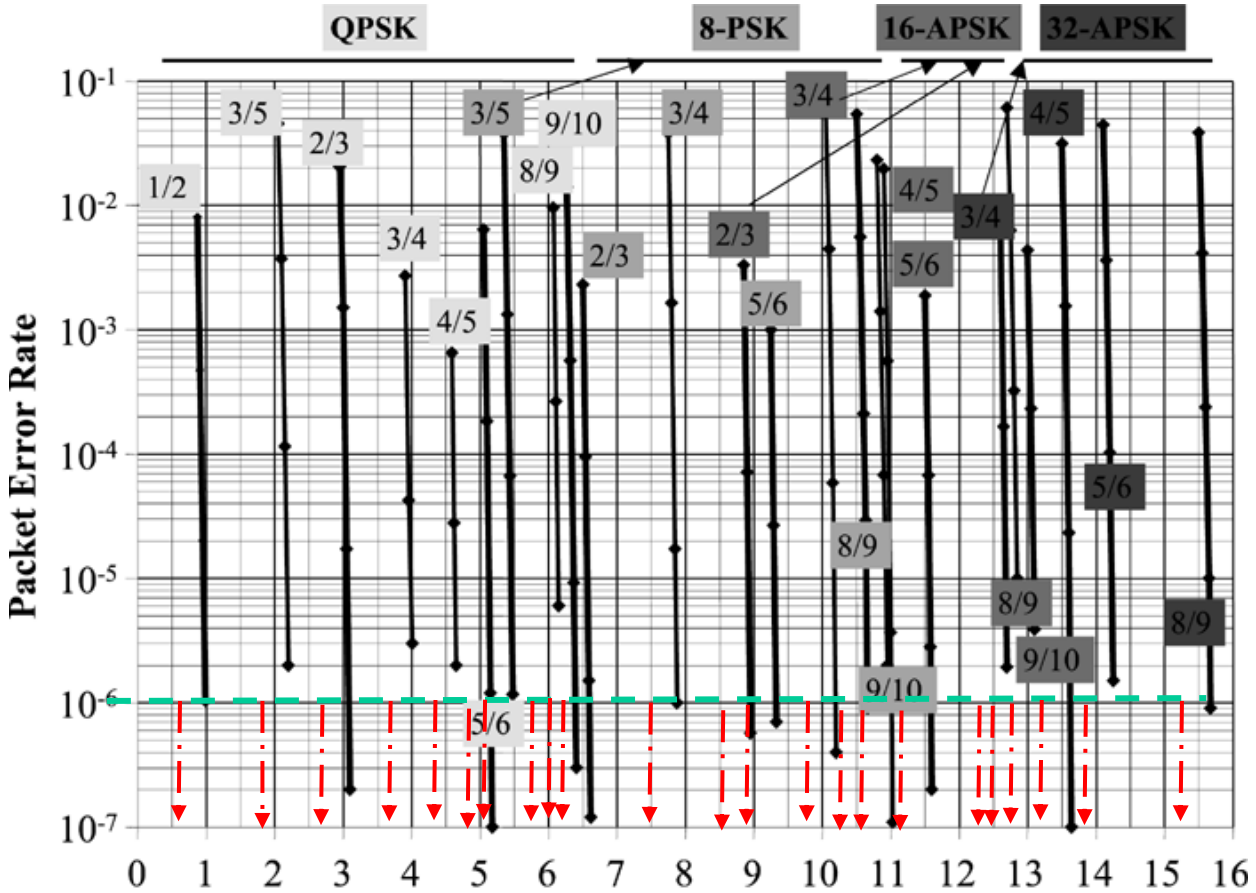
16APSK





QPSK

DVB-S2 modulation and coding scheme 2/2



$(E_s/N_0)_{th}$ for different modulations and code rates

The higher the protection (more Forward Error Correction code redundancy bits), the more robust is the signaling scheme w.r.t noise power and lower is the $(E_s/N_0)_{th}$

However, the higher the protection, the lower the data rate.

… on the Shannon Plane…