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Erasmus+ Programme  
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Digital Broadcasting and Broadband Technologies (Master Studies)  
Erasmus+ Project No. 561688-EPP-1-2015-1-XK-EPPKA2-CBHE-JP

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**DBBT**

**Digital Broadcasting &  
Broadband Technologies**

# Digitalni radiodifuzni sistemi i tehnologije

## Digitalni TV prijemnici

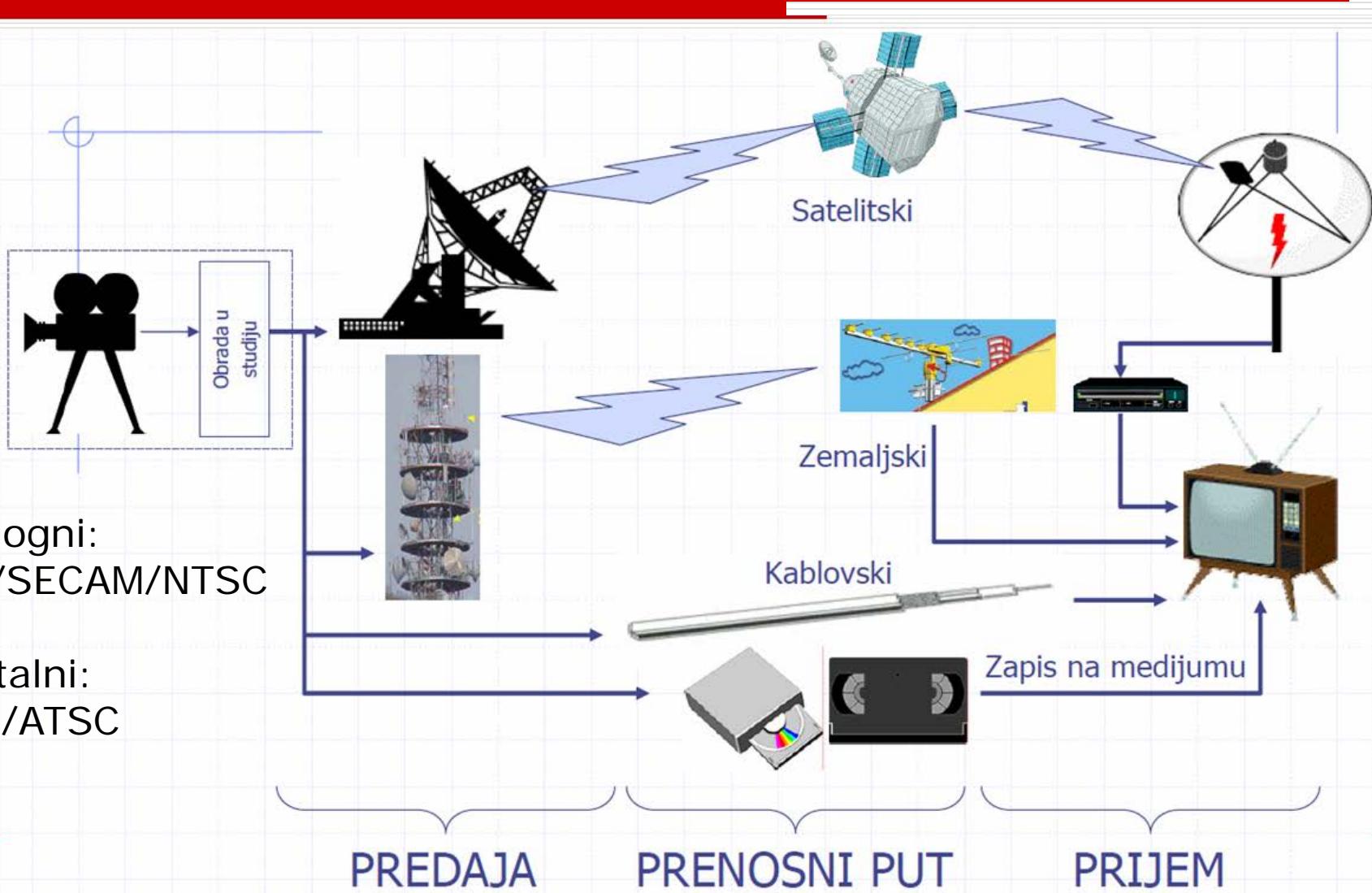
*Doc. dr Jugoslav Joković*

[jugoslav.jokovic@gmail.com](mailto:jugoslav.jokovic@gmail.com)

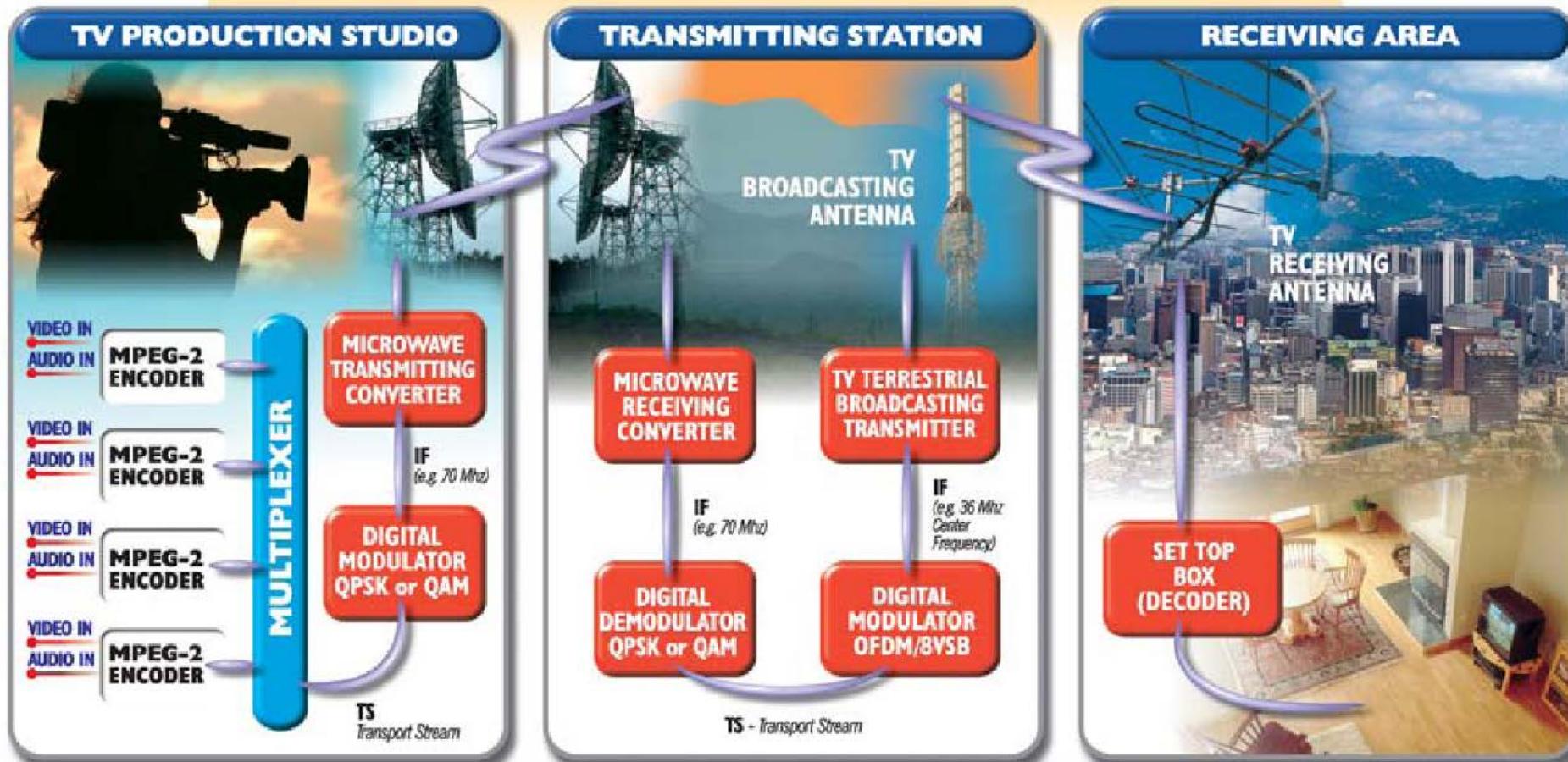
Elektrotehnički fakultet Banja Luka

*Banja Luka, 2017.*

# TV sistem



# DIGITAL TELEVISION BROADCASTING SYSTEM

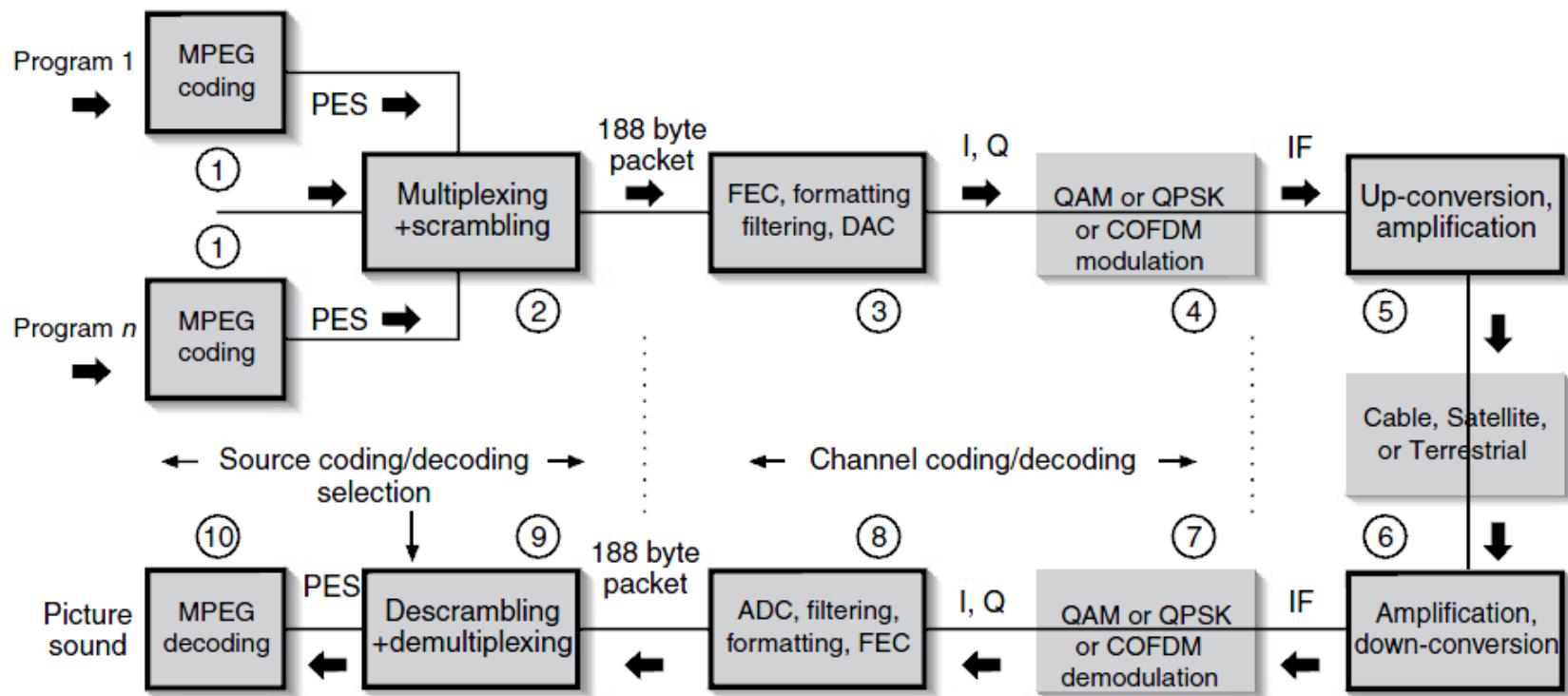


# Digitalni TV sistem – elementi

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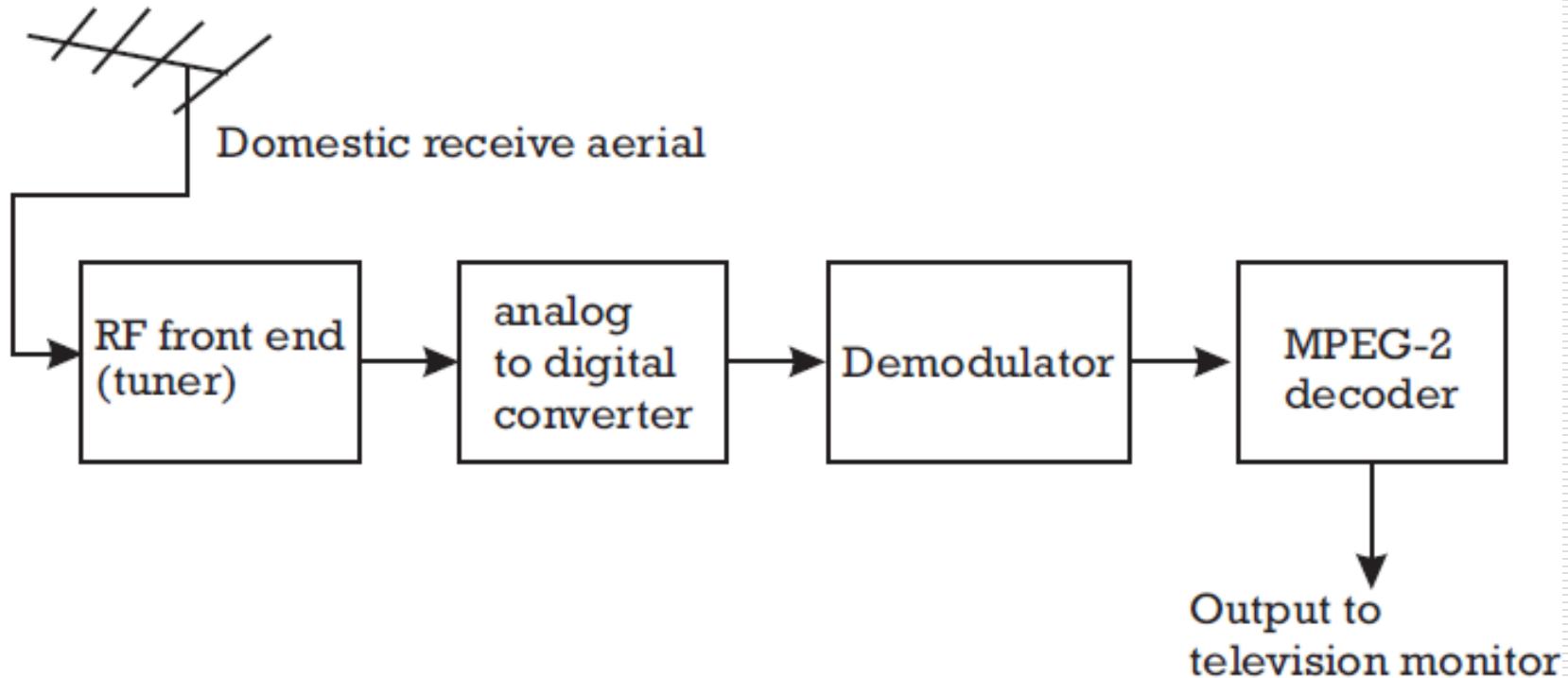
- Izvorno kodovanje
    - MPEG 2 / H.264
  - Dodatni servisi
    - SI, TXT, Subtitle
  - **Multipleksiranje**
  - **Digitalni prenos (DVB-T, S, C)**
    - Kanalno kodovanje
    - Modulacija
  - **Digitalni TV predajnik**
  - **Digitalni TV prijemnik**
  - **Middleware**
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# Digitalni TV sistem – elementi

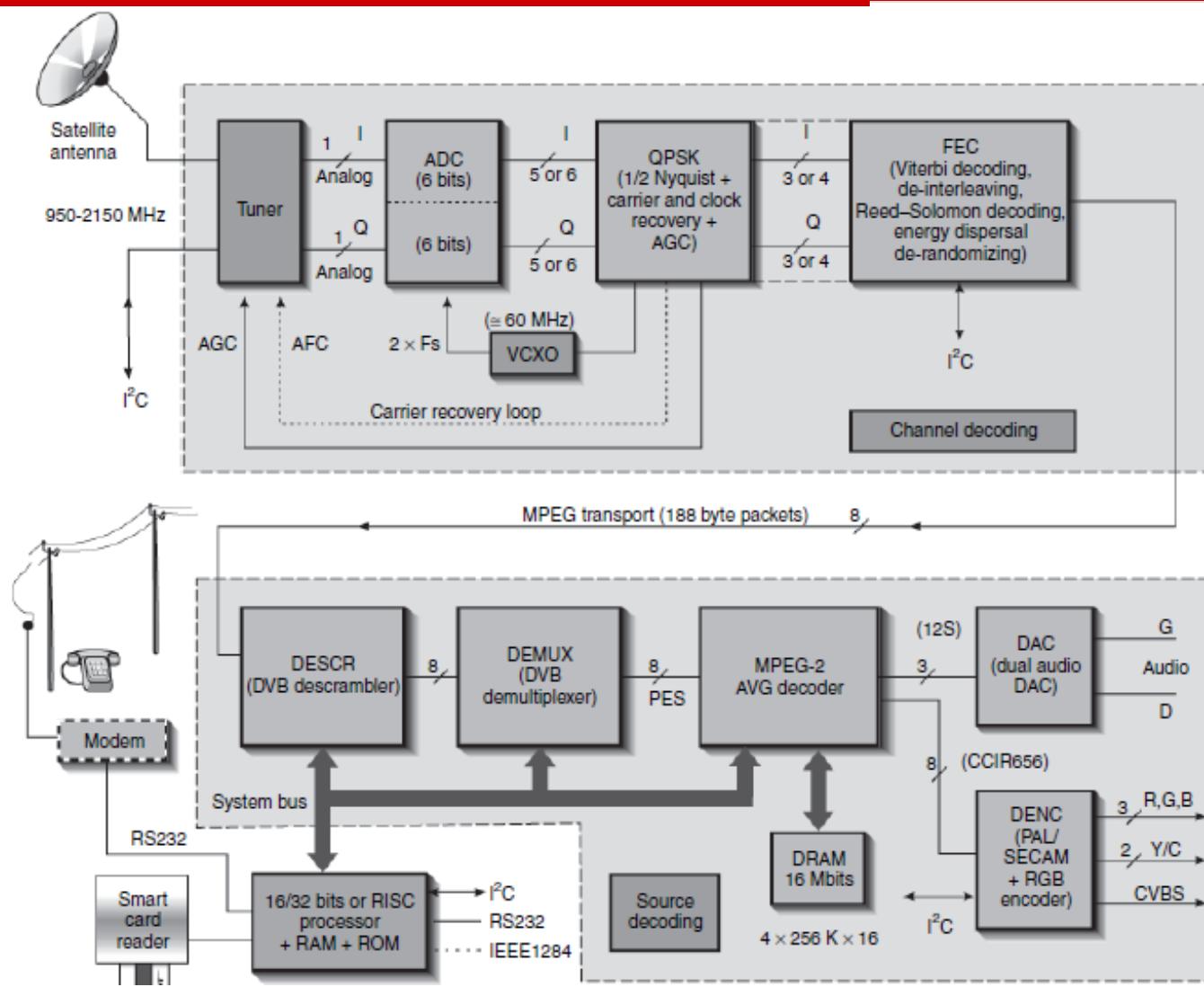


# Digitalni TV prijemnik

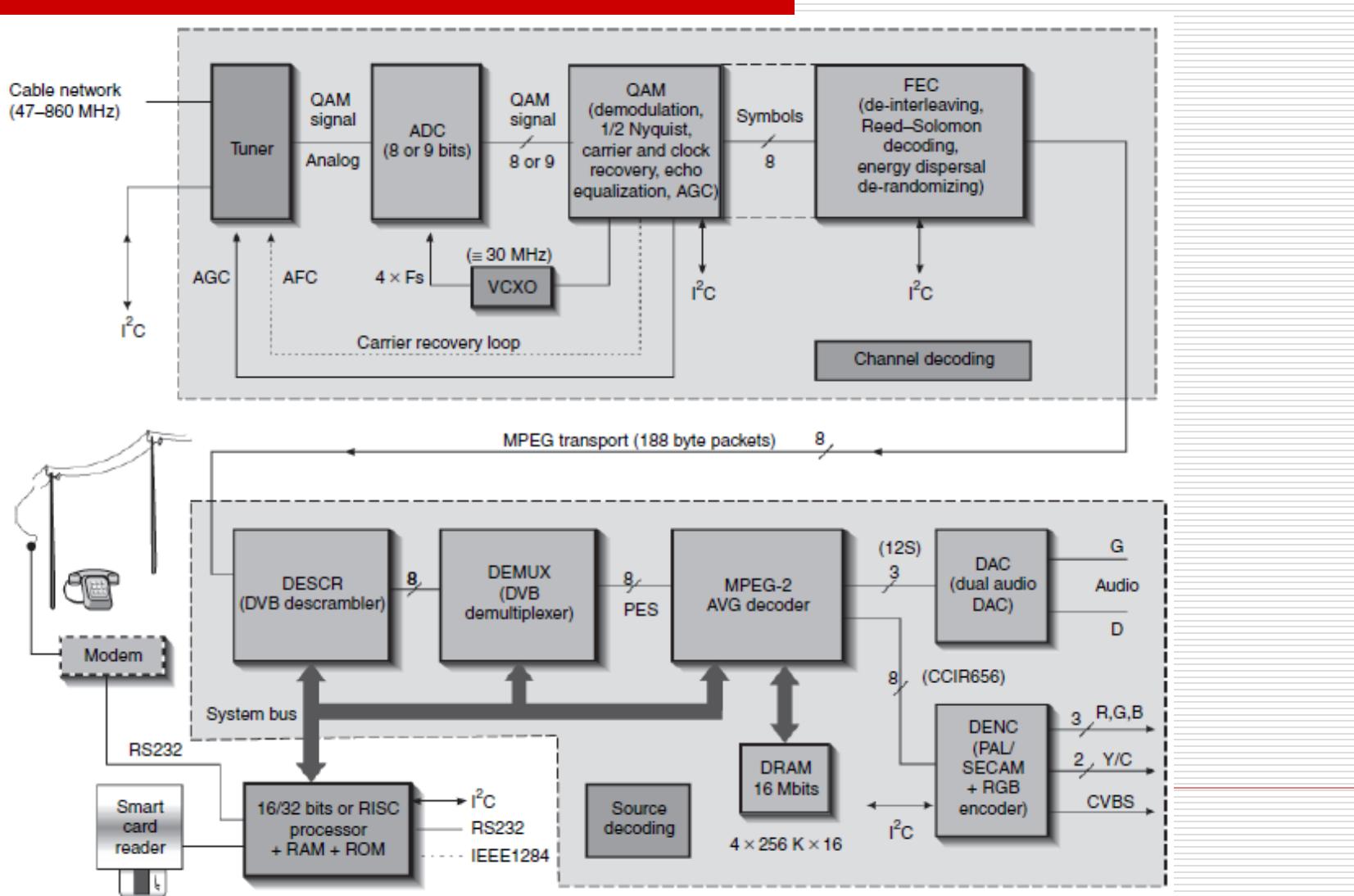
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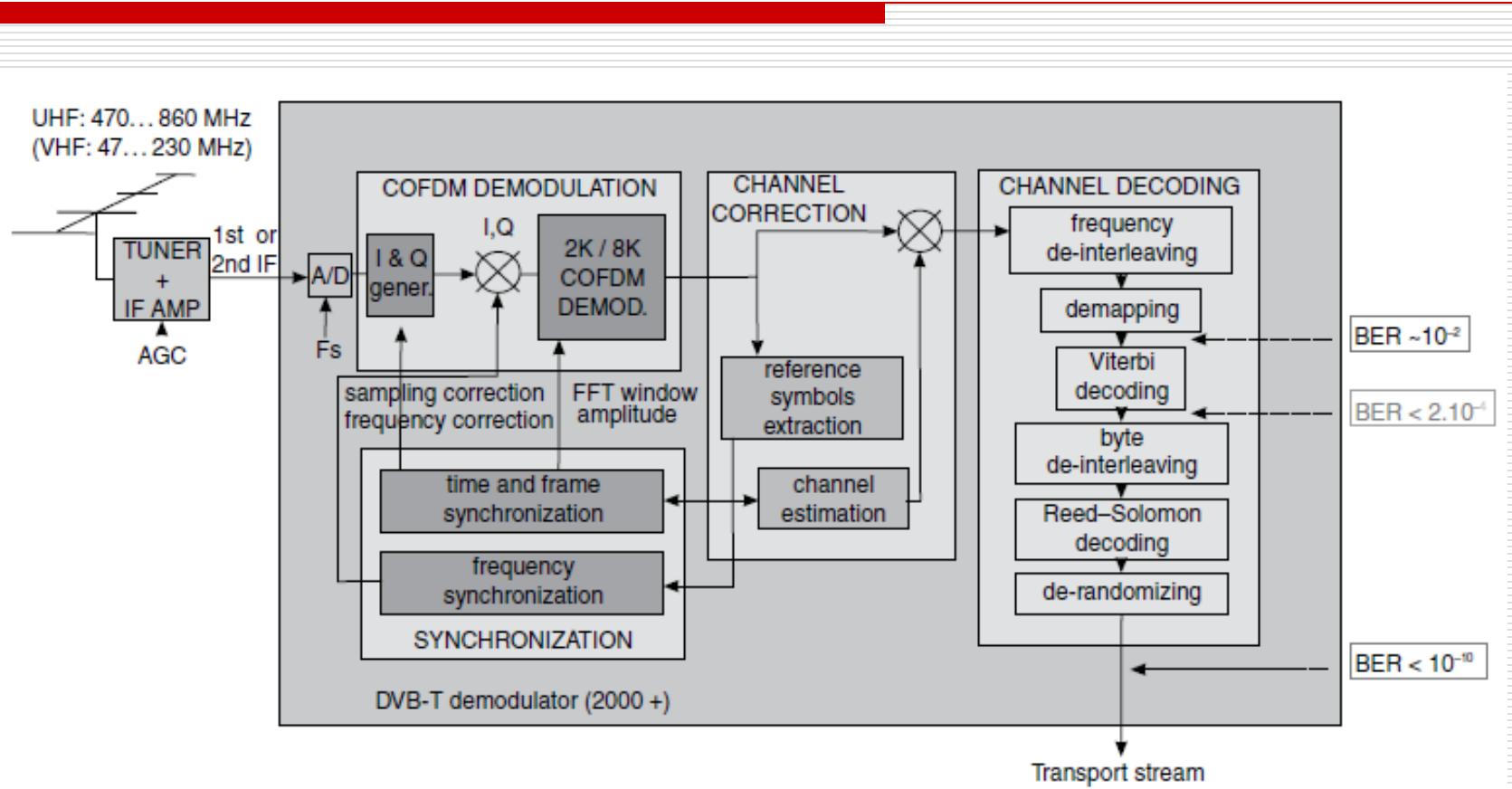
# Satelitski DTV prijemnik



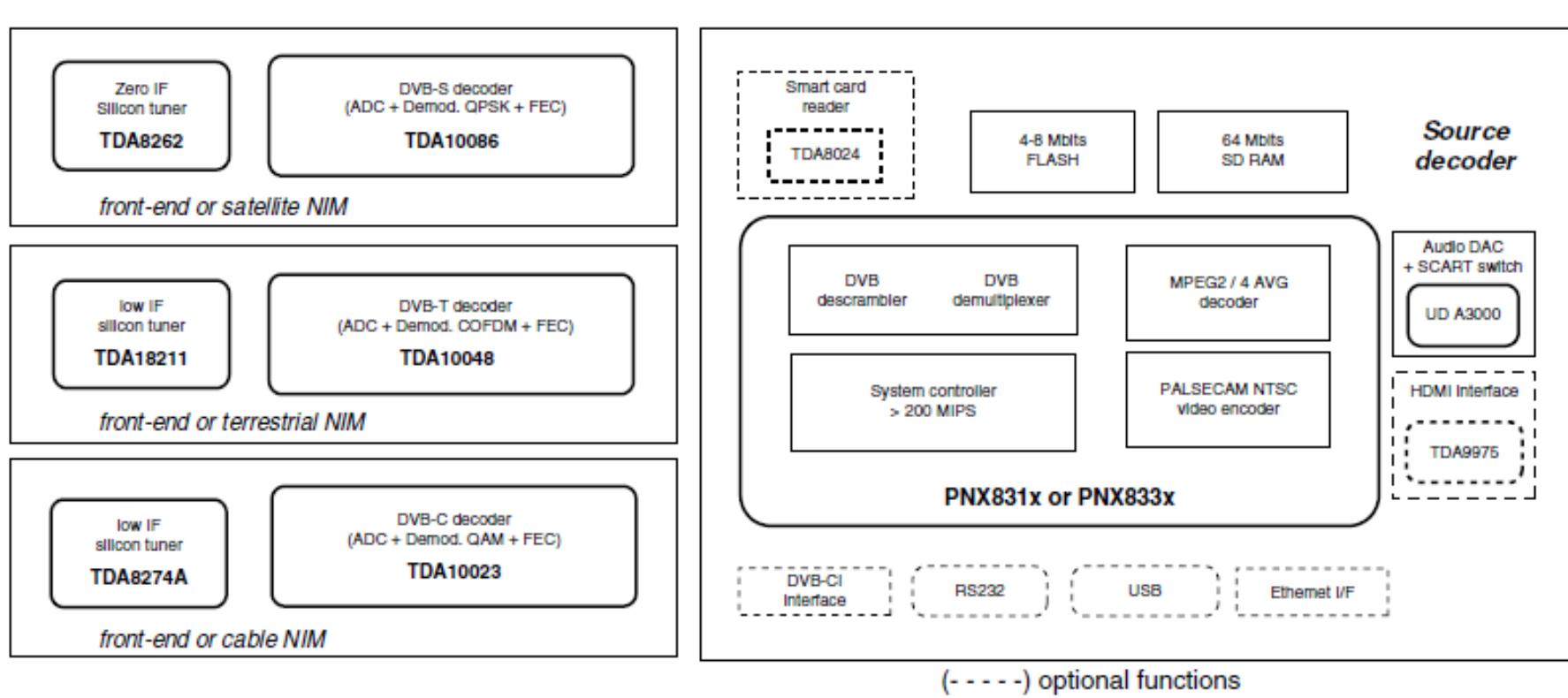
# Kablovski DTV prijemnik



# Zemaljski DTV prijemnik



# *Chip set DTV prijemnika – pr.*



# Merenja na prijemu

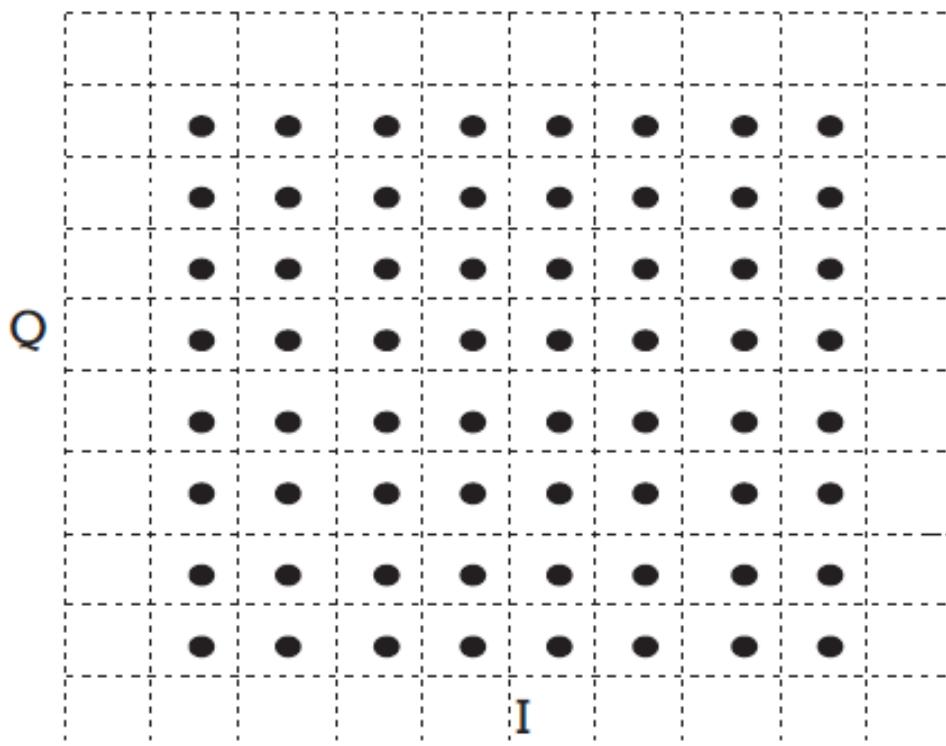
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- **RF i IF snaga signala** - termalni senzor za merenje snage
- **Snaga šuma** - integrisana preko kompletног propusnog opsega
- **Odnos signal nosioca-šum (C/N)**
- **BER u zavisnosti od C/N** –PRBS je input modulatora, up-konvertovana na frekvenciju kanala i pojačana za emitovanje
- **Back-off izlaz predajnika**
- **Fazni šum** - nestabilnost lokalnog oscilatora
- **Linearnost predajnika** - merenje ivičnih delova spektra RF signala
- **Ekvivalentna degradacija šuma (END)** – mera dodatih gubitaka (smanjenje u C/N) koji su izazvani u uslovima idealnog prenosnog sistema dodavanjem bilo koje stavke realne opreme.
- **Odnos modulacione greške (MER)** – vektorski signali
- **Kvalitet usluga (QoS)** - dužina i kvalitet prenosnog puta, proces dekodiranja - digitalni prenos

# ANALIZA SIGNALA U VREMENSKOM DOMENU (IQ)

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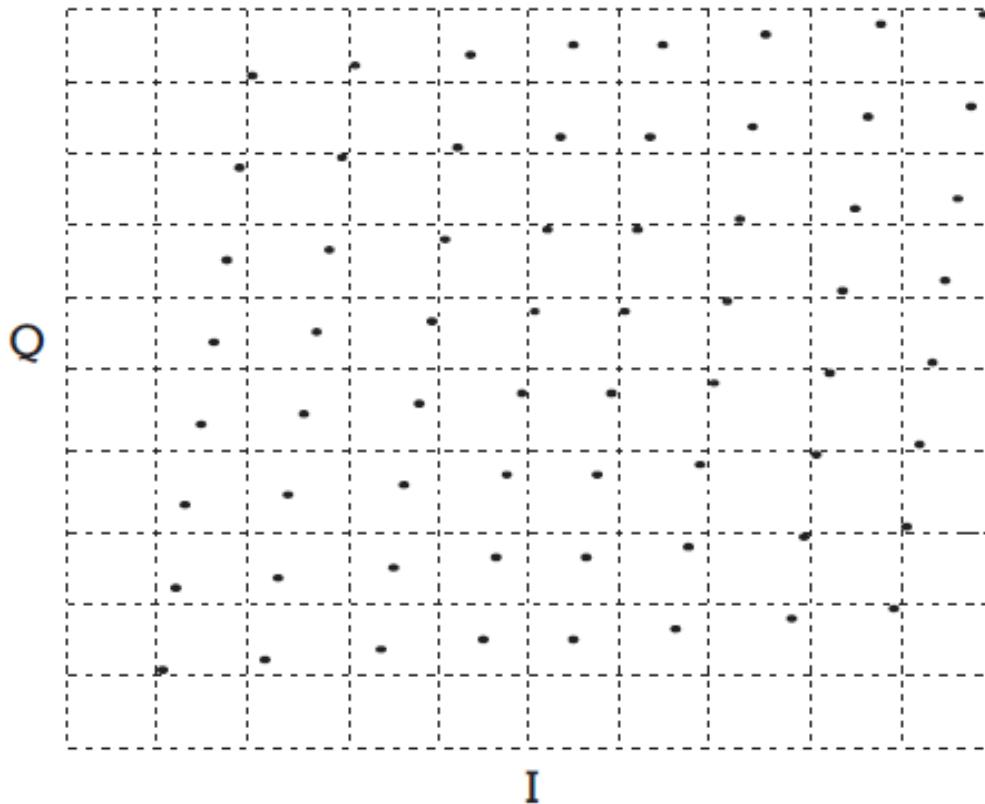
- Tipičan 64-QAM konstelacioni dijagram (bez greške)



# ANALIZA SIGNALA U VREMENSKOM DOMENU (IQ)

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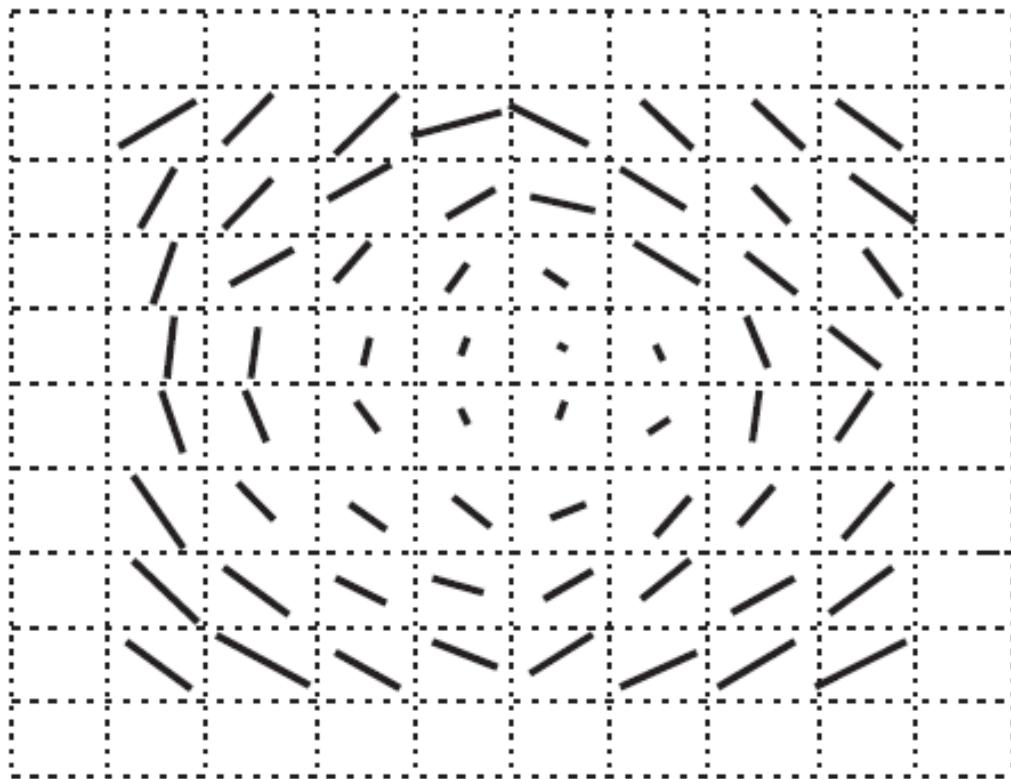
- 64-QAM sa konstantnom faznom greškom



# ANALIZA SIGNALA U VREMENSKOM DOMENU (IQ)

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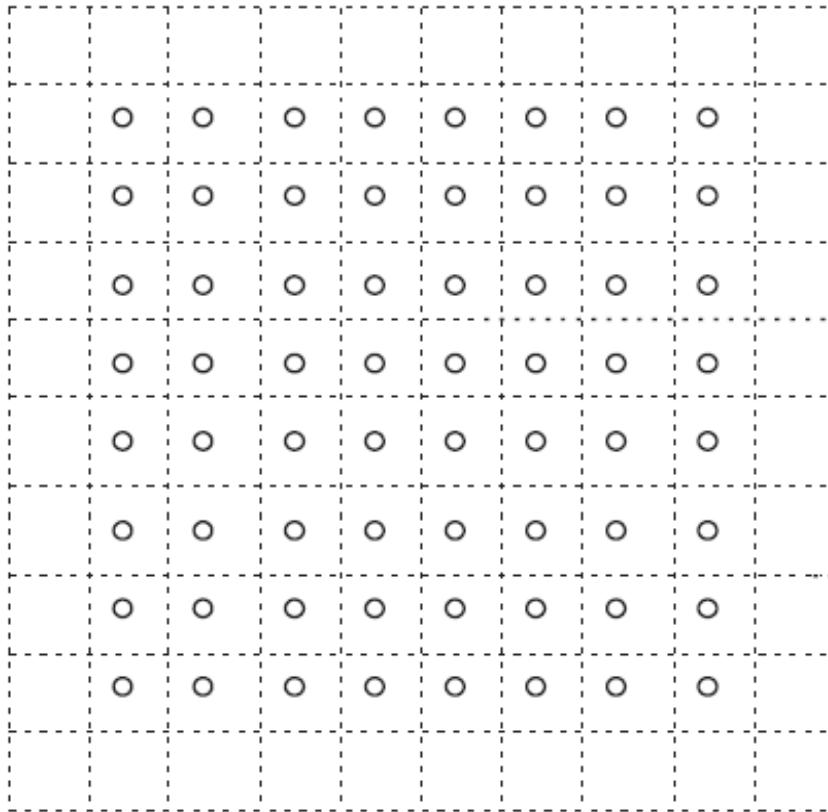
- 64-QAM sa faznim jitter-om



# ANALIZA SIGNALA U VREMENSKOM DOMENU (IQ)

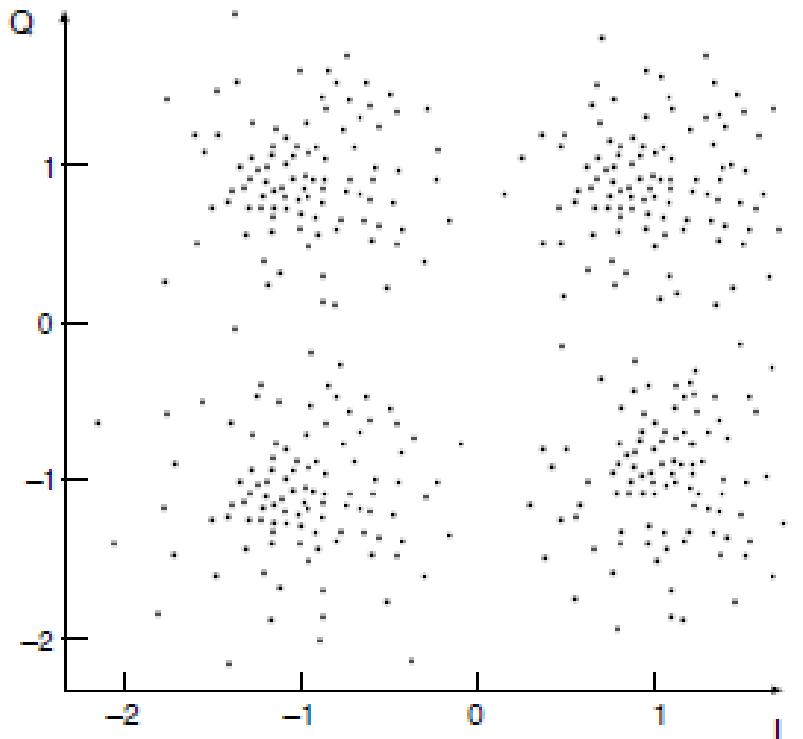
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- 64-QAM konstelacioni dijagram sa signalom interferencije



# ANALIZA SIGNALA U VREMENSKOM DOMENU (IQ)

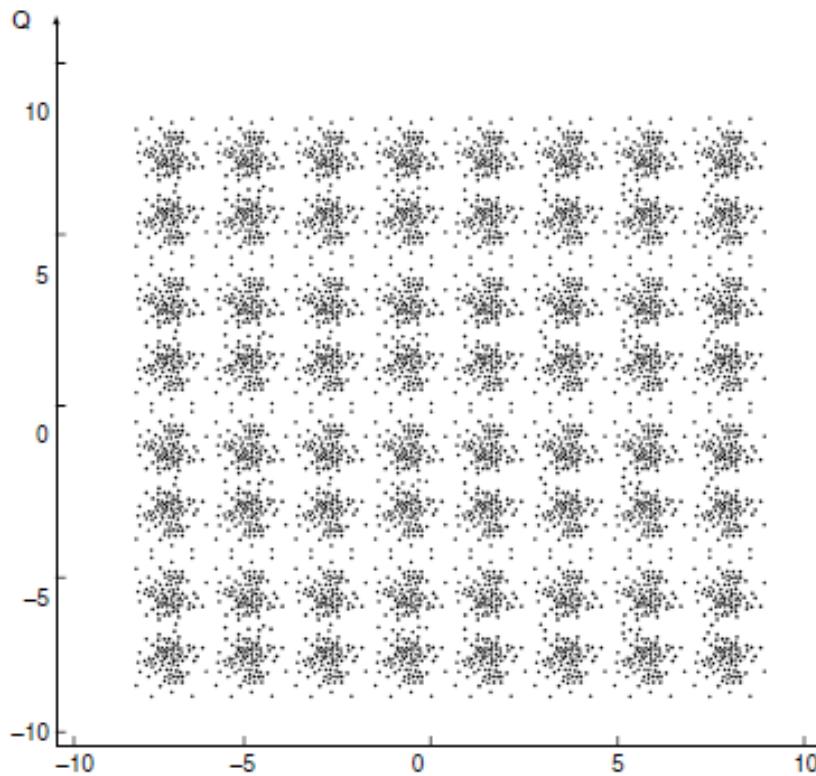
- QPSK konstelacioni dijagram – slab satelitski prijem



# ANALIZA SIGNALA U VREMENSKOM DOMENU (IQ)

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- 64-QAM konstelacioni dijagram –  $SNR=23dB$

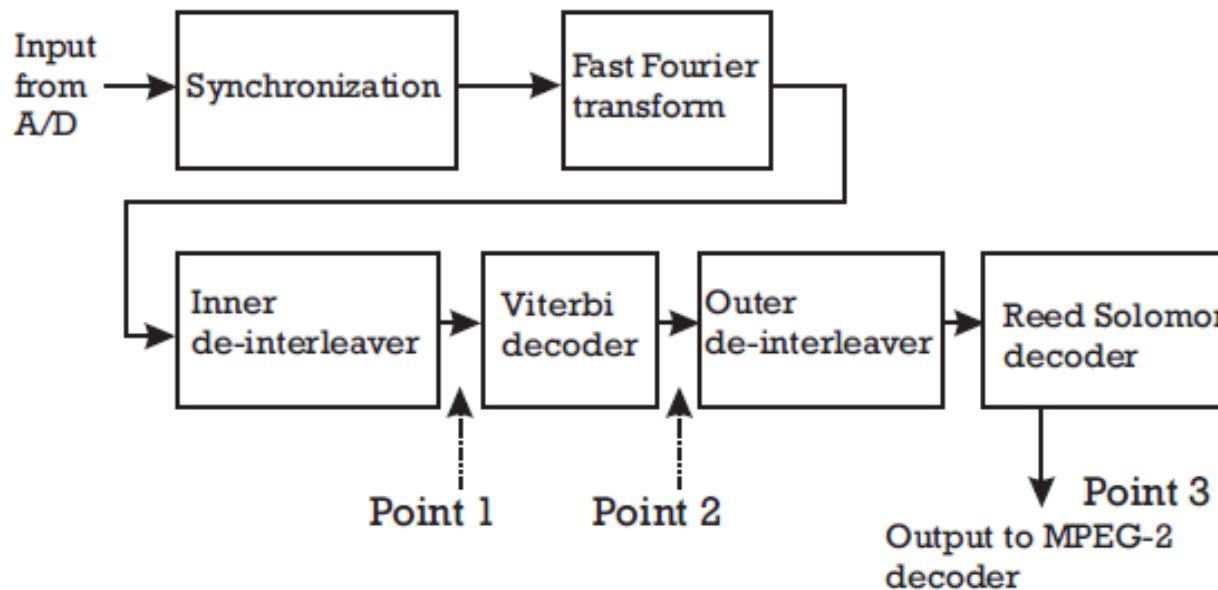


# MERENJE BER

- **Bit Error Ratio**

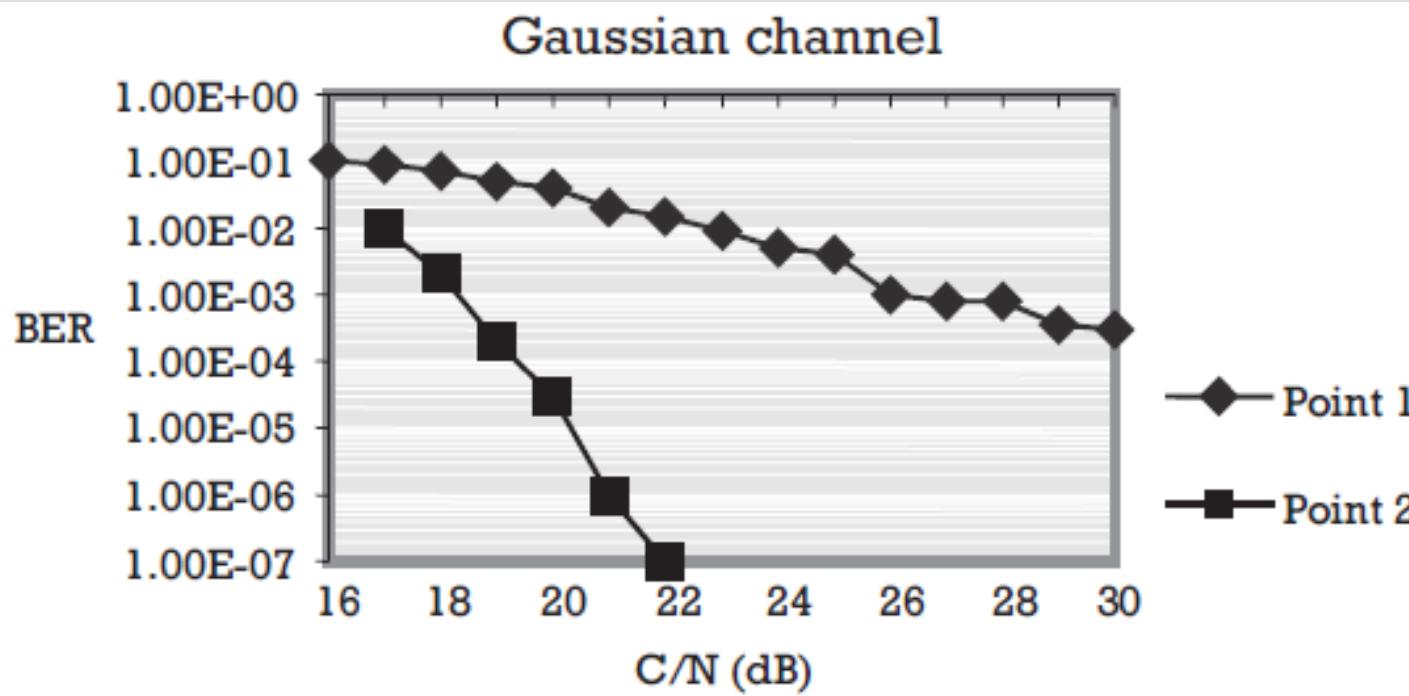
- poređiti predajnu i primljenu sekvencu bita
- odnos broja pogrešnih bita i totalnog broja bitova
- test sekvence bita - PRBS signal

- **BER merne tačke za DVB-T prijemnike**



# BER merne tačke za DVB-T prijemnike

- BER u zavisnosti od odnosa C/N,  
64-QAM, kodni količnik 2/3 – COFDM signal





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