



New Functions of DMR Tier III

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Satellite Communications and Navigation



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The DMR Association

About

The DMR Association is a global organization whose purpose is to help grow the DMR market by removing barriers to interoperability and supporting innovation and adoption of the standard via the creation of new devices and services.

Mission

To ensure that LMR buyers of today's digital radio technology gain ongoing value through the competition and choice derived from an open, multi-vendor value chain.

Activities

- Interoperability certification of DMR products
- Development of enhanced features
- Feedback to ETSI
- Information & Promotion

www.dmrassociation.org

Facts and Figures

Founded in 2005

- 2006 decision to adopt the AMBE+2 Vocoder
- 2009 Technical Working Group and a Marketing Working Group established
- 2011 Incorporated in the UK as limited company
- Three categories of Membership
 - Category 1 Equipment Manufacturers
 - Category 2 Application Developers, Test Equipment Manufacturers, Systems Integrators & Test Houses
 - Category 3 Users, Regulators & Operators
- Today the DMR Association counts over 150 Members, including over 60 manufacturers

ETSI DMR Standard Parts

Current (September 2019) Standard

- ETSI TS 102 361-1 V2.5.1 (2017-10) DMR Air Interface Protocol
- ETSI TS 102 361-2 V2.4.1 (2017-10) DMR Voice and Generic Services
- ETSI TS 102 361-3 V1.3.1 (2017-10) DMR Data Protocol
- ETSI TS 102 361-4 V1.10.1 (2019-08) DMR Trunking Protocol

- ETSI TR 102 398 V1.4.1 (2018-11) DMR General System Design

*All these documents can be freely downloaded from the
ETSI or DMR Association websites:*

www.etsi.org
www.dmrassociation.org



ETSI DMR Standard Parts

DMR Tier I: Unlicensed

- Products for license-free, non-professional use: PMR446



DMR Tier II: Conventional

- Professional licensed conventional radio systems operating in PMR frequency bands 30 to 1000 MHz. Targeted at users who need smooth migration from analogue with existing spectrum & licensing, spectral efficiency, advanced voice features and integrated IP data services in licensed bands

DMR Tier III: Trunked

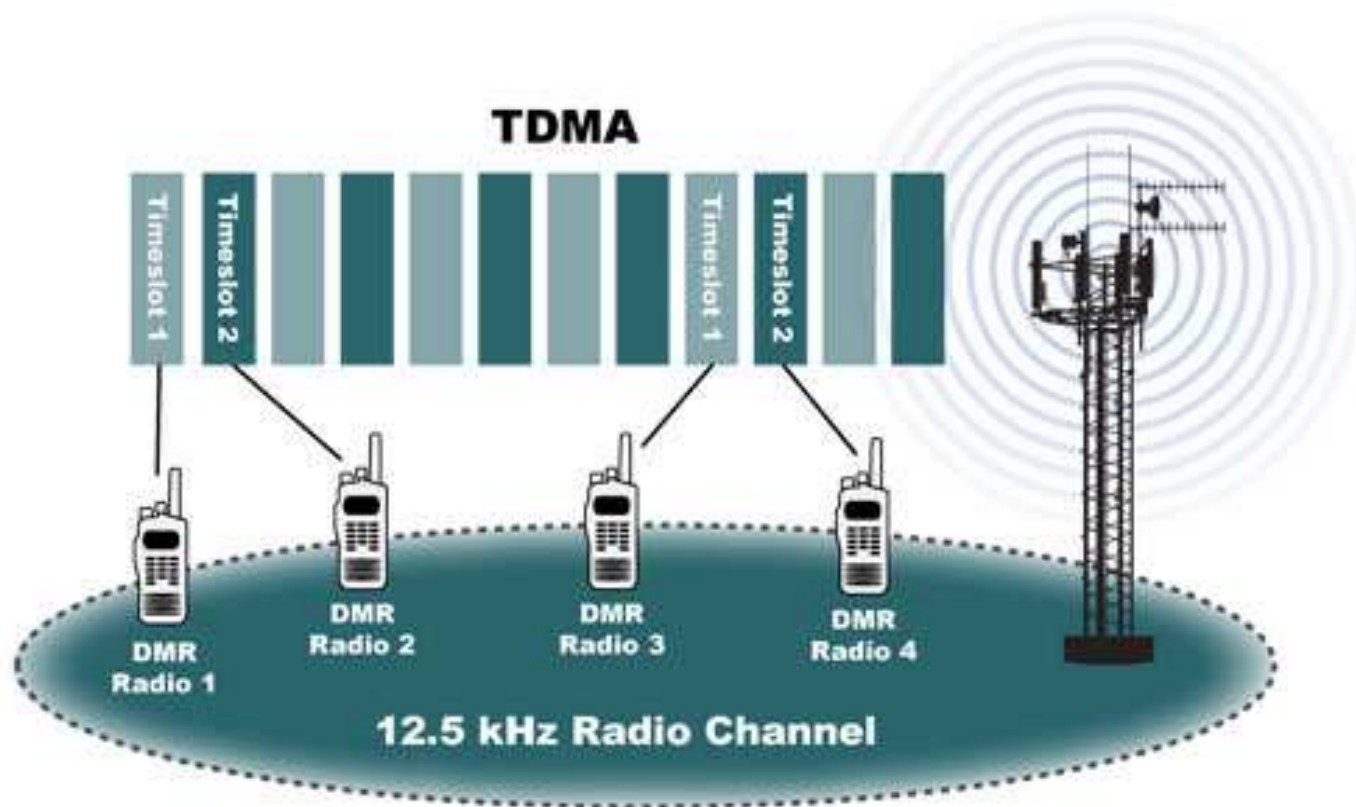
- Professional trunking operation in frequency bands 30 to 1000 MHz. The ETSI Tier III standard is derived from MPT1327 and is based on Tier II building blocks and features with plenty of additional added-value features

DMR Technology Overview

DMR Overview

- 12.5 kHz channel compatible with current analogue frequency allocation schemes
- Free combination of tx and rx frequencies (for complex freq. assignments)
- 9.6 kbps gross bit rate
- 4FSK modulation: constant envelope for simple RF design
- 2 slot TDMA channel => 6,25 kHz equivalent channel: 2 communication paths; permitting forward and reverse transmission on a time division basis
- Built around a 30ms slot structure
- 50% duty cycle slot structure allows
- Transmission can be used either for voice, data or signalling
- Low cost, low complexity
- Great range: same or better link budget than analogue
- Conventional (Tier II), Trunking (Tier III), Simulcast

DMR 2 Slot TDMA



DMR Tier III Features

Basic Features

- Mobile Station (MS) Access control and management
- MS Location by Radio Site Identification and Registration
- MS and BaseStation (BS) Authentication
- Message / Transmission / Quasi-Transmission Trunking
- Aligned and Offset Timing (enables full-duplex calls)
- Unified Data Transport (UDT) to support Short Data Service, Supplementary User Data service and Gateway addresses
- Broadcast of system parameters to MS
- Reverse Channel (to control transmitting MS's)
- Dedicated and Non-Dedicated Control Channel
- Second Control Channel (to manage more MS's and/or more localisation data)

DMR Tier III Features

Voice Features

- Talkgroup Call
- Late Entry (for Talkgroup Call)
- OACSU (Off Air Call Set Up) Individual Call
- FOACSU (Full Off Air Call Set Up) Individual Call
- Priority and Emergency Call
- Broadcast Call (mono-directional)
- All MS Call (mono-directional to pre-defined Talkgroup Addresses)
- Gateway Calls (PSTN, PABX, Dispatch) Half- and Full-Duplex
- Full-Duplex MS to MS Call

DMR Tier III Features

Generic Data Features

- Protected data with $\frac{1}{2}$ rate (high protection), $\frac{3}{4}$ rate (medium protection) and rate 1 (unprotected) Forward Error Correction
- Acknowledged and unacknowledged

The following building blocks are used:

- Control Signalling Block (CSBK, for signalling purposes)
- Unified Data Transfer (UDT) Short Data Message service
- Packet Data service: IP over DMR + UDP/IP header compression
- Unified Single Block Data (e.g. for high throughput positioning data)

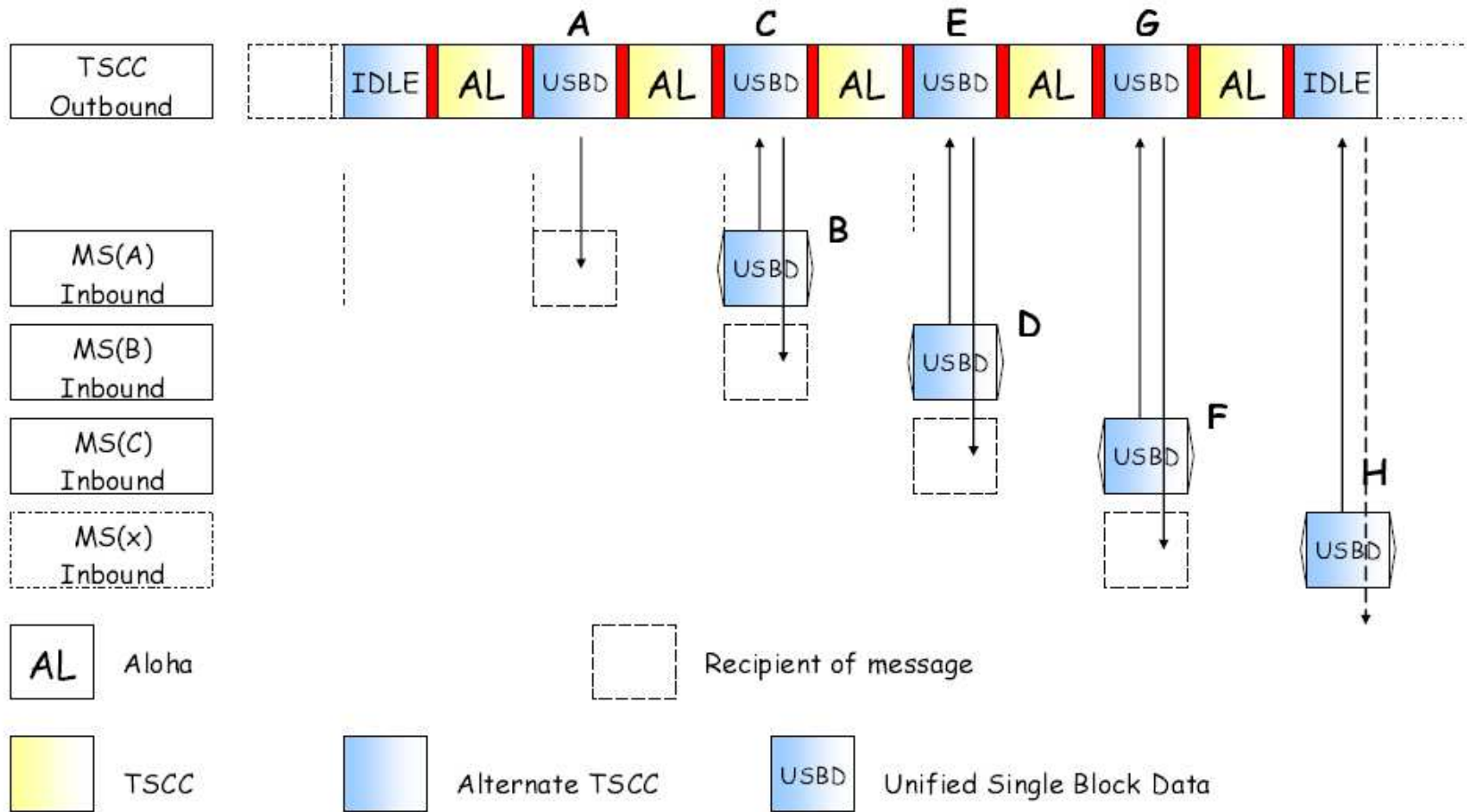
NOTE: these are the building blocks of the User Data Features

DMR Tier III Features

User Data Features

- Text Messaging over UDT
- Text Messaging over UDP/IP
- Location Messaging over UDT (basic approach – smaller fleets)
- Location Messaging over UDP/IP – Location Information Protocol (LIP) (compatible with IP-based localisation SW's)
- Voice associated in-band data features (radio position and talker alias together with speech)
- Unified Single Block Data Polling – LIP Positioning (advanced approach – up to 1000 terminals per minute in one Timeslot of the TDMA channel)
- Generic IP data
- Full-Duplex MS to MS Packet Data Call

USB-D Polling - LIP Positioning: how it works



USBD Polling - LIP Positioning: how it works

The USBD Polling Service supports LIP Immediate Reporting. This, combined with the USBD Polling Service provides a highly efficient method of supporting large quantities of location updates:

- LIP messages are compressed to be sent as DMR air interface PDU's
- Latitude, Longitude, Velocity and Direction of Travel are conveyed
- There is no impact on any other logical channels (all voice, data and signalling ongoing activities are unaffected)

The 2 slot TDMA channel of DMR with a 30 ms slot structure allows for a positioning data update to be sent every 60 ms

⇒ up to 1000 radios per minute can be polled using just one Timeslot of the TDMA channel

DMR Tier III Features

Supplementary Features

- Common Dialling Plan
- Talker Identification
- Radio Check
- Short Data Polling
- Status Delivery
- Status Polling
- MS Stun and Revive
- MS Kill
- Answer Call (immediate or deferred)
- Cancel Call
- Call Diversion
- Ambient Listening (if enabled)

DMR Tier III Features

Supplementary Features (continuation)

- Channel Authorisation (to avoid collisions in Talkgroup Calls)
- Supplementary User Data Transfer (e.g. sensor data at call set-up time)
- Network System Announcements
- Emergency Alarm (e.g. transmission of alarm status to Control Rooms)
- Emergency Pre-emptive Call
- PTT De-key
- Transmit Interrupt
- MS Dynamic Power Control
- Group Subscription/Attachment
- Dynamic Group Number Assignment
- Trunk Station Control Channel Alternate Slot management
- Optional End-to End Encryption (ARC4, DES, AES128, AES256 – introduced by the DMR Association)

Emergency Pre-emptive Call: how it works

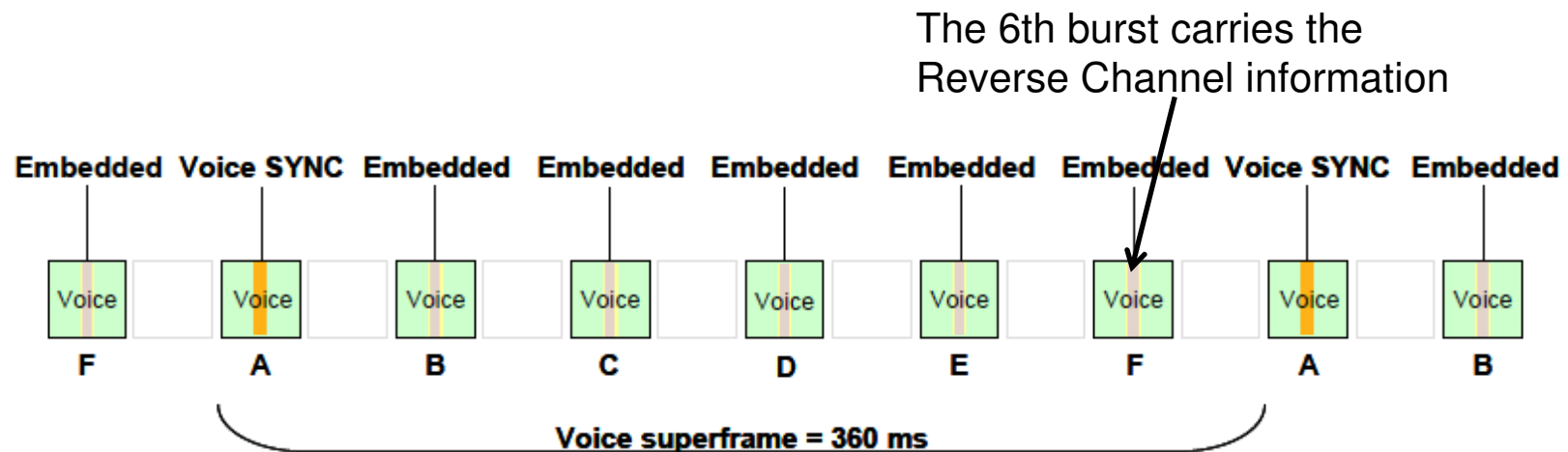
The system may force an existing non-emergency call to be prematurely cleared down, if a payload channel is not available at the time an Emergency Pre-emptive Call is initiated. The TSCC is then able to connect the Emergency Pre-emptive Call on that payload channel.

Reverse Channel signalling is used to free the payload channel (PTT De-key), if one of the radios in the call is transmitting (PTT pressed).

Emergency Pre-emptive Call: how it works

The outbound bursts, which carry the traffic for call "A", contain SYNC or embedded signalling data, see picture below, as dictated by the content of call "A", except for every 6th burst which carries the Reverse Channel information for call "B", when needed.

The radio transmitting in call "B" in the same physical channel as call "A" can revert to reception, listen to this Reverse Channel information, stop transmitting and free the channel.



DMR Tier III Features

Further Features

- Possibility of implementing specific encryption algorithms
- Application Interface Specification (AIS - Introduced by the DMR Association)
- Flexibility to introduce new and/or proprietary features
- Database queries
- SCADA

DMR as a more sophisticated business tool

Application development on DMR technology

- Community of 100's of application developers who are developing vertical market and customer specific applications



DMR Tier III Conclusions

The feature set of DMR Tier III has grown significantly over the passed couple of years.

We believe that the combination of radio link performance, set of functions, number of suppliers and simplicity makes DMR the first choice for business critical mobile radio applications.



DMR technology is
already supporting
12 Million users
worldwide.



Thank you!

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<https://dmrassociation.org>