

# DBBT

Digital Broadcasting &  
Broadband Technologies

Co-funded by the  
Erasmus+ Programme  
of the European Union

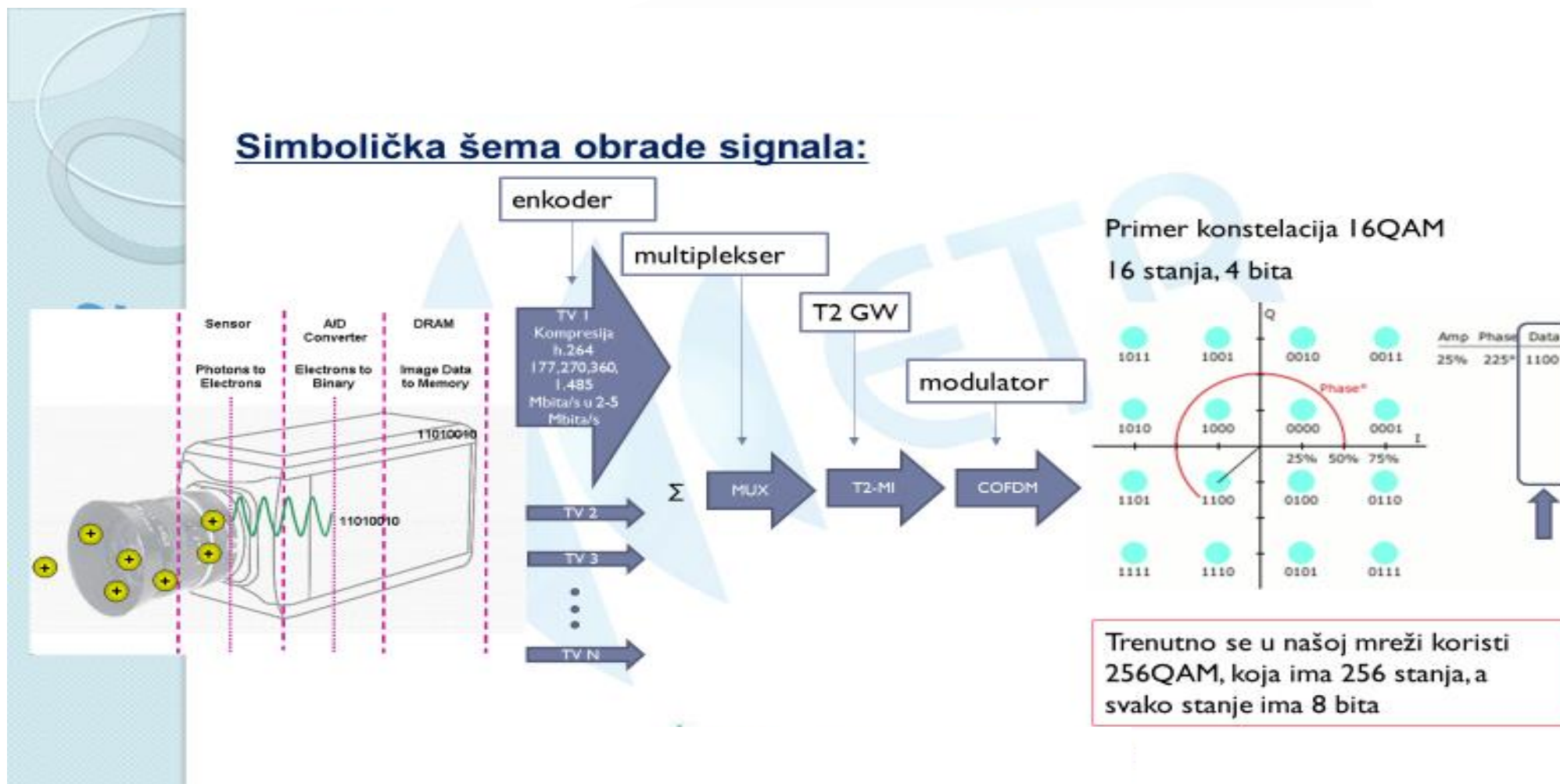


## Opis tehnološkog sistema za emitovanje digitalnog TV programa

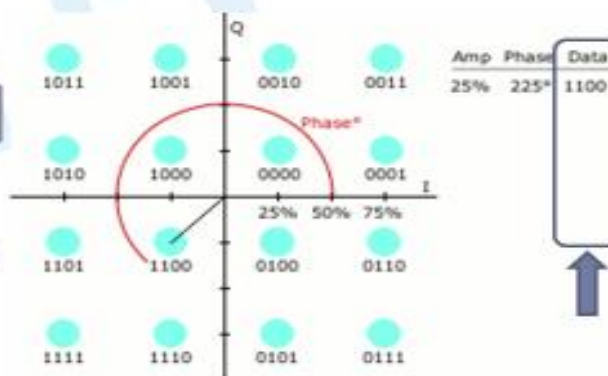
Jovan Zlatanović, dipl.ing.  
jovan.zlatanovic@etv.rs



### Simbolička šema obrade signala:



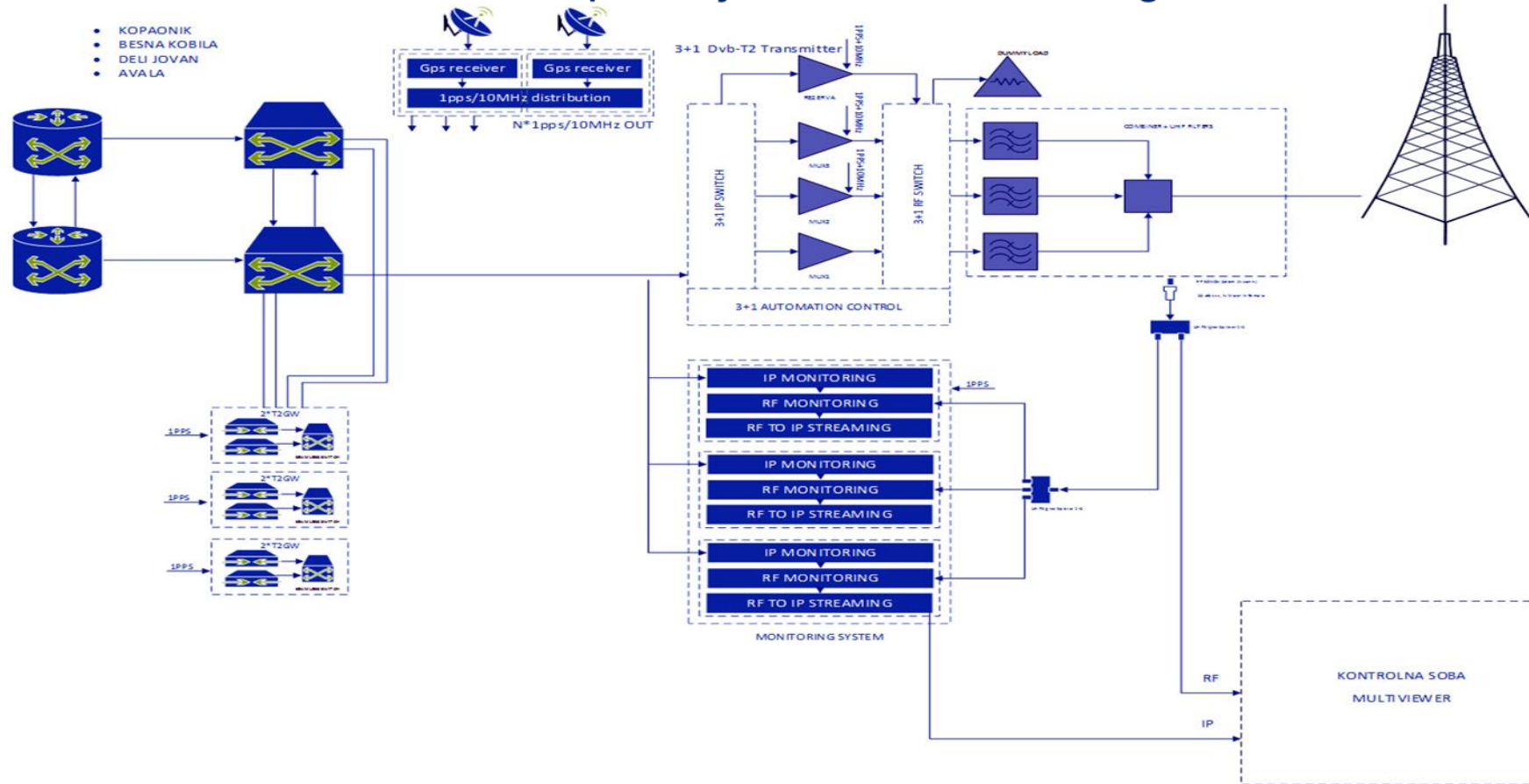
Primer konstelacija 16QAM  
16 stanja, 4 bita



Trenutno se u našoj mreži koristi 256QAM, koja ima 256 stanja, a svako stanje ima 8 bita



### - Emisione stanice sa predajnicima velikih snaga- blok šema:





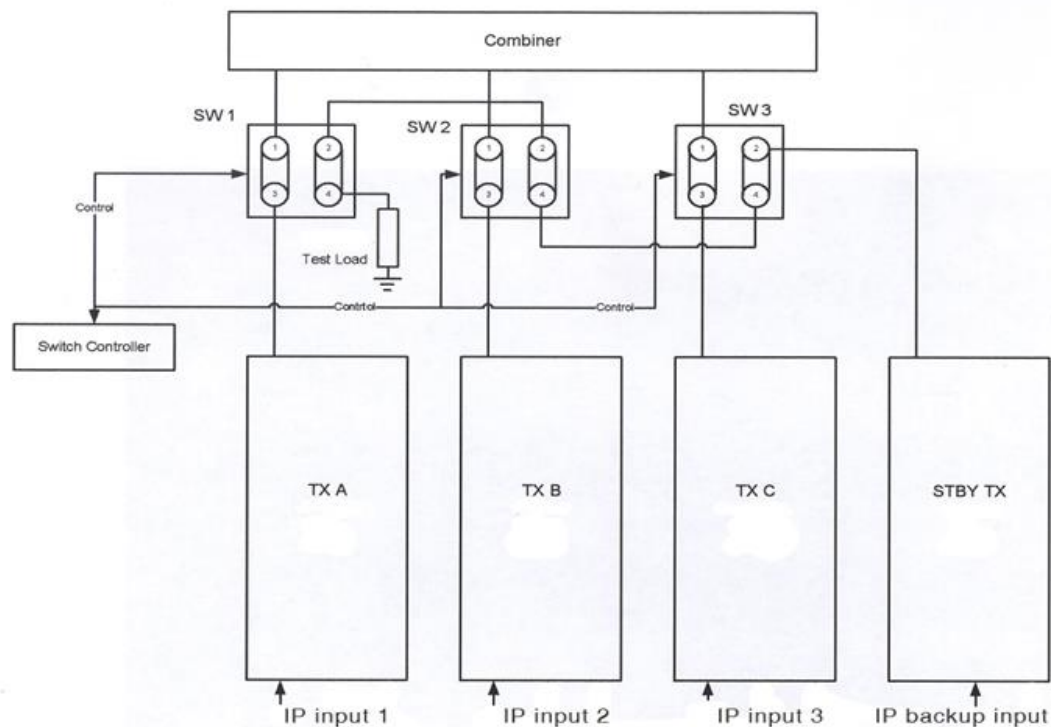
## Emisione stanice sa predajnicima velikih snaga- tehnološke celine:

- Energetska postrojenja:
  - dalekovodi
  - trafo stanice
  - agregati
  - UPS-evi
- Predajnici:
  - n+1 backup konfiguracija
  - visoka efikasnost (oko 35 %) - Doherty
  - COFDM modulacija
  - IP ulaz
- Kombajneri:
  - CIB kombajner (Constant Impedance Broadband)
  - Starpoint (manifold) kombajner
  - Stretch line (Phase Shift) kombajner
- Antenski sistemi:
  - Patch panel
  - Split antenski sistem



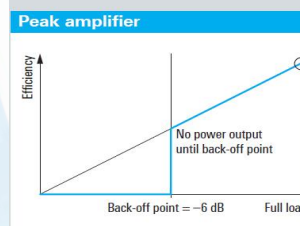
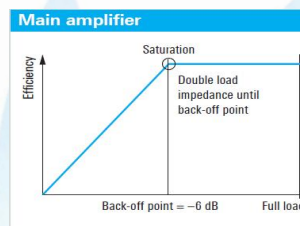
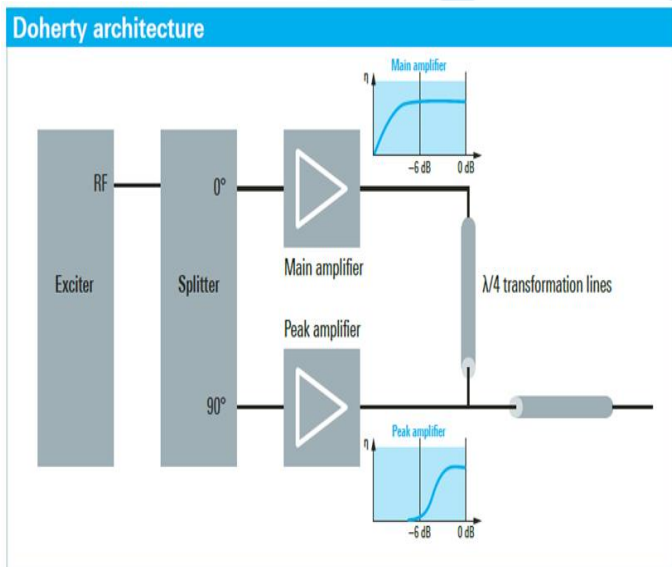


- Predajnici:  
- n+1 backup konfiguracija

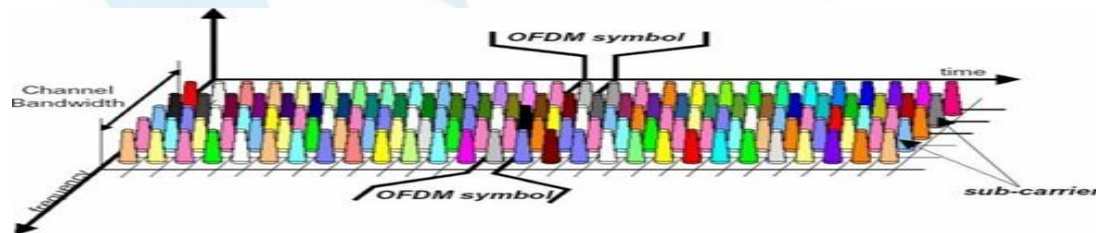




- Doherty sistem za povećanje efikasnosti izlaznih pojačavača snage predajnika:

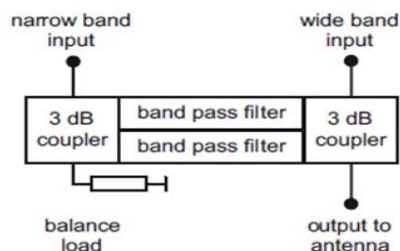


- COFDM modulacija (Coded Orthogonal Frequency Division Multiplexing)

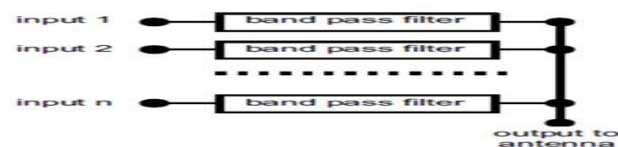




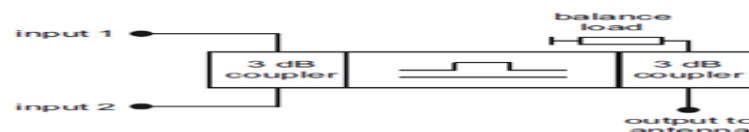
- Kombajneri: služe za povezivanje više predajnika na jedan emisijski sistem
  - CIB kombajner (Constant Impedance Balanced)



- Starpoint kombajner



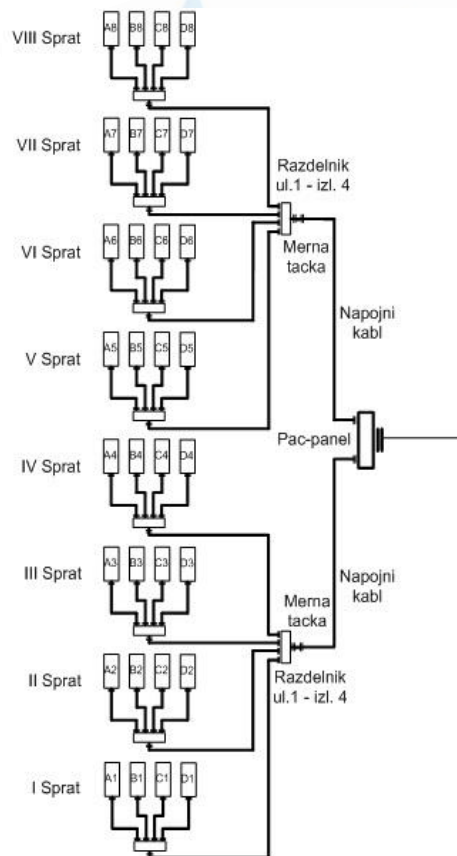
- Stretch line (Phase Shift) kombajner







- Antenski sistemi:
  - Patch panel
  - Split antenski sistem



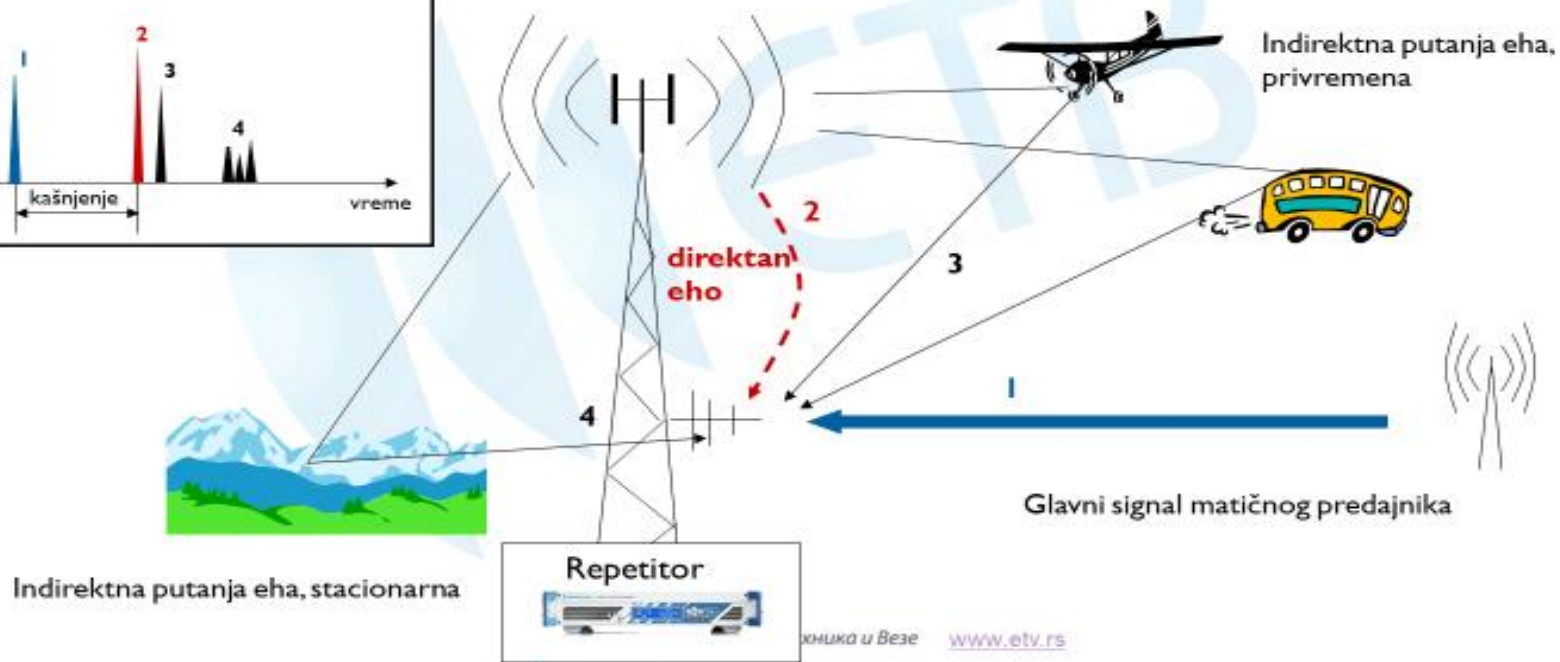
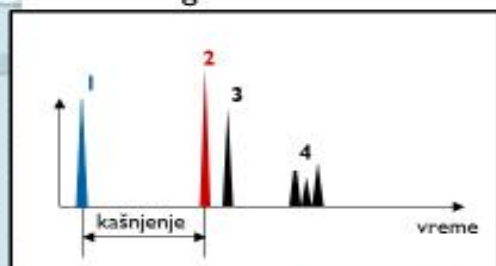




DVB-T2

- Problem realizacije SFN konfiguracije mreže kod Gap fillera:

Ulazni signal GF



Техника и Везе [www.etv.rs](http://www.etv.rs)



## SFN mreža

- Veličina zona emitovanja određena je parametrima mreže i to pre svega dužinom trajanja **zaštitnog intervala GI** koji u našoj mreže iznosi **1/16** trajanja upotrebljivog signala (3584  $\mu$ s) što iznosi **224  $\mu$ s**
- Imajući u vidu da je u SFN mreži zbog sinhronizacije rada predajnika i repetitora neophodno da u celoj zoni emitovanja razlika kašnjenja signala, u bilo kojoj tački pokrivenoj sa 2 ili više predajnika, ne bude veća od vremena trajanja zaštitnog intervala dobija se da maksimalno rastojanje između predajnika ne sme da bude veće od **67 km**. Svaki signal koji u tački prijema dolazi sa međusobnom razlikom u kašnjenju (relativno kašnjenje) većim od trajanja zaštitnog intervala predstavljaće ometajući signal korisnom i u zavisnosti od intenziteta unosiće manju ili veću degradaciju signala. U najgorem slučaju dovešće i do nemogućnosti dekodiranja odnosno nemogućnosti prijema signala
- Merenja u praksi pokazala su da je potrebno da ometajući signal na istom radnom kanalu i istog sadržaja, koji dolazi van zone GI bude bar **25 dB** nižeg nivoa od korisnog da ne bi unosio degradaciju kvaliteta signala



## SFN mreža

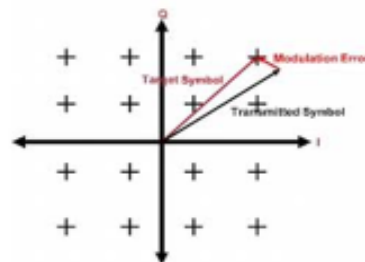
- Osnov za rad SFN mreže je kvalitetna sinhronizacija rada predajnika i repetitora. Za sinhronizaciju rada koristi se GPS signal (signal sa satelita radi u opsegu od **1,5 GHz**) odakle se dobijaju 3 bitna signala za sinhronizaciju:
  - **1PPS** ( **1-Pulse-Per-Second**) jedan impuls u sekundi za potrebe preciznog određivanja početka trajanja simbola. Vremenska preciznost je bolja od  $1\mu\text{s}$
  - **10MHz** referenca za precizno podešavanje frekvencije lokalnog oscilatora predajnika i repetitora. GPS antene se povezuju na GPS interni prijemnik unutar predajnika/repetitora ili na eksterni GPS prijemnik koji može dati reference za više uređaja. Ova referenca omogućava tačnost frekvencije predajnika/repetitora od 1Hz
  - **Datum i vreme**



## Kvalitet signala

- Parametri kvaliteta emitovanog signala su:
- MER - „Modulation Error Ratio“, greška u modulaciji koja ukazuje na odstupanje vektora modulisanog signala po amplitudi i fazi od zadate pozicije
- BER- „Bit Error Ratio“, bitska greška koja ukazuje na broj pogrešenih u odnosu na ukupan broj bita
- $BER = \frac{\text{Broj bita sa greškom}}{\text{Ukupan broj prenesenih bita}}$

$$MER(dB) = 10 \cdot \log \left[ \frac{\sum_{j=1}^N (I_j^2 + Q_j^2)}{\sum_{j=1}^N (\delta I_j^2 + \delta Q_j^2)} \right]$$







## DAB+ SISTEM ZA EMITOVANJE DIGITALNOG RADIJA

- ETSI EN 300 401 V2.1.1 Radio Broadcasting Systems; Digital Audio Broadcasting (DAB) to mobile, portable and fixed receivers
- ETSI TS 102 563 V2.1.1 DAB+ definiše metode za kodovanje audio servisa koristeći MPEG HE-AACv2.
- ETSI TS 300 799 uspostavlja metod za distribuciju DAB signala između multipleksera i modulacione opreme na lokaciji -ETI
- ETSI TS 102693 (I.25) definiše mehanizme između ostalog za enkapsulaciju ETI strima podataka za distribuciju preko IP mreže - EDI



Izlazna brzina odabiranja HE-AACv2= 16,24,32,48 kHz  
 Audio bit rates je max= 192kHz  
 Audio super frame= 120ms



Figure 1: Conceptual diagram of the outer coder and interleaver

## 5 Audio

### 5.1 HE-AACv2 audio coding

For generic audio coding, a subset of the MPEG-4 High Efficiency Advanced Audio Coding v2 (HE-AACv2) profile chosen to best suit the DAB system environment is used. The HE-AACv2 Profile, Level 2 according to [3] shall apply with the following additional restrictions for the DAB system:

- Sampling rate: permitted output sampling rate of the HE-AACv2 decoder are 32 kHz and 48 kHz, i.e. when SBR is enabled the AAC core shall be operated at 24 kHz or 34 kHz, respectively. If SBR is disabled then the AAC core shall be operated at 32 kHz or 48 kHz respectively.
- Transform length: the number of samples per channel per AU is 960. This is required to guarantee HE-AAC v2 lengths to allow the construction of an integer number of AUs to build an audio super frame of 120 ms duration.
- Audio bit rates are restricted to fit within a maximum sub-channel size of 192 kbps (approximately 175 Mbps for audio, assuming no FACH).
- Audio super framing: AUs are composed into audio super frames, which always correspond to 120 ms in time. The AUs in the audio super frames are encoded together such that each audio super frame is of constant length, i.e. that bit exchanges between AUs is only possible within an audio super frame. The number of AUs per super frame are: six (32 kHz AAC core sampling rate with SBR enabled), four (24 kHz AAC core sampling rate) or six (48 kHz AAC core sampling rate).

Each audio super frame is carried in five consecutive logical DAB frames (see clause 7) which require simple synchronization and management of received packets. The size of the audio super frame is defined by the size of the MSC sub-channel (see ETSI EN 300 401 [1], clause 6.2.1) which carries the audio super frame. Sub-channels are multiples of 4 kbps in size. The size of the audio super frame in bytes is given by the expressions below:

$$\text{subchannel\_index} = \text{MSC sub-channel size (kbps)} - 8$$

$$\text{audio\_super\_frame\_size (bytes)} = \text{subchannel\_index} + 119$$

The first byte of the audio super frame is byte 0 and the last byte is byte (audio\_super\_frame\_size - 1).

NOTE: The subchannel\_index parameter may take the values 1 to 24 due to the restriction limiting the maximum sub-channel size to 192 kbps.

AU sadrže audio odbirke.

$RS(120, 110, \tau=5)$   
 def. Kroz polinomijalne funkcije, polja Galoa  
 - 120 bytes dužine  
 - 10 bytes je super frame  
 - 10 bytes je parity bytes  
 - Do 5 bytes je odabranih se mogu korigovati

8.26 x 11.69 m

ETB



Super frame je sastavljen od AU UVELIČINI 120ms.  
AU su veličine 20,30,40 ili 60 ms u zavisnosti od brzine odabiranja.

AU po super  
frame:  
Za 16kHz je 2  
Za 24kHz je 3  
Za 32kHz je 4  
Za 48kHz je 6

### 5.2 Audio super framing syntax

Table 1: Syntax of the\_aac\_super\_frame()

Syntax	No. of bits	Note
the_aac_super_frame_header() <pre>                     the_aac_super_header()                     for (i = 0; i &lt; num_aac_aus; i++)                     {                     AAC_AU[i]                     }                     </pre>	$9 + \text{num\_aus} \times 10$	determines num_aac

NOTE: an aacsuperframe is one single access unit  
Each au is protected by a 16-bit CRC.  
The size of the aac\_super\_frame() is equal to aac\_super\_frame\_size.

#### the\_aac\_super\_frame\_header()

The header contains the audio parameters for the audio super frame and the respective start positions of each AU within the audio super frame, along with an error protection word. The au\_start values for the second and subsequent AUs are stored consecutively in the header. Depending on the number of AUs, 4 padding bits are added to achieve byte alignment.

#### num\_aac

The number of AUs in the audio super frame is determined by the settings of the audio parameters: num\_aac may take the values 2, 3, 4 or 6 (see table 2).

#### au[i]

The AU contains the audio samples for 20 ms, 30 ms, 40 ms or 60 ms of audio depending on the core sampling rate, respectively 48 kbit/s, 33 kbit/s, 24 kbit/s or 16 kbit/s.

#### au\_start[i]

This is the size in bytes of the AU.

#### au\_crc[i]

Each AU is protected by a 16-bit CRC.

The CRC shall be generated according to the procedure defined in ETSI IS130 410 [1], annex 3. The parameter shall be based on the polynomial

$$G(x) = x^8 + x^7 + x^6 + 1$$

The CRC word shall be complemented (1 is complement) prior to transmission. At the beginning of each CRC word calculation, all register stages shall be initialized to '1'.

Crc je  
polinomijalna  
funkcija



## STI :

1. STI-D , sadrži korisne podatke za emitovanje
2. STI-C , podatke potrebne za kontrolu i monitoring

EDI-def. Metod za distribuciju DAB+ signala ka predajnicima za rad u SFN

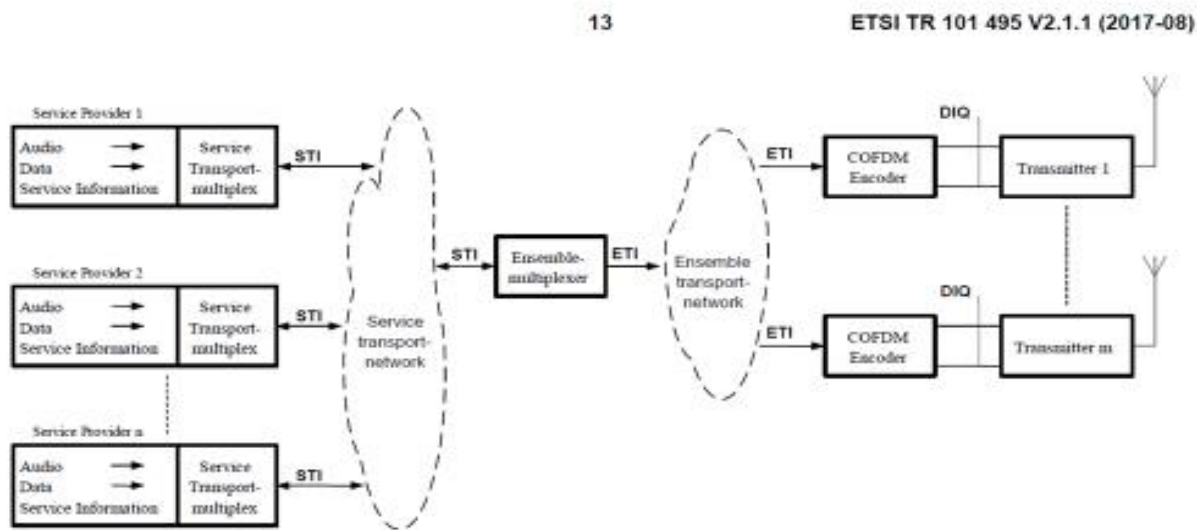


Figure 2: Conceptual DAB transmission network and related standards

ETI- definiše mehanizme za enkapsulaciju STI-D i ETI strimove podataka za distribuciju preko ip mreže. Koristi otvorene internet standarde: Unicast, multicast UDP/IP, TCP/IP...

## 6.2 Contribution networks - STI

ETSI EN 300 797 [i.11] provides a standardized way of transporting DAB service components, service information and control information in a DAB contribution network. The contribution network connects the studios of the various Service providers to the Ensemble provider's ensemble multiplexer.





## HE-AACV2 audio coding

- BRZINA ODABIRANJA 124kHz, kodna reč 16 bita  
2.048 Mbps
- BRZINA ODABIRANJA 192kHz, kodna reč 16 bita  
3.2Mbps
- Ovo su podaci WORLDCAST systema sa APT codecom
- 2WCOM nam daje izbor kodne reči 16. 20,24 bita, tj.  
rezoluciju dok je brzina odabiranja 0d 132kHz do  
192kHz, protoci od 2.2Mbps do 3.2 Mbps MM01 codec



Fully compliant with all the Eureka 147 family of standards (EN 300 401, TS 102 563, TS 102 427/428, TS 102 693, TS 300 799, TR 101 496 -1,-2,-3 Guide line...

MFN and SFN  
operation (NTP  
client included).  
Embedded GPS  
receiver on  
optional PCIe  
board.

### FLEXIDAB DAB/DAB+/DMB Multiplexing and Encoding Platform



#### Technical Specifications

##### Inputs / Outputs

- 1 x digital (optional) or RCA or 5 Pin D-sub connector or 4 analog (optional, 500k minimum) audio input via internal audio PCI board (hardware option)
- 4 x digital (optional, TBS) or 4x analog (optional, 500k) audio input via Termination BNC inputs via external audio panel (hardware option)
- 1 x Audio over IP input: SDP, SPD over network or MPEG TS over ethernet via LAN (optional)
- 1 x 6 x CD output, or inputs compliant with TS 102 553 on Gigabit Ethernet 10/100 Base T - RJ45 connector
- 1 x IP input for data services with interfaces to different play out systems, remote FTP access
- 1 x SDI or 1 x 1080i HD output (up to 4 levels on 400 pins, or 2 on 3 RJ45 ports, or 1 on 1 RJ45 port and MiniPCI)
- 1 x Up to 2 x (TBS/GT2) or (TBS/A204) inputs or outputs (programmable) on BNC (TBS)
- 1 x And/or with 1 x RF Board to (144000 kHz - 220000 kHz) output: 500mW (1-2 400mW output power)
- 1 x GPS serial input on an RS485-TNC connector

#### APPLICATIONS

- DAB/DAB+/DMB multiplexing and encoding in situ, in a central site or directly at the transmitter site
- Service Multiplex, Terrestrial Multiplex, Re-Multiplex, Audio Encoder, Data Encoder
- DMB Test transmission in field

#### KEY BENEFITS

- Field Proven Used in France, South Africa, UK, Hungary, Florida and Australia
- Extremely portable solution on different industrial PC (386,386, 486, Celeron) and virtual machine platforms
- Multi-encoding (audio/data) and multi-routing
- Perfectly optimized for IP based distribution and contribution network architecture and virtual machines
- Easy to use, user friendly GUI, straight forward architecture
- 1+1 hot redundancy (optional)
- SDI, STI and RF output possible
- SDI Redundancy Gateway Software
- Virtual Service Multiplex and User Right Management
- Push and Pull Data

#### Features

- Fully compliant with all the Eureka147 family of standards (EN 300 401/TS 102 563, TS 102 427/428, TS 102 553, TS 300 799, TR 101 496 -1,-2,-3 Guide Line...)
- Different industrial PC platforms on Windows 7 (optional: 486, 286, 186 or Mini-PC, Dual Auto-range Power Supply, 1600k Base Redundant System (for 286 and 486 Platform only)
- Multi-Multiplex and Multi-Encoder
- Virtual Service Multiplex with third party remote access and user right management
- MFN and SFN operation (NTP client included), Embedded GPS receiver on optional PCIe board
- 1+1 Hot Redundancy
- Option - IP Redundancy Gateway
- Dynamic Reconfiguration supported
- Audio encoder software options:
  - DAB Audio Encoders (based on MPEG-1 / 2 Audio Layer 10 24/48 kHz sample rates)
  - DAB+ Audio Encoders (based on MPEG-2 / 4 HE AAC 32/48kHz sample rates with SBR or PS)
  - DMB Audio Encoders (based on MPEG-2 / 4 HE AAC10/18/24 kHz sample rates with SBR or PS and low bit rate 896/34.3VC/4054)
  - BIFS insertion (only with DMB audio encoder)
- All audio encoders are delivered with DUC/A text message feature
- All audio encoders can be delivered with MPEG surround option
- Both encoder software options (PRG and NRNG):
  - News Service Journales
  - Broadcast Website
  - Slide Show
  - Electronic Program Guide
  - TRG
  - IP Tuning

DAB Audio Encoders (based on MPEG-1 / 2 Audio Layer 10 24/48 kHz sample rates)

- DAB+ Audio Encoders (based on MPEG-2 / 4 HE AAC) 32/48kHz sample rates with SBR or PS
- DMB Audio Encoders (based on MPEG-2 / 4 HE AAC) 32/48kHz sample rates with SBR or PS and low bit rate MPEG4 AVC H264
- BIFS insertion (only with DMB audio encoder)

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Specifications subject to change without prior notice

# DBBT

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Co-funded by the  
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Godina 2017: Ovo je naš predajnik  
10kW VHF, koji će nadogradnjom  
emitovati DAB+ digitalni radio!

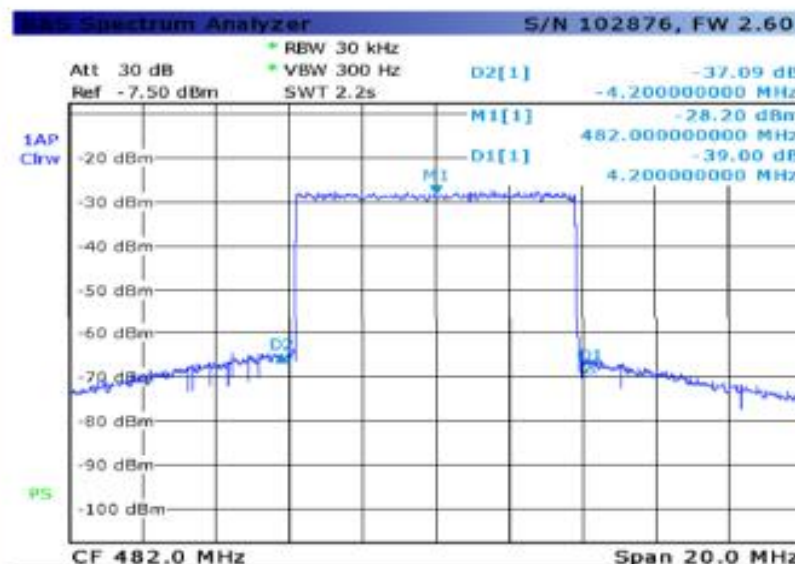
Posedujemo 6 predajnika serije  
7000 R&S koji će emitovati  
DAB+ digitalni radio

KAKO JE TO  
MOGUĆE?

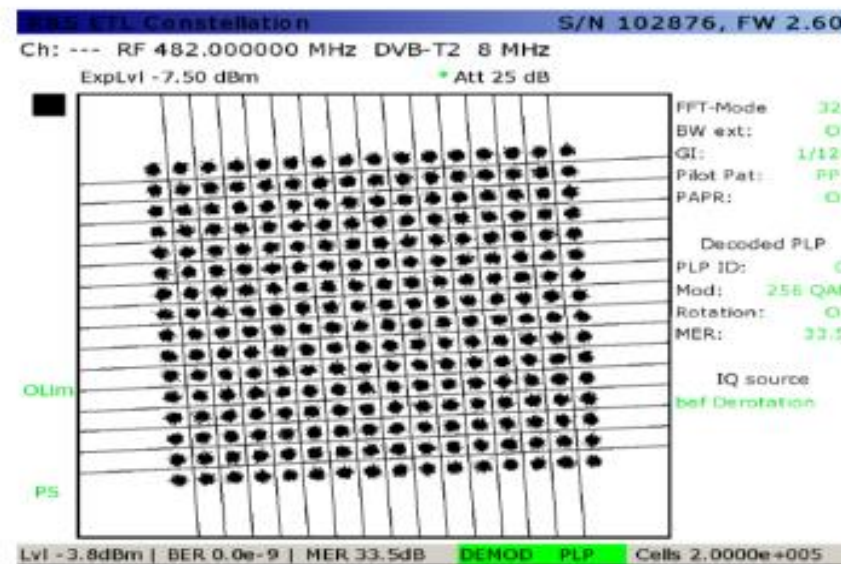




### A on će nam omogućiti: da dobijemo predajnik koji emituje DAB+ digitalni radio



Date: 18.DEC.2013 10:24:55



Date: 18.DEC.2013 10:31:38



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Broadband Technologies

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