DMR

DIGITAL MOBILE RADIO ASSOCIATION

How DMR Works, Benefits

Part 1

Alessandro Guido
DMR System Design
Selex Elsag

Summary

- DMR Requirements
- DMR Tiering and ETSI DMR Standard Parts
- DMR Technology Overview
- DMR Tier II Features
- Benefits of DMR

DMR Requirements

Main requirements for a new ETSI PMR/LMR standard

- Higher traffic capacity
- Higher spectral efficiency
- Access to digital features for improved functionalities
- Improved security
- Smooth migration from analog systems with the existing spectrum organisation and licensing
- Improved voice quality
- Longer battery duration
- Low cost, low complexity
- Open standard
- Conventional, trunking, simulcast

Summary

- DMR Requirements
- **DMR Tiering and ETSI DMR Standard Parts**
- DMR Technology Overview
- DMR Tier II Features
- Benefits of DMR

DMR Tiering and ETSI DMR Standard Parts

There are three Tiers in the DMR standard

DMR Tier I: Unlicensed

- Products for license-free use in the 446 MHz band.

DMR Tier II: Conventional

- Licensed conventional radio systems, mobiles and hand portables operating in PMR frequency bands 30 to 1000 MHz. The ETSI DMR Tier II standard is targeted at users who need spectral efficiency, advanced voice features and integrated IP data services in licensed bands.

DMR Tier III: Trunked

- Trunking operation in frequency bands 30 to 1000 MHz. The ETSI Tier III standard supports voice and short messaging handling similar to MPT 1327.

DMR Tiering and ETSI DMR Standard Parts

Standard Parts

- ETSI TS 102 361-1 DMR Air Interface Protocol
- ETSI TS 102 361-2 DMR Voice and Generic Services
- ETSI TS 102 361-3 DMR Data Protocol
- ETSI TS 102 361-4 DMR Trunking Protocol

- ETSI TR 102 398 DMR General System Design

ETSI World Class Standards

DMR Tiering and ETSI DMR Standard Parts

Status of the parts of the standard

- ETSI TS 102 361-1 *Published April 2005*

  Latest V1.4.5 Dec 2007

- ETSI TS 102 361-2 *Published April 2005*

  Latest V1.2.6 Dec 2007

- ETSI TS 102 361-3 *Published Jan 2006*

  Latest V1.1.7 Dec 2007

- ETSI TS 102 361-4 *Published Jan 2006*

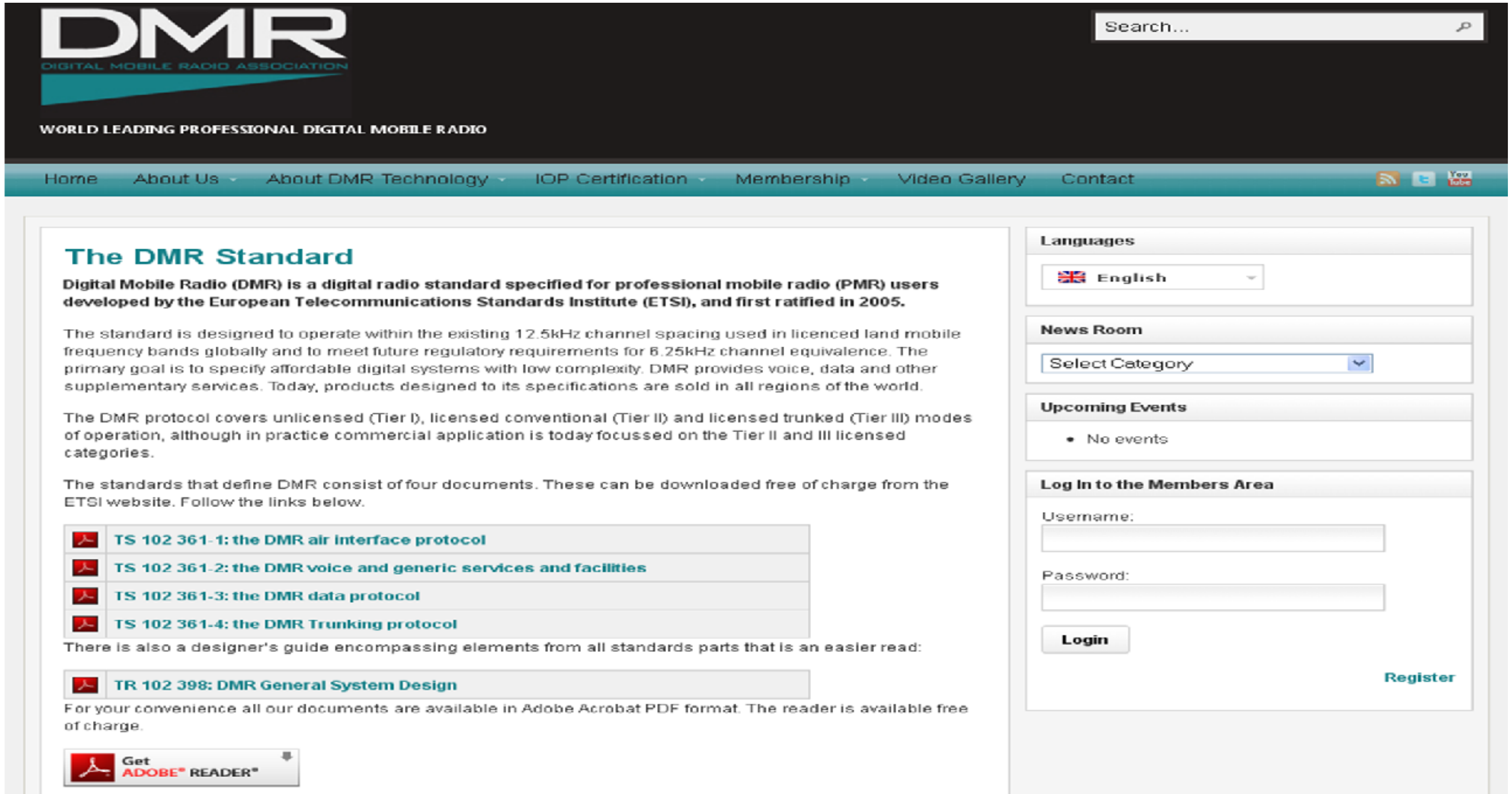
  Latest V1.4.1 Jan 2012

- ETSI TR 102 398 *Published May 2006*

  Latest V1.2.1 Feb2011

DMR Tiering and ETSI DMR Standard Parts

All DMR standards are available on the DMR Associations website http://dmrassociation.org/



DMR
DIGITAL MOBILE RADIO ASSOCIATION
WORLD LEADING PROFESSIONAL DIGITAL MOBILE RADIO

Search...

Home | About Us | About DMR Technology | IOP Certification | Membership | Video Gallery | Contact

The DMR Standard

Digital Mobile Radio (DMR) is a digital radio standard specified for professional mobile radio (PMR) users developed by the European Telecommunications Standards Institute (ETSI), and first ratified in 2005.

The standard is designed to operate within the existing 12.5kHz channel spacing used in licenced land mobile frequency bands globally and to meet future regulatory requirements for 6.25kHz channel equivalence. The primary goal is to specify affordable digital systems with low complexity. DMR provides voice, data and other supplementary services. Today, products designed to its specifications are sold in all regions of the world.

The DMR protocol covers unlicensed (Tier I), licensed conventional (Tier II) and licensed trunked (Tier III) modes of operation, although in practice commercial application is today focussed on the Tier II and III licensed categories.

The standards that define DMR consist of four documents. These can be downloaded free of charge from the ETSI website. Follow the links below.

- TS 102 361-1: the DMR air interface protocol
- TS 102 361-2: the DMR voice and generic services and facilities
- TS 102 361-3: the DMR data protocol
- TS 102 361-4: the DMR Trunking protocol

There is also a designer's guide encompassing elements from all standards parts that is an easier read:

- TR 102 398: DMR General System Design

For your convenience all our documents are available in Adobe Acrobat PDF format. The reader is available free of charge.

Get ADOBE® READER®

Languages

English

News Room

Select Category

Upcoming Events

- No events

Log In to the Members Area

Username:

Password:

Login

Register

Summary

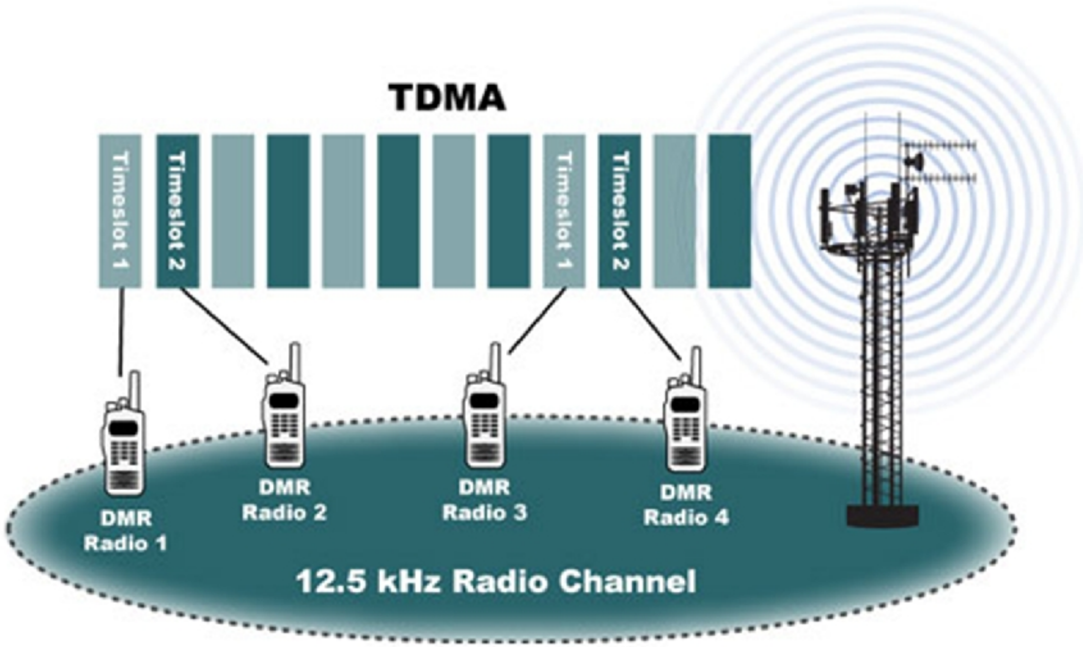
- DMR Requirements
- DMR Tiering and ETSI DMR Standard Parts
- **DMR Technology Overview**
- DMR Tier II Features
- Benefits of DMR

DMR Technology Overview

DMR Main Characteristics

- 12,5 kHz channel
- 9,6 kbps gross bit rate
- 4-FSK modulation (constant envelope)
- 2-slot TDMA channel
- Built around a 30 ms slot structure
- 50% duty cycle slot structure allows forward and reverse transmission on a time division basis
- Transmission can be used either for voice, data or generic signalling
- Frequency bands 30 to 1000 MHz

DMR 2-slot TDMA channel



DMR Technology Overview

Slotted structure provides the opportunity for:

- possibility of two calls on the same radio channel
- permits units to receive signals even while user is talking, e.g. to interrupt the talkers' transmission
- battery-save options
- 6,25 kHz channel equivalence without the need to split the channel in the frequency domain

Both inbound slots used for transmission if desired.

This allows a very wide range of applications to be supported.

DMR Technology Overview

Vocoder

- The protocol was designed to be independent of choice of vocoder
- However, DVSI AMBE+2™ vocoder was adopted by the DMR MoU (now DMRA) in 2006 as a common vocoder for interoperability. This decision does not affect the operation of the protocol
- DVSI AMBE+2™ is based on Multi-Band Excitation (MBE), i.e. a frequency-domain approach
- Main charracteristics are:
  - very low bit rate 2450 bps (voice) + 1150 bps (FEC) = 3600 bps
  - very high voice quality at very low bit rate
  - rubust to strong background noise and to PMR/LMR channel
  - moderate complexity, easy to implement on a low-cost DSP
  - language independent
  - proven technology MBE family was adopted by TIA for P25 and in many radiomobile satellite standards
  - 20 ms voice frame and FEC optimised for PMR/LMR applicaitons
  - soft bits based decoding

Summary

- DMR Requirements
- DMR Tiering and ETSI DMR Standard Parts
- DMR Technology Overview
- **DMR Tier II Features**
- Benefits of DMR

DMR Tier II Features

ETSI-defined DMR Tier II voice and generic Features

- Group call
- PATCS (Press And Talk Call Setup) individual call
- OACSU (Off Air Call Set Up) individual call
- All call (one-way call to all MS's of a timeslot)
- Broadcast call (one-way call to a predefined set of MS's)
- Unaddressed call (to permit different MS's behaviours)
- OVCM (Open Voice Channel Mode) call (to permit to involve also MS's not target of the call)
- Priority and emergency call
- With BS / network of BS's and in Direct Mode
- BS activation
- Feature not supported
- Late entry
- Polite / Impolite channel access
- Colour Code to manage channel access

DMR Tier II Features

ETSI-defined DMR data and added value Tier II features

- IP over DMR
- Short Data (Status / Pre-coded, Raw Data, Defined Data)
- Protected data with ½ rate, ¾ rate and rate 1 (unprotected) Forward Error Correction (FEC) acknowledged and unacknowledged
- Individual / group
- With BS / network of BS's and in Direct Mode
- Possibility of implementing specific encryption algorithms
- Flexibility to introduce new and/or proprietary features

DMR Tier II Features

DMRA-defined Tier II features

- Radio check (to verify if a MS in switched on, in working order and under coverage)
- Call alert
- MS disable
- MS enable
- Remote monitor (activates transmission of a MS without giving notice to the MS user)
- Emergency alarm
- Emergency call
- With BS / network of BS's and in Direct Mode

Summary

- DMR Requirements
- DMR Tiering and ETSI DMR Standard Parts
- DMR Technology
- DMR Tier II Features
- **Benefits of DMR**

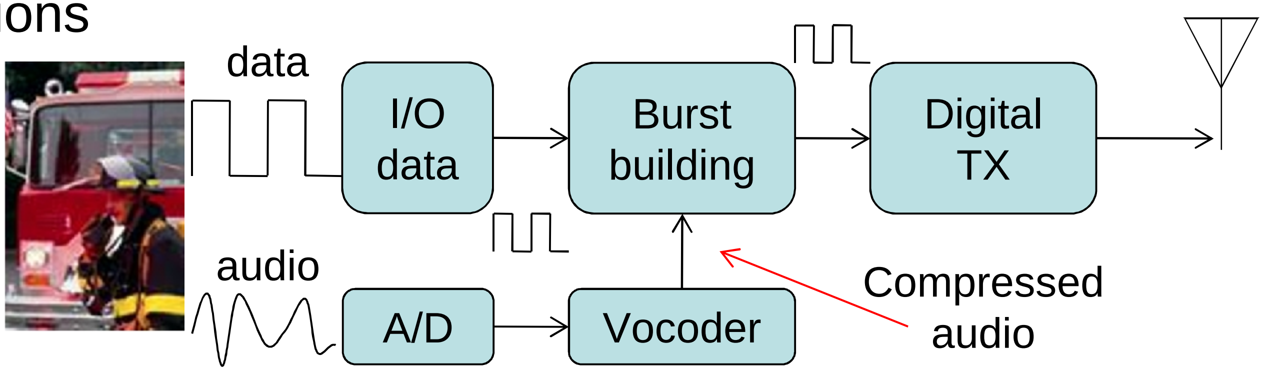
Benefits of DMR

- Benefits of digital communications
- Smooth migration from analog
- TDMA communications
- Constant envelope modulation
- Flexibility and simplicity
- Open world-wide standard
- Cost effectiveness
- Infrastructure flexibility

Benefits of DMR

Benefits of digital communications

- Audio and data communications on the same equipment: no external modem needed, efficient text messaging service
- Flexibility in communication management: individual, group, all and emergency call
- Communications security without degrading voice quality: easy to encrypt, both voice and data
- Fleet management and communication traceability: caller/callee identification
- A variety of additional features can be implemented by manufactures and application partners: IP based data capability, short message based applications



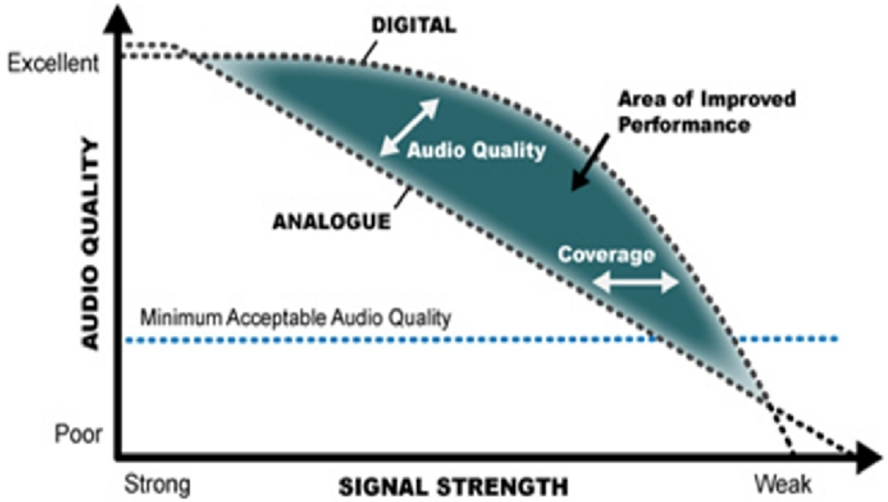
Benefits of DMR

… and common limits of digital vs analog

•The vocoded audio quality sounds different from analog: digital does not mean “CD” quality

• Increased audio delay: some care is needed in delay sensitive applications like phone bridging

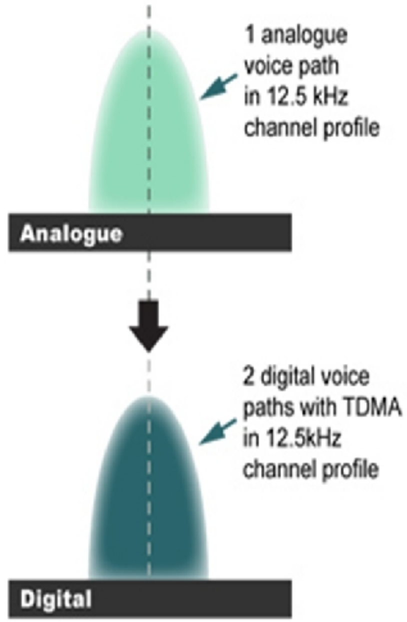
• Abrupt on/off of communication instead of smooth degradation at the fringes of coverage area

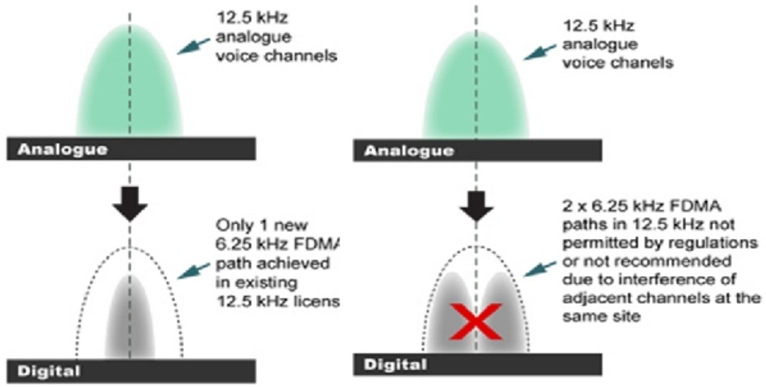


Benefits of DMR

Smooth migration from analog

- Predictable doubling of capacity in existing 12,5 kHz licensed channels
- Backwards spectrum compatibility with 12,5 KHz analogue systems
- Ideal for migration, conventional and trunked
- Licensing straight forward, no added complexity
- Excellent for incorporating data applications to existing systems
- Digital migration to 6,25 kHz FDMA is much more complex and expensive

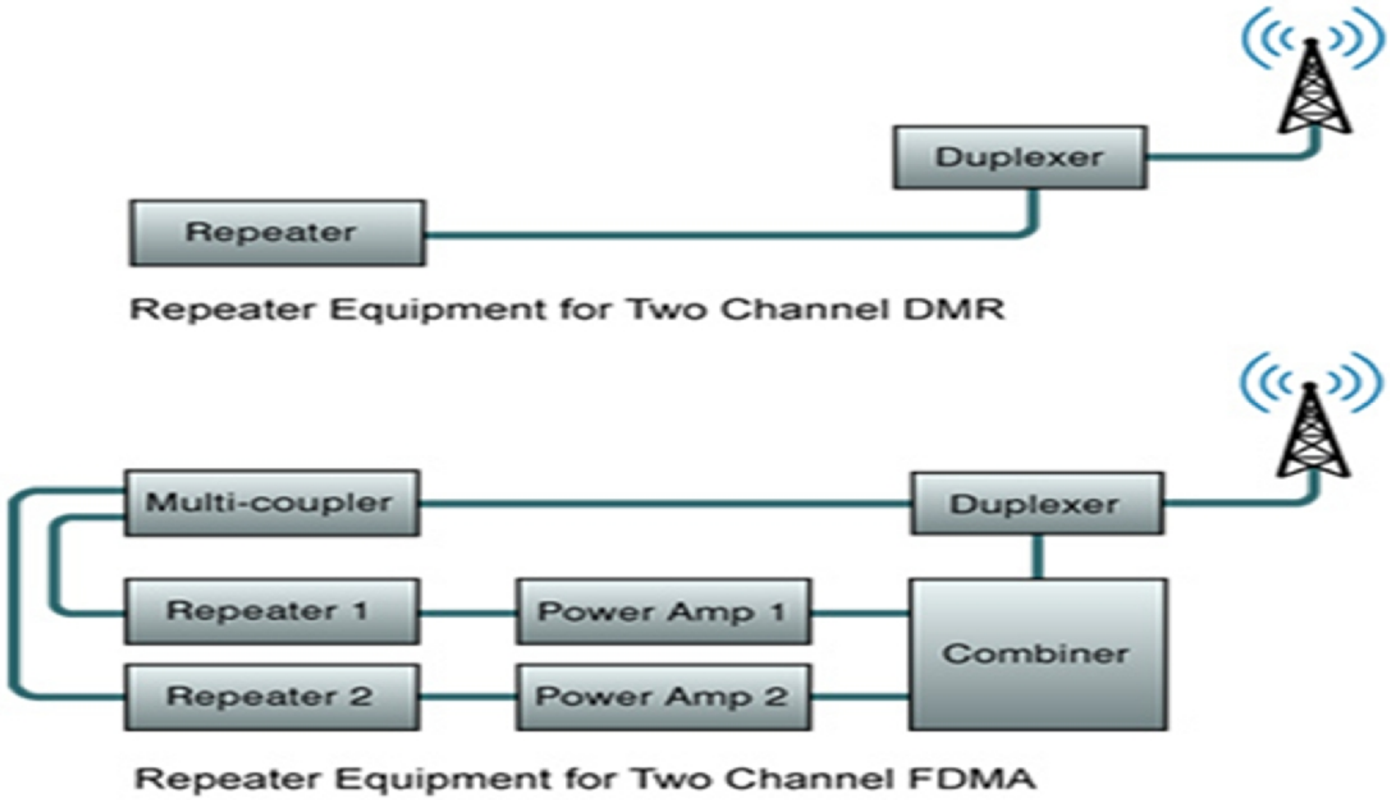




Benefits of DMR

Smooth migration from analog

Efficient and simple use of infrastructure equipment
saving money, power, space, work and maintenance



Benefits of DMR

Smooth migration from analog

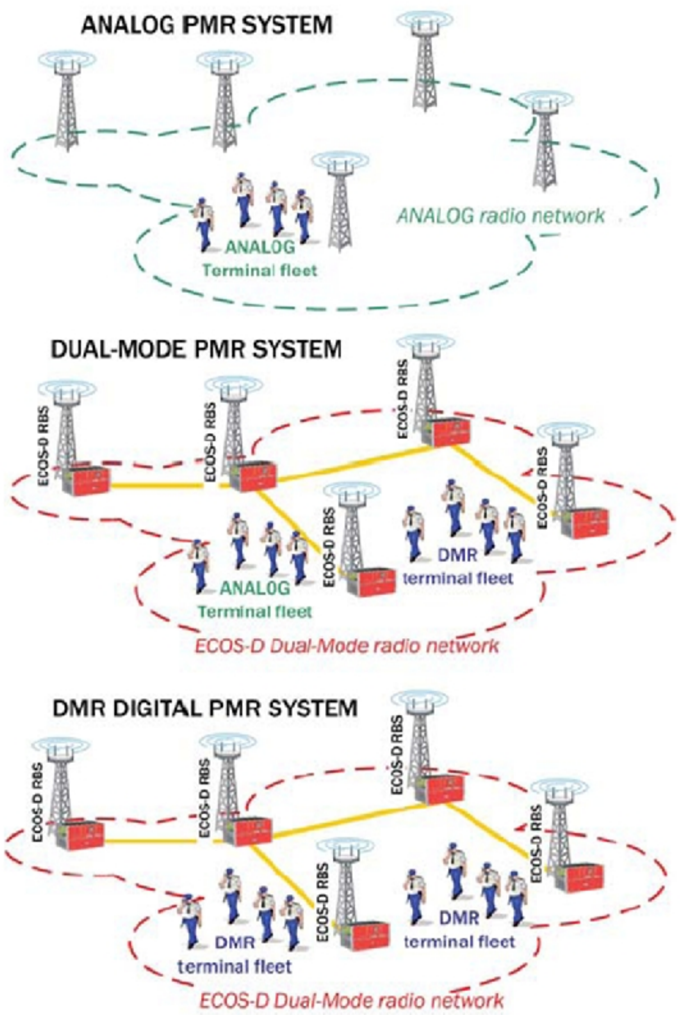
- Subscriber-based Migration:
  - Dual-Mode Radios
  - Analog/Digital Scanning
- Infrastructure-based Migration:
  - Dual-Mode Radio Base Stations
  - Automatic Dual-Mode/Mixed-Mode Radio Base Stations

Benefits of DMR

Smooth migration from analog

- Re-use of allocated licensed channels
- FCC part 90 compliant
  (6,25 kHz equivalent in 12,5 kHz channel spacing)
- Re-use of infrastructures like installation sites, antennas, power sources
- Link budget (RF propagation and coverage) is very similar to current analogue systems

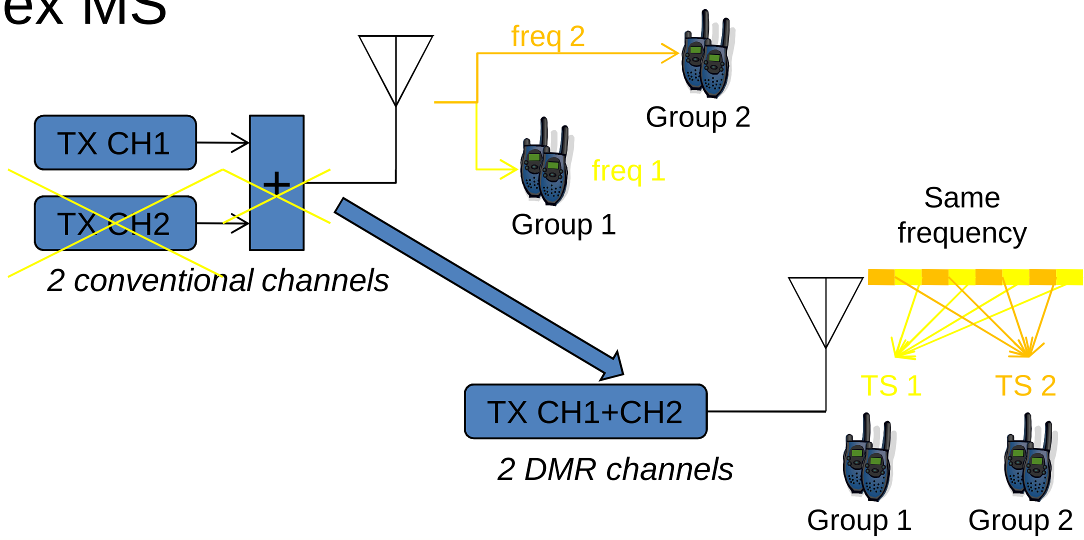
DMR delivers
backwards spectrum compatibility
with legacy analogue systems



Benefits of DMR

TDMA communications

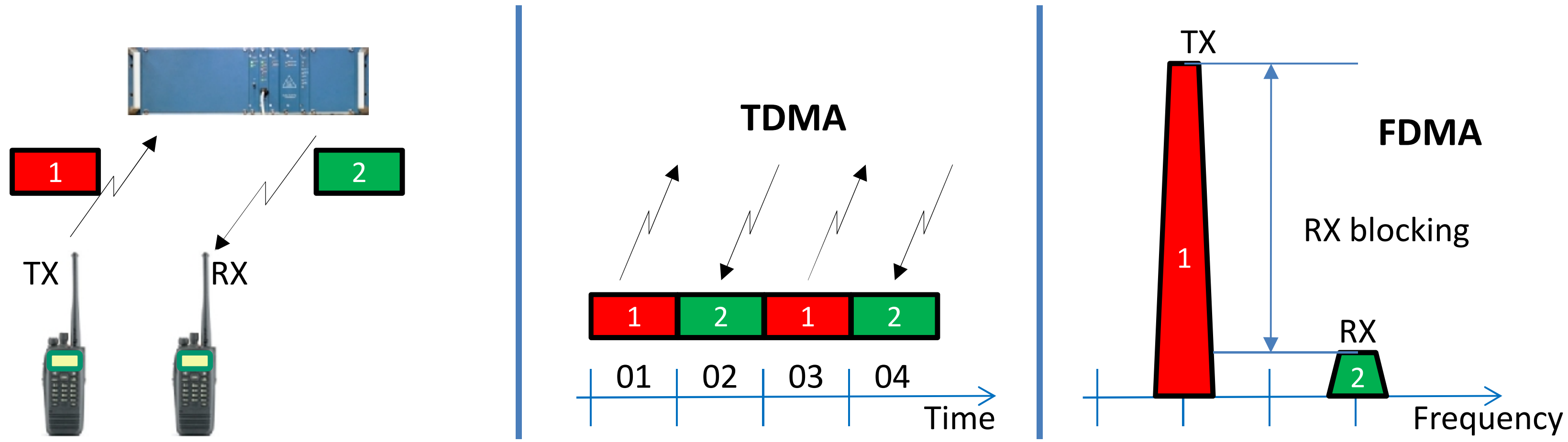
- Lower branching costs
- Data and voice at the same time
- Variable communication bandwidth using one or both timeslots
- Same coverage of analog but transmission reduced in time by 50% => increase in battery life
- Time division duplex communications: no need of duplexer on future duplex MS



Benefits of DMR

TDMA communications

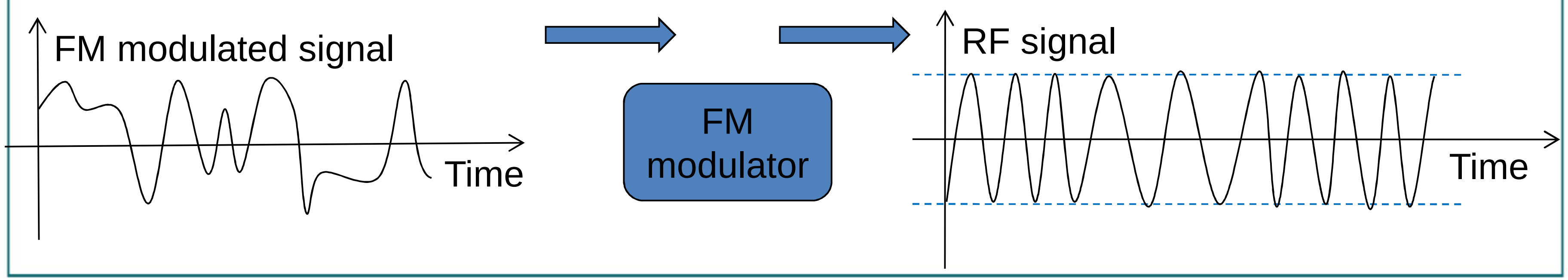
- No blocking effect TX/RX (near-far problem)
- Complete “adjacent” channel isolation (between timeslots)
- Less sensitive to frequency stability (XTAL reference and filters) with respect to FDMA
- More robust to adjacent carrier interference



Benefits of DMR

Constant envelope modulation

- Transmitters can implement class C or higher: low cost realization, low power consumption and low heat to dissipate
- Solar panel ready due to high amplifier efficiency
- Modulation compatible with COTS external RF power amplifier (repeater only)
- Easy reuse of analog RF test instruments



Benefits of DMR

Flexibility and simplicity

- A lot of network configurations available from a single repeater to several connected base stations
- Able to realize the same structures of most existing two-way radio systems
- No need of new coverage design (it's the same as for existing analog)
- No special "digital" skill required (same concepts of analog)
- Easy system start-up and tuning using well known analog communications tools

Benefits of DMR

Open world-wide standard

- Large and increasing number of radio manufacturers, application developers, system integrators, test equipment manufacturers, test houses, users, regulators and operators: real multi-vendor environment
- Latest digital radio technology (2005 ETSI standardized, 2012 last update)
- Interoperability between different radio manufacturers for Tier II:

MOTOROLA

Vertex Standard

Hytera
Respond & Achieve

Radio Activity
Solutions

SELEX ELSAG
Secure Networking Solutions
A Finmeccanica Company

Benefits of DMR

Open world-wide standard

Mission Critical	**APCO-25** FDMA & TDMA Standards Based, Phases I & II	**TETRA** 25KHz TDMA ETSI standard ETSI World Class Standards	**Tetrapol** 12.5KHz FDMA Publically Available Specification
Operation Critical	**DMR** 12.5KHz TDMA ETSI standard	**dPMR** 6.25KHz FDMA ETSI standard	**NXDN™** 6.25KHz FDMA Proprietary protocol, application for license

ETSI World Class Standards

Benefits of DMR

Cost effectiveness

- Low and progressive migration costs (large re-use of the existing infrastructure)
- Cost reduction due to the large standardization
- 2 channels at the same price level of 1 analog only
- Exceptional cost/performances ratio for the feature set offered

Why to pay more for your needs?

Benefits of DMR

Infrastructure flexibility

- Single-site single carrier conventional
- Single-site multi-carrier trunking
- Multi-site simulcast conventional
- Multi-site trunking
- Multi-site simulcast trunking

Thank you for your time and attention!

Any questions?

More information on DMR technology available in Appendix to this presentation

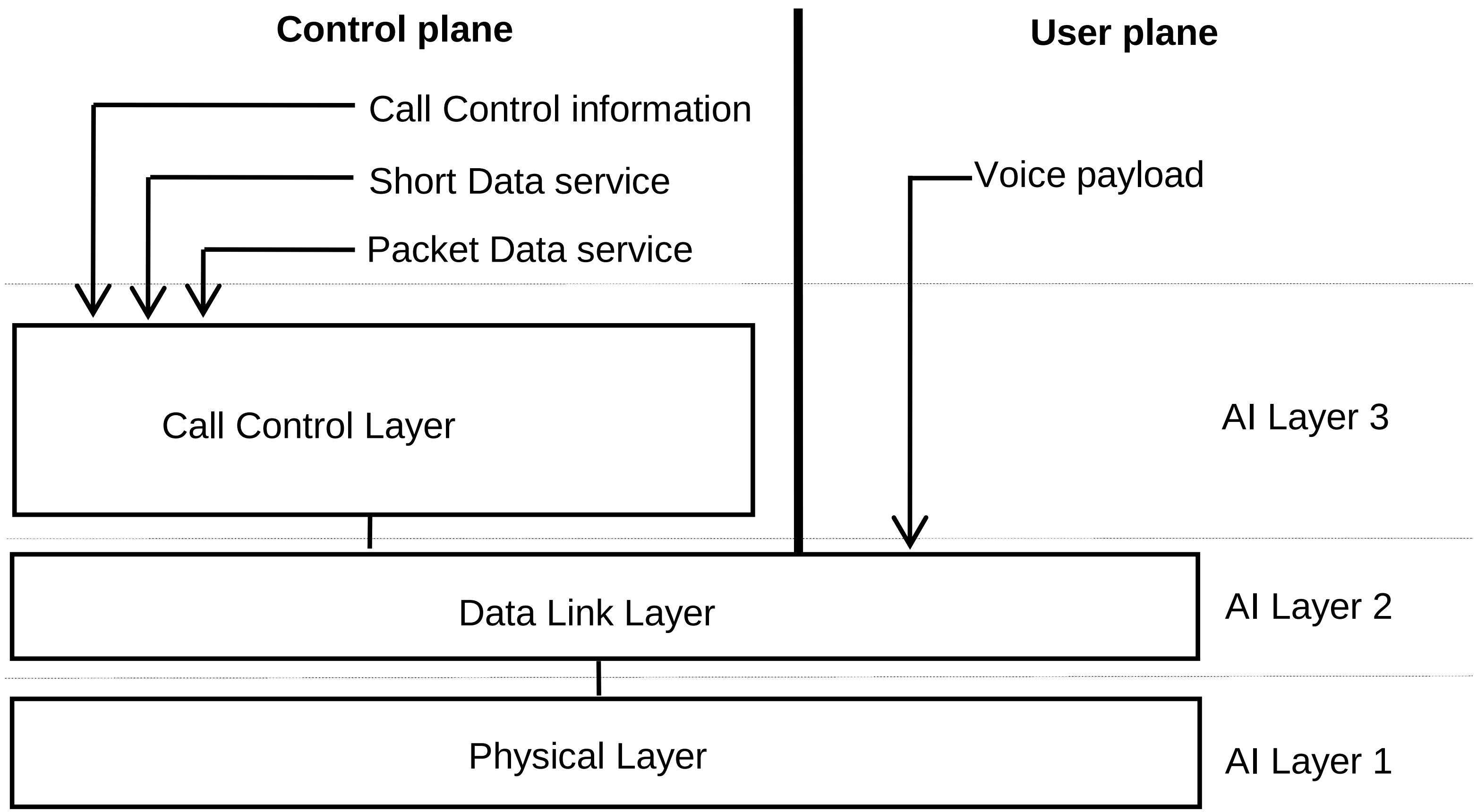
How DMR Works, Benefits

Part 1 - Appendix on DMR Technology

Alessandro Guido
DMR System Design
Selex Elsag

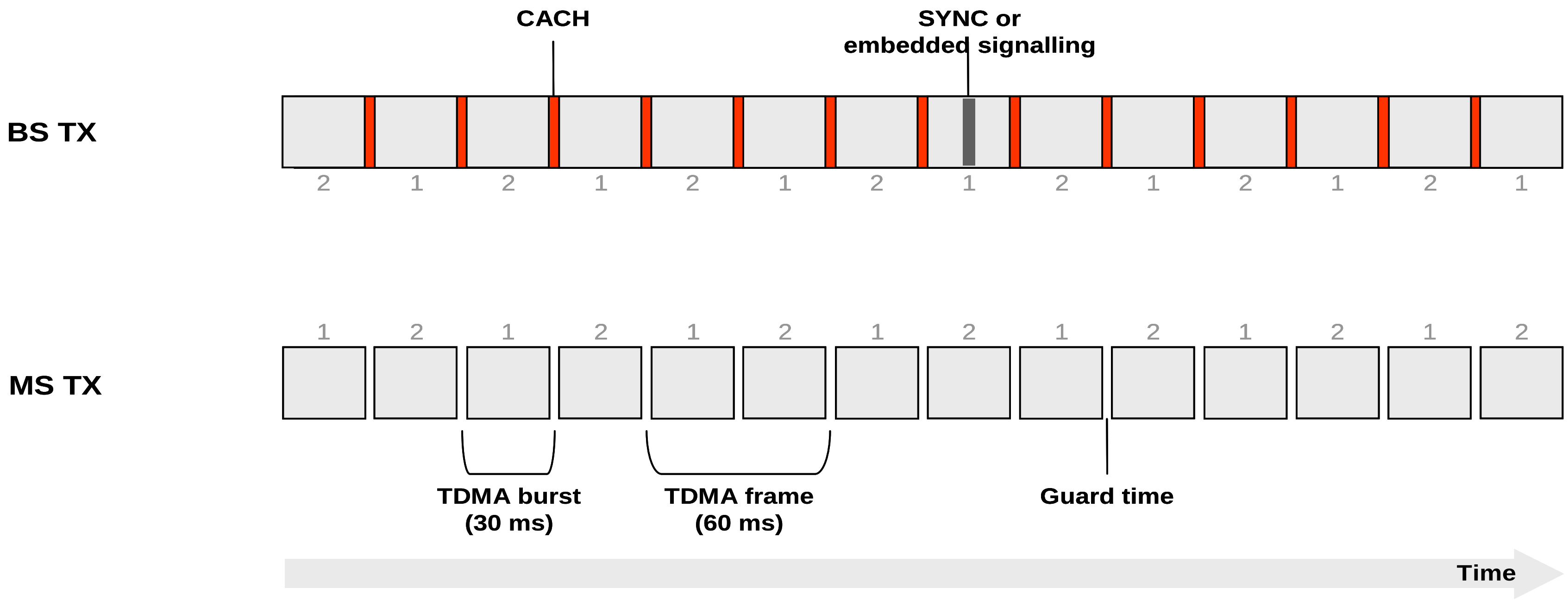
DMR Technology

DMR ISO/OSI Layering



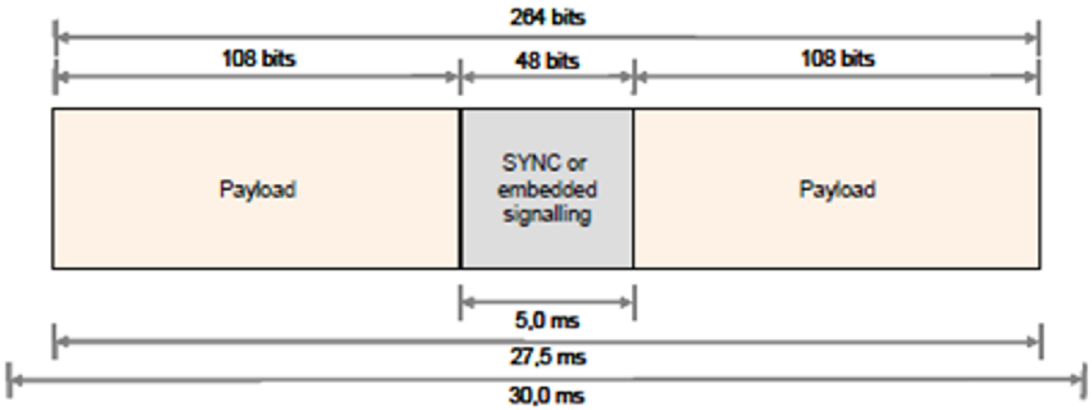
DMR Technology

The protocol calls for means to synchronize the transmitter and the receiver at each end of the conversation such that one always receives at time when the other is permitted to transmit:



DMR Technology

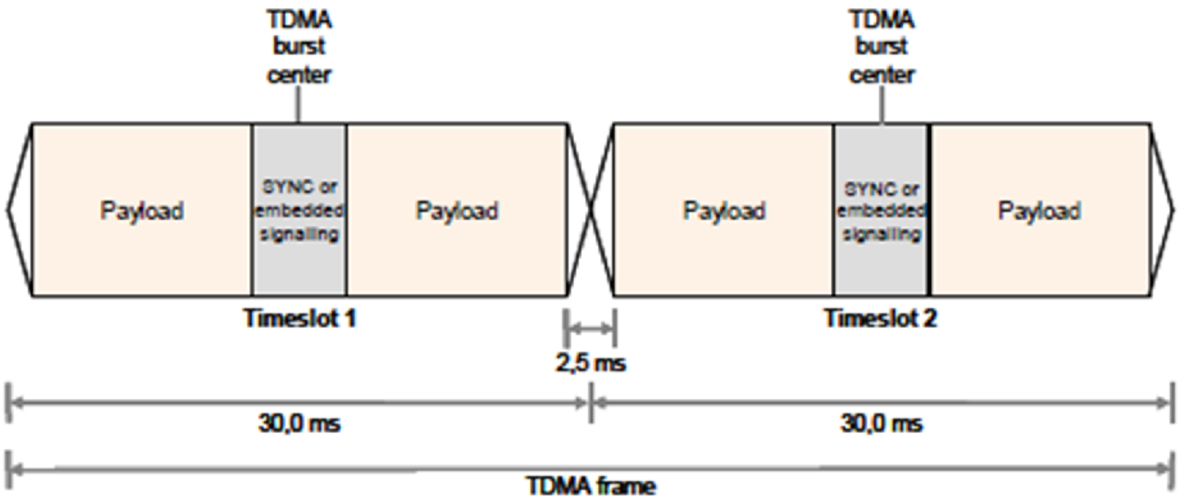
The generic burst structure consists of two 108-bit payload fields and a 48-bit synchronization or signalling field. Each burst has a total length of 30 ms but 27,5 ms are used for the 264 bits content, which is sufficient to carry 60 ms of compressed speech, using 216 bits payload.



DMR Technology

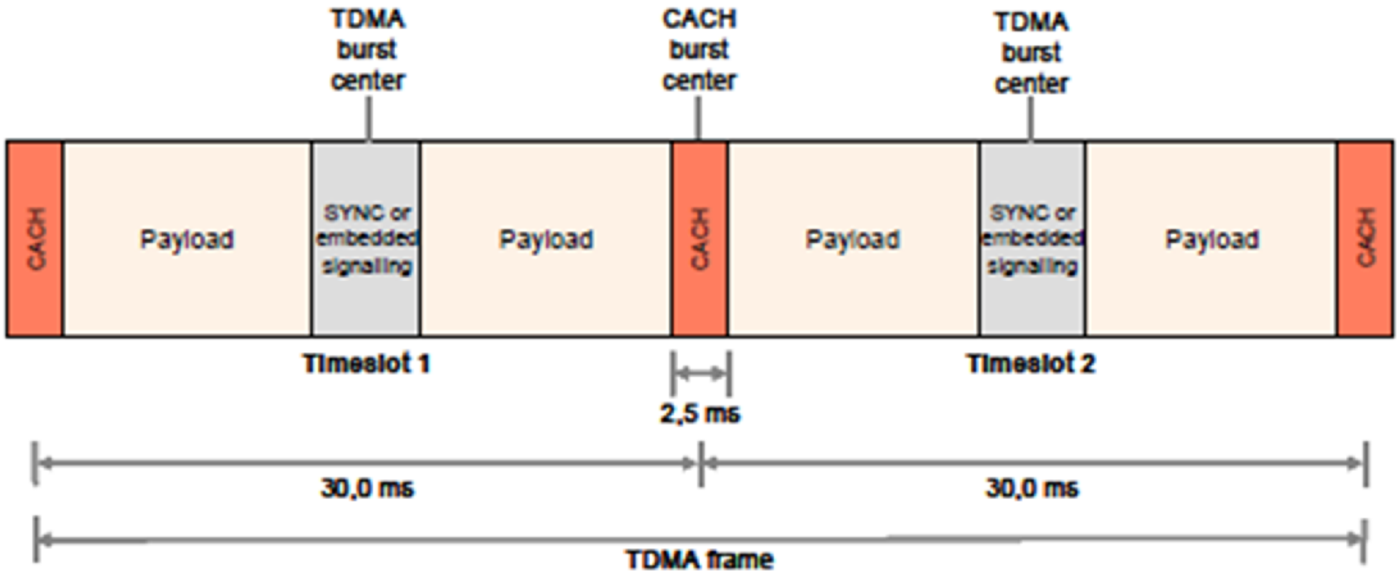
The centre of each burst has a field that carries either synchronization or embedded signalling. This field is placed in the middle of a burst to support Reverse Channel signalling.

On the inbound channel, the remaining 2,5 ms is used to allow for PA ramping and as guard time for propagation delay and oscillators inaccuracies.



DMR Technology

On the outbound channel, this 2,5 ms is used for a Common Announcement Channel (CACH) that carries TDMA frame numbering, channel access indicators, and low speed signalling for an outbound frame



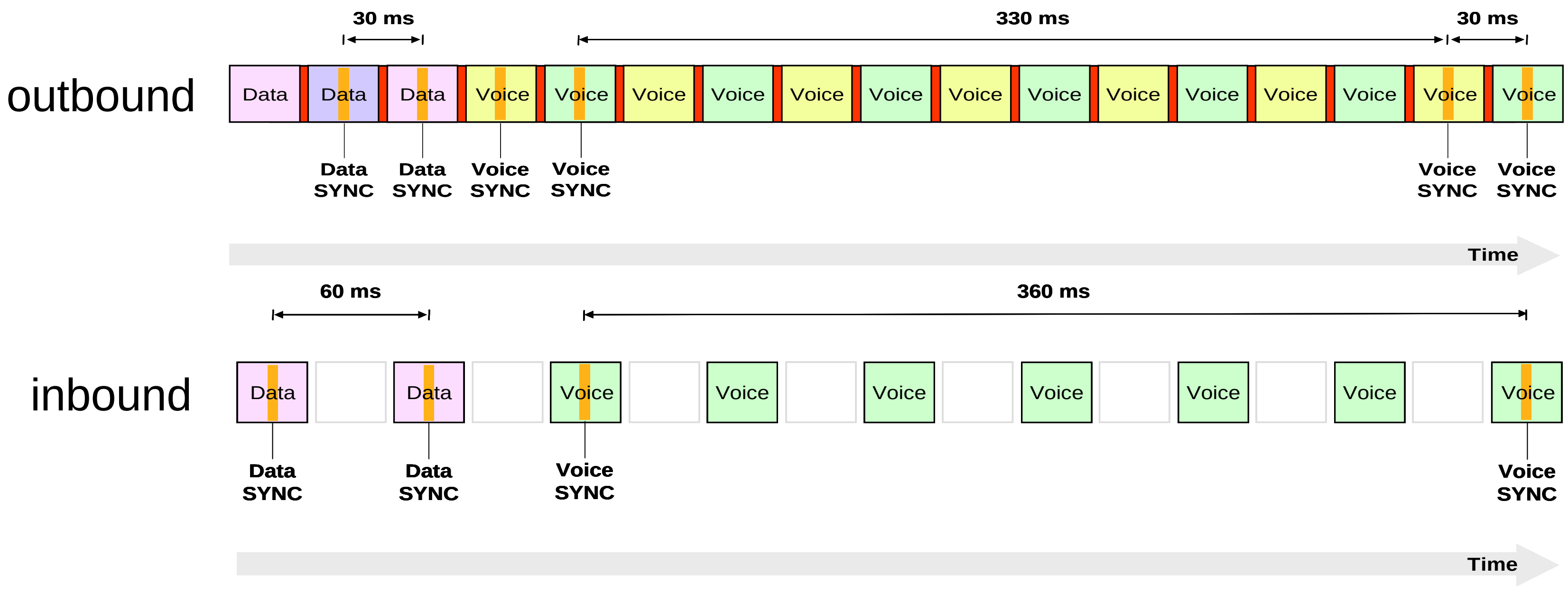
DMR Technology

- Multiple SYNC patterns are used to:
  - differentiate voice bursts from data/control bursts and from Reverse Channel bursts; and
  - differentiate inbound channels from outbound channels.

- To accomplish this, the following SYNC patterns have been defined:
  - BS sourced voice;
  - BS sourced data;
  - MS sourced voice;
  - MS sourced data;
  - MS sourced standalone Reverse Channel.

DMR Technology

SYNC opportunities can occur as frequently as every 60 ms. During a voice call, SYNC opportunities occur every 360 ms, the length of a voice superframe. The first burst of every inbound transmission contains a SYNC pattern in order to allow the target to detect and synchronize to the transmission.



DMR Technology

Repeater mode timing relationship

- When operating with a BS, an MS will synchronize to an outbound channel and base its inbound timing entirely on the outbound timing
- This insures that all MS units are working off of the same timing reference

Direct mode timing relationship

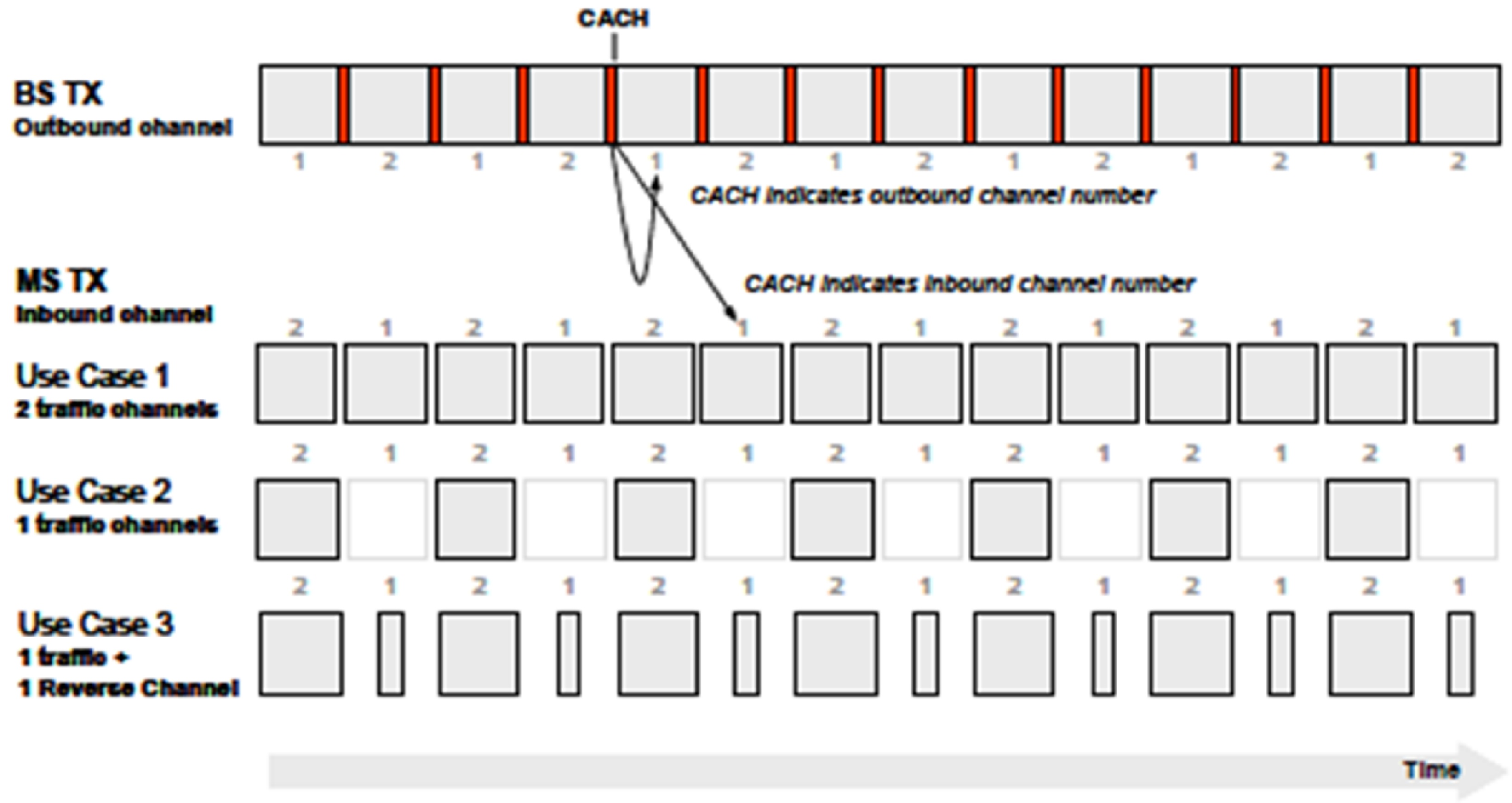
- The transmitting MS will establish the timing reference
- Any MS wishing to send RC signalling back to the source will synchronize to the forward path and base RC timing on the forward path timing
- Once the source MS stops transmitting, any other MS wishing to transmit will begin sending information asynchronously and establish a new and independent time reference

Colour Coding

- A 4 bit Colour Code is present in the signalling field and general data burst to provide a simple means of distinguishing overlapping radio sites.
- Tier III systems assign the physical channels automatically therefore the MS and TS should know and be in agreement which Colour Code is allocated for each physical channel. If a Colour Code has been assigned to a Tier III system, MS are polite to the Colour Code.

DMR Technology

Channel Access



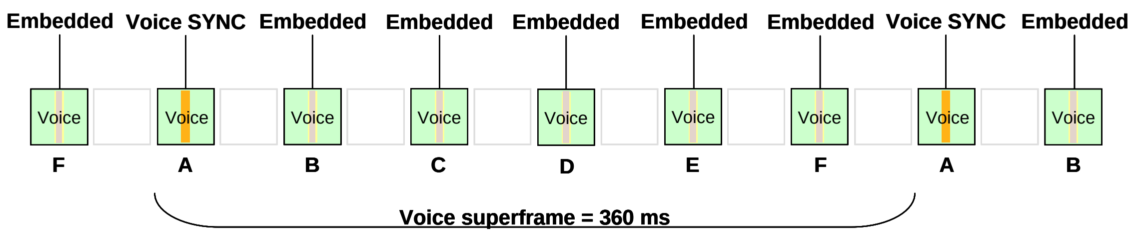
Transmit Admit Criteria

- **Polite to all**: The MS shall refrain from transmitting on a channel while the channel state is busy with other activity (either DMR or otherwise).
- **Polite to own Colour Code**: The MS shall refrain from transmitting on the logical channel while the channel state is busy with other DMR activity containing the MS’s own Colour Code.
- **Impolite**: The MS shall transmit on a channel regardless of any other activity (either DMR or otherwise) already present on the channel.

DMR Technology

Voice superframe

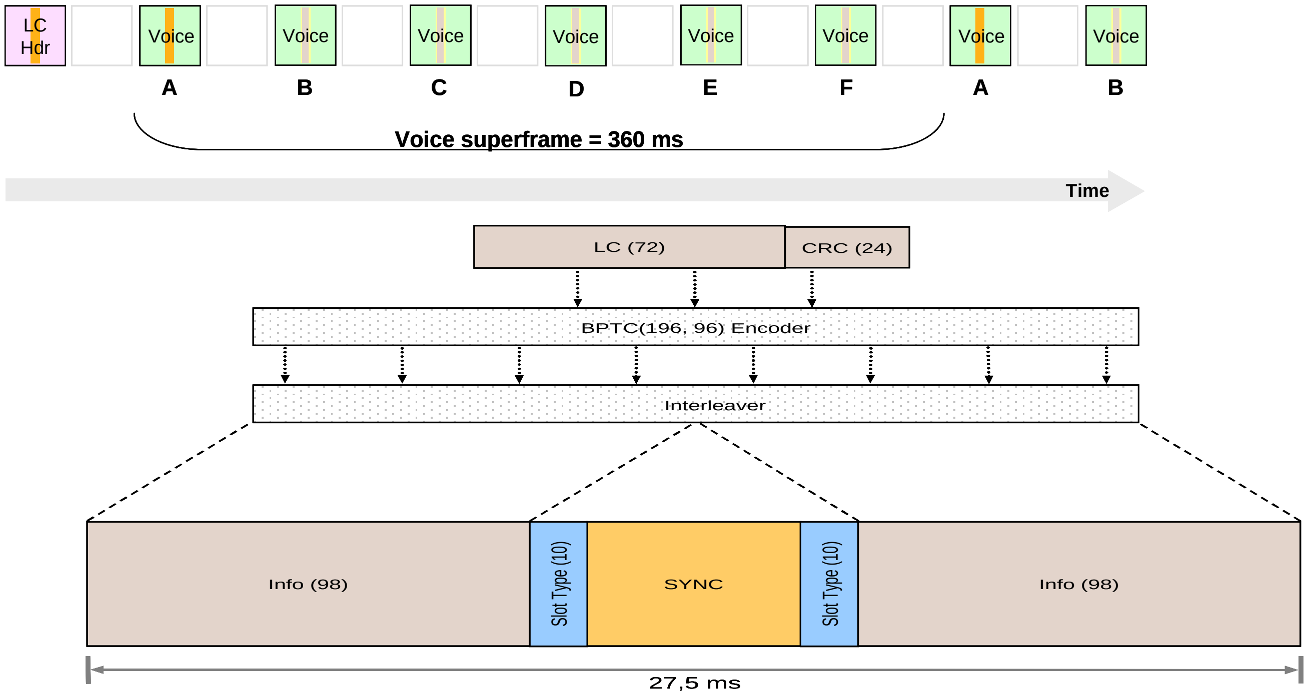
- voice superframe duration: 360 ms
- made up of 6 consecutive bursts
- burst labelled with letters: A, B, C, D, E, F.
- burst A identifies the beginning of the voice superframe and trasports:
    - voice payload (3 vocoder frames, 3 x 20 ms = 60 ms)
    - synchronisation sequences (outbound or inbound)
- burst B to F:
    - voice payload (3 vocoder frames, 3 x 20 ms = 60 ms)
    - embedded signalling (for late entry or low speed data)



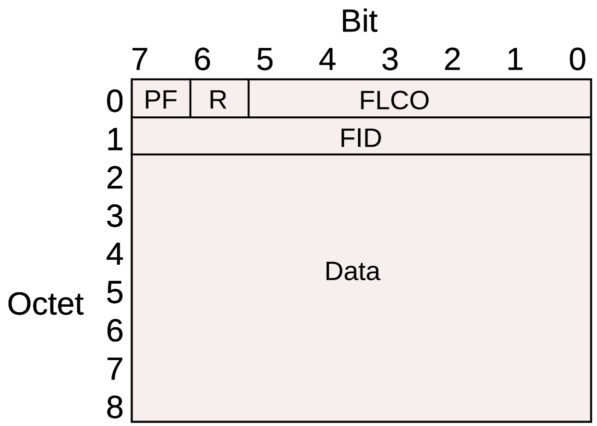
DMR Technology

Every voice transmission:

- begins with signalling burst(s) (Voice LC Header)
- is followed by so many voice superframes as needed to carry speech
- ends with terminator signalling burst(s) (Voice LC Terminator)

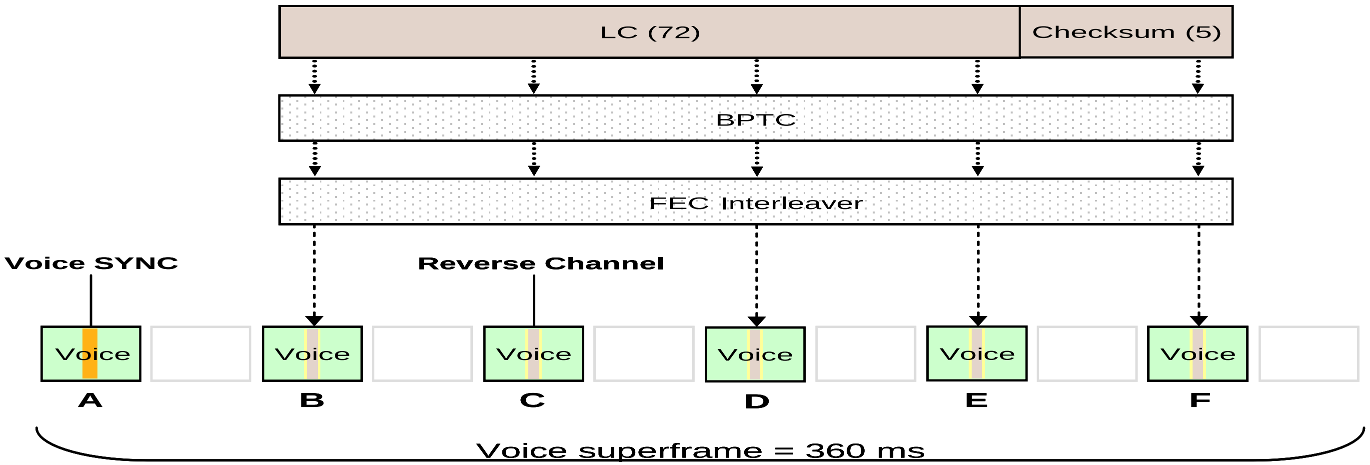


Voice LC Header and LC Terminator content



Information element	Length	Remark
Message dependent elements		
Protect Flag (PF)	1	
Reserved	1	This bit shall be set to 02
Feature elements		
Full Link Control Opcode (FLCO)	6	
Feature set ID (FID)	8	Shall be set to 000000002
Service Options	8	
Target address	24	
Source address	24	

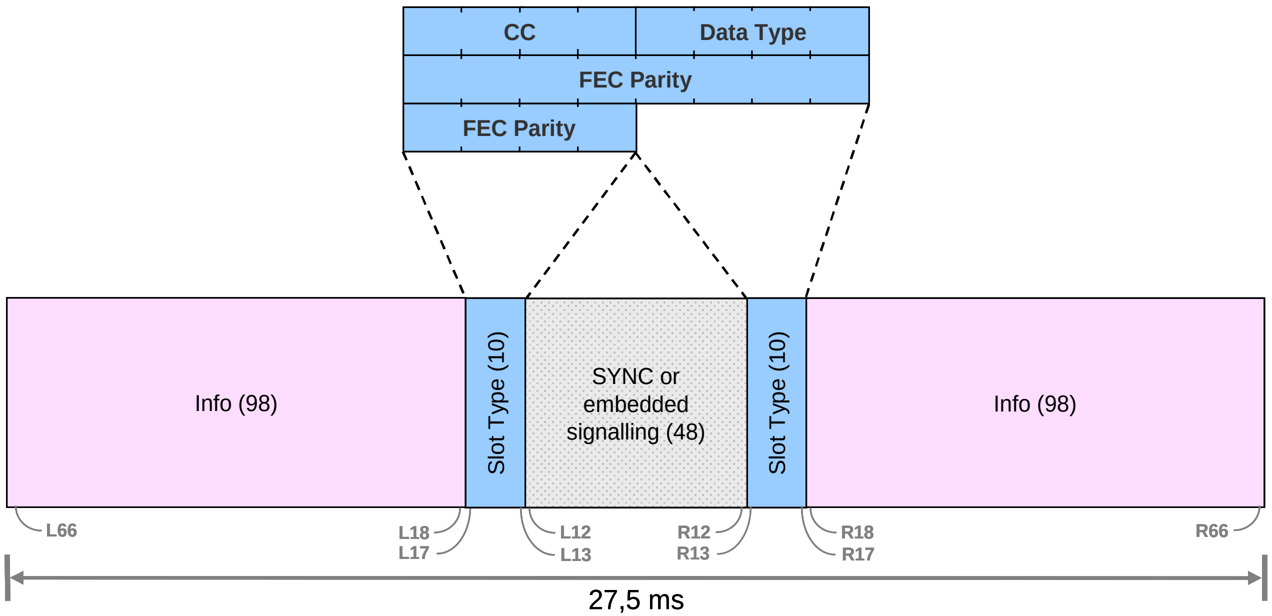
LC in embedded signalling



DMR Technology

Signalling and data transmission:

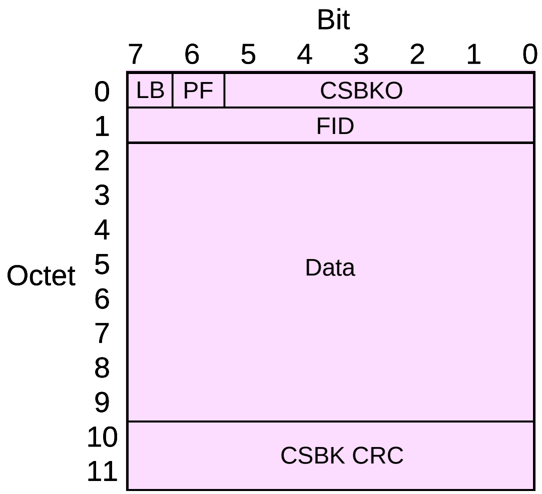
- have the same burst format
- the burst can be used for: signalling and for the Packet Data Protocol, which consists of the Short Data Message protocol and IP protocol
- the Data Type indicates the usage of the burst



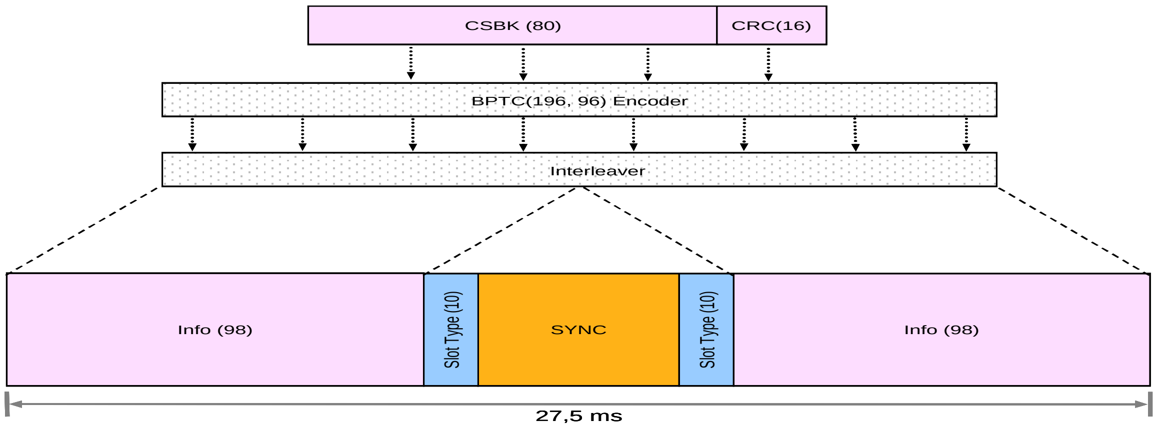
Data Types in signalling and data transmission

Data Type	Purpose	Payload FEC
PI Header, see note	Privacy Indicator information in a standalone burst	BPTC(196,96)
Voice LC Header	Indicates the beginning of voice transmission, carries addressing information	BPTC(196,96)
Terminator with LC	Indicates the end of transmission, carries LC information	BPTC(196,96)
CSBK	Carries a control block	BPTC(196,96)
MBC Header,	Header for multi-block control	BPTC(196,96)
MBC Continuation	Follow-on blocks for multi-block control	BPTC(196,96)
Data Header	Carries addressing and numbering of packet data blocks	BPTC(196,96)
Rate ½ Data Continuation	Payload for rate ½ packet data	BPTC(196,96)
Rate ¾ Data Continuation	Payload for rate ¾ packet data	Rate ¾ Trellis
Idle	Fills channel when no info to transmit	BPTC(196,96)

Signalling: the Control Signalling BlocK (CSBK)



Information element	Length	Remark
Last Block	1	This bit shall be set to 1
Protect Flag	1	
CSBK Opcode (CSBKO)	6	
FID	8	The FID shall be either SFID or MFID
CSBK Data	64	
CSBK CRC	16	



DMR Technology

Packet Data Protocol provides at Layer 2:

- Unconfirmed (unacknowledged) data transmission
- Confirmed (acknowledged) data transmission
- Confirmed data response (acknowledgement)
- ½ rate, ¾ rate and full rate transmission
- Single slot data rates 1333~3200 bit/s
- Possible doubling of data rate if both slots used

Packet Data Protocol provides at Layer 3:

- Status / Pre-coded data (10-bit)
- Raw Short Data service
- Defined Short Data service
- IPv4 Packet Data service
- Unified Data Transport Mechanism (UDT)

DMR Technology

Short data provides a service directly between radio-to-radio or to an attached 3rd party application; the amount of user data carried by a single Short Data message is a function of the combination of the mode (confirmed vs. unconfirmed) and protection rate (½ vs. ¾ vs. 1) selected

Status / Pre-coded data consists of 10 bits of payload

Raw Data is the transmission of a small quantity of data that leaves the management of the format of the transmitted data to the applications themselves

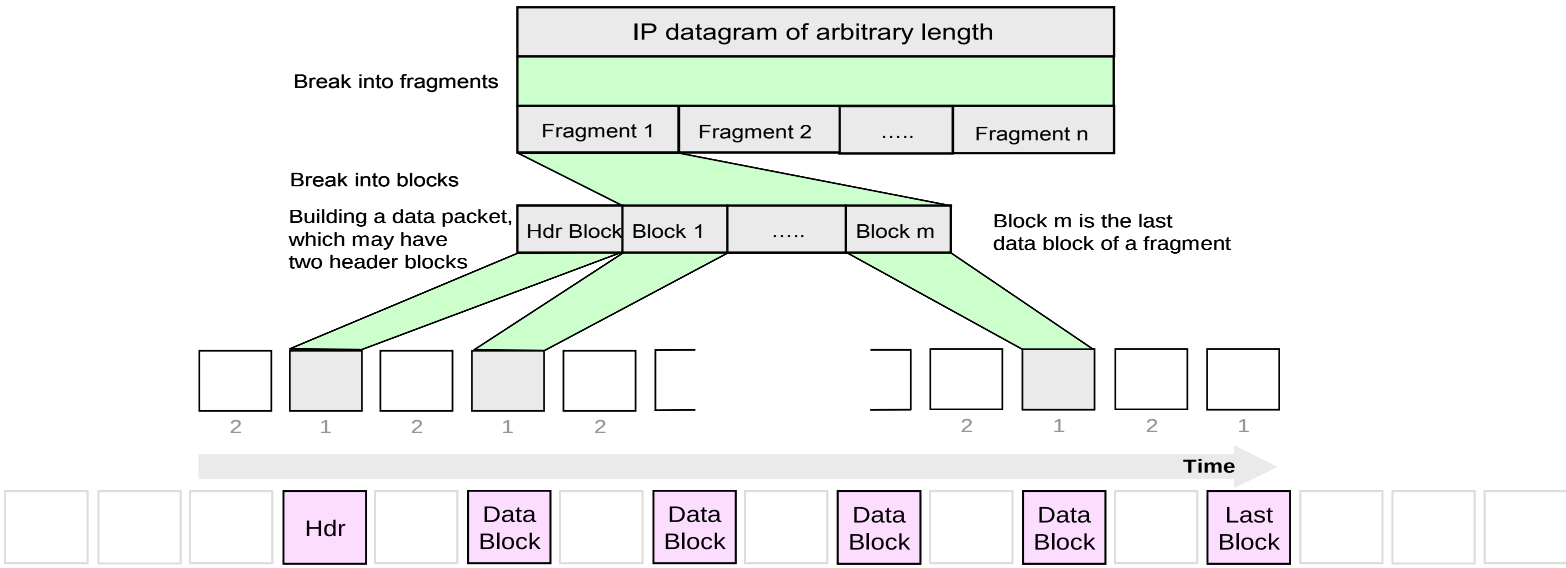
Defined Data is the transmission of a small quantity of data with a predefined data format; the available "DD Formats" are:

- Binary
- BCD
- 7 bit character
- 8 bit ISO 8859
- Unicode UTF-8, -16, -16BE, -16LE, -32, -32BE, -32LE

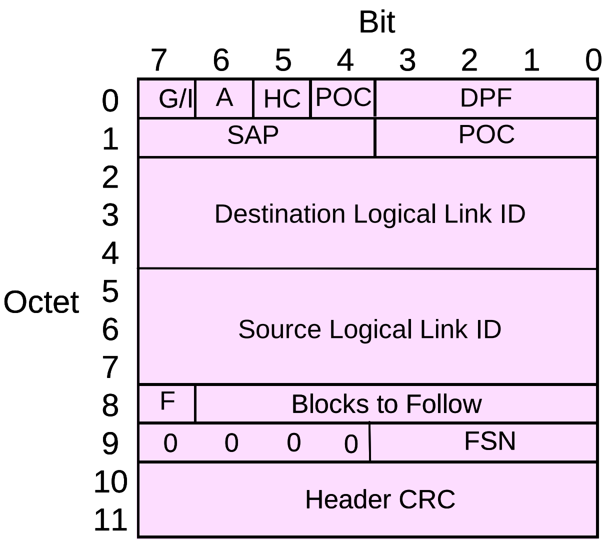
DMR Technology

IP packet data uses a connectionless, best-effort IPv4 datagram delivery service, utilising higher layer protocols e.g. TCP, UDP in an Internet environment; IP data are used to make a DMR system act as an IP subnet. This enables application programmers to build their applications in a standardised environment.

Mapping of IP datagram onto DMR air interface: fragmentation of an IP datagram, fragment mapping into blocks, association of blocks to timeslots:



IP packet data transmission: the Header

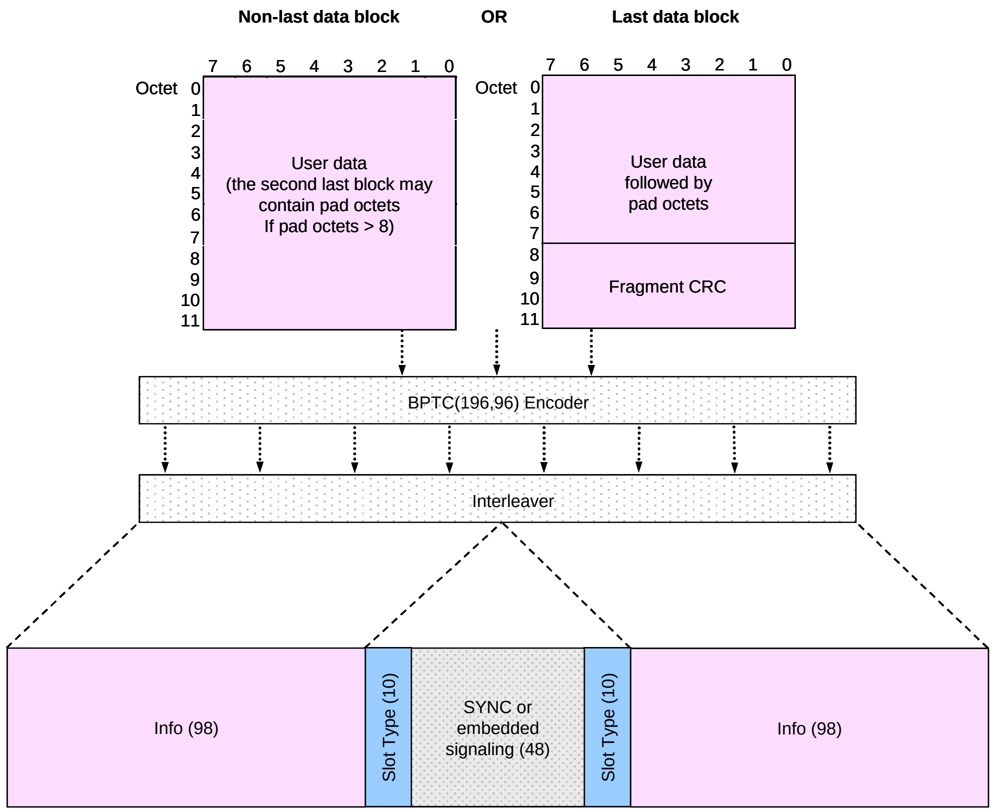


Header for unconfirmed transmission

Information element	Length	Remark
Group or Individual	1	This bit is set to indicate that the destination LLID is for a group
Response Requested (A)	1	This bit shall be set to 0
Header Compression (HC)	1	
Format	4	Data packet identification
SAP Identifier	4	
Pad Octet Count (POC)	5	
Logical Link ID (LLID)	24	Destination
Logical Link ID (LLID)	24	Source
Full Message Flag (FMF)	1	This bit shall be set to 1
Blocks to Follow (BF)	7	
Reserved	4	These bits shall be set to 0
Fragment Sequence Number (FSN)	4	
Header CRC	16	The CRC-CCITT shall be used as described in clause B.3.8

DMR Technology

IP packet data transmission: the Data Block



Data block for Header for unconfirmed rate ½ transmission

FEC and CRC/Checksum summary

Field	FEC code	Checksum
EMB field	Quadratic Residue (16,7,6)	none
Slot Type	Golay (20,8)	none
CACH TACT bits	Hamming (7,4)	none
Embedded signalling	Variable length BPTC	5-bit CheckSum (CS)
Reverse Channel (RC) Signalling	Variable length BPTC	defined as part of RC message
Short LC in CACH	Variable length BPTC	8-bit CRC
PI Header	BPTC(196,96)	CRC-CCITT
Voice LC header	BPTC(196,96)	(12,9) Reed-Solomon
Terminator with LC	BPTC(196,96)	(12,9) Reed-Solomon
CSBK	BPTC(196,96)	CRC-CCITT
Idle message	BPTC(196,96)	none
Data header	BPTC(196,96)	CRC-CCITT
Rate ½ data continuation	BPTC(196,96)	Unconfirmed: none
		Confirmed: CRC-9
Rate ½ last data block	BPTC(196,96)	Unconfirmed: 32-bit CRC
		Confirmed: 32-bit CRC and CRC-9
Rate ¾ data continuation	Rate ¾ Trellis	Unconfirmed: none
		Confirmed: CRC-9
Rate ¾ last data block	Rate ¾ Trellis	Unconfirmed: 32-bit CRC
		Confirmed: 32-bit CRC and CRC-9
Rate 1 non-last data block	Rate 1 coded	Unconfirmed: none
		Confirmed: CRC-9
Rate 1 last data block	Rate 1 coded	Unconfirmed: 32-bit CRC
		Confirmed: 32-bit CRC and CRC-9
Response header block	BPTC(196,96)	CRC-CCITT
Response data block	BPTC(196,96)	32-bit CRC
MBC header	BPTC(196,96)	CRC-CCITT
MBC continuation	BPTC(196,96)	none
MBC last block	BPTC(196,96)	CRC-CCITT
UDT header	BPTC(196,96)	CRC-CCITT
UDT continuation	BPTC(196,96)	none
UDT last block	BPTC(196,96)	CRC-CCITT

DMR Technology

Numbering and Addressing

DMR ID	Name	Number of addresses	Remark
Talkgroup addressing			
000000_{16}	Null	1	Null, see note
000001_{16} - $FFFCDF_{16}$	Talkgroup ID	> 16M	MS talkgroup addresses
$FFFCE0_{16}$ - $FFFFDF_{16}$	Reserved	768	Reserved for future expansion
$FFFFE0_{16}$ - $FFFFEF_{16}$	Unaddressed Idn (n=0-15)	16	Special unaddressed talkgroup IDs
$FFFFF0_{16}$ - $FFFFFF_{16}$	All talkgroup Idn (n=0-15)	16	Special talkgroups containing all MSs
Individual addressing			
000000_{16}	Null	1	Null, see note
000001_{16} - $FFFCDF_{16}$	Unit ID	> 16M	MS individual addresses
$FFFCE0_{16}$ - $FFFEDF_{16}$	Reserved	512	Reserved for future expansion
$FFFEE0_{16}$ - $FFFEEF_{16}$	System gateway Idn (n=0-15)	16	Gateways to system (e.g. repeater) and system interfaced devices not addressable via the DMR ID (e.g. PABX, PSTN, SMS router)
$FFFEF0_{16}$ - $FFFFEF_{16}$	Custom	256	Available for customization
$FFFFF0_{16}$ - $FFFFFF_{16}$	All unit Idn (n=0-15)	16	Special IDs used to address all MSs
NOTE: This is not a valid source or destination address.			