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# Mobile Communication Systems: TETRA Terrestrial Trunked Radio System

**Mário Jorge Leitão**

Partially adapted with permission from

**Mobile Communication: Wireless Telecommunication Systems - Jochen Schiller**

<http://www.jochenschiller.de>

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## PMR overview

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- ❑ PMR: Private Mobile Radio
  - ❑ cost effective mobile communications for private networks
  - ❑ many specialised facilities not available in public mobile networks
  - ❑ usually stand-alone networks
  - ❑ advanced systems allow interconnection with fixed network (voice/data)
  - ❑ use of VHF/UHF allow good coverage with small antennas
  
- ❑ Target users
  - ❑ police forces
  - ❑ fire brigades
  - ❑ emergency health
  - ❑ military forces
  - ❑ transportation fleets: goods, taxi, buses
  - ❑ utilities: electricity, gas, water

## PMR systems

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- ❑ Basic mobile radio systems
  - ❑ simple two-way radio without base stations
  - ❑ users within range of each other
  - ❑ fixed frequency assignment (sometimes manually selectable)
  - ❑ usually no privacy
  
- ❑ Advanced mobile radio systems
  - ❑ cellular network architecture - trunked systems
  - ❑ secure communications
  - ❑ efficient use of frequency spectrum
  - ❑ possibility of shared resources - PAMR: Public Access Mobile Radio
  - ❑ examples of technologies: TETRA / TETRAPOL

## PMR special requirements (I)

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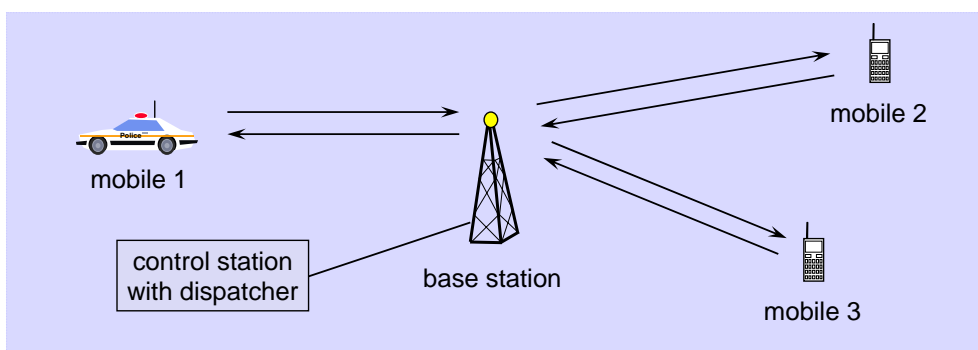
- ❑ Reliability
  - ❑ high service availability
  - ❑ minimum service still possible in case of large breakdown
  
- ❑ Centralised / Decentralised operation
  - ❑ central dispatch point to organise users
  - ❑ possibility of direct mode operation (without central control or any infrastructure at all)
  
- ❑ Various types of call
  - ❑ point-to-point (single user to single user)
  - ❑ group (pre-defined number of users)
  - ❑ broadcast (all users in the network; all users in a selected area)

## PMR special requirements (II)

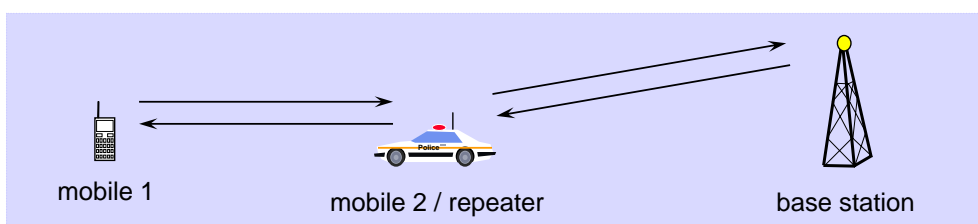
- ❑ Call set-up
  - ❑ sub-second call set-up time
  - ❑ PTT - Press Io Talk operation
  - ❑ usually no need for action to answer
- ❑ Security
  - ❑ increased security
  - ❑ possibility of end to end encryption
- ❑ Call priorities
  - ❑ classes of users with higher priority
  - ❑ urgent calls may be able to pre-empt other call types

## PMR configurations (I)

- ❑ Trunked mode operation with dispatch

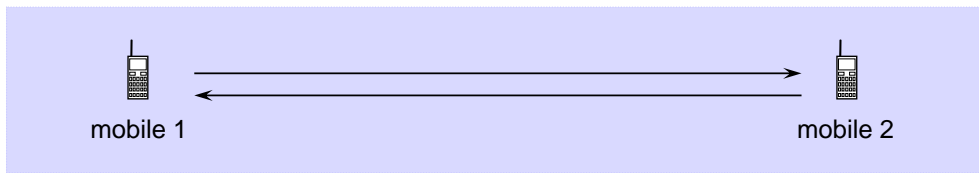


- ❑ Repeater operation (e.g. vehicle mounted)

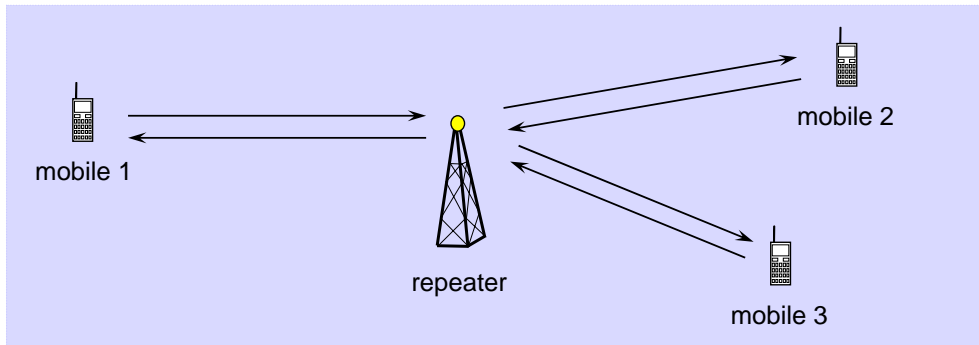


## PMR configurations (II)

### □ Basic Direct Mode Operation (DMO)



### □ Repeater DMO



## TETRA overview

### □ ETSI standard

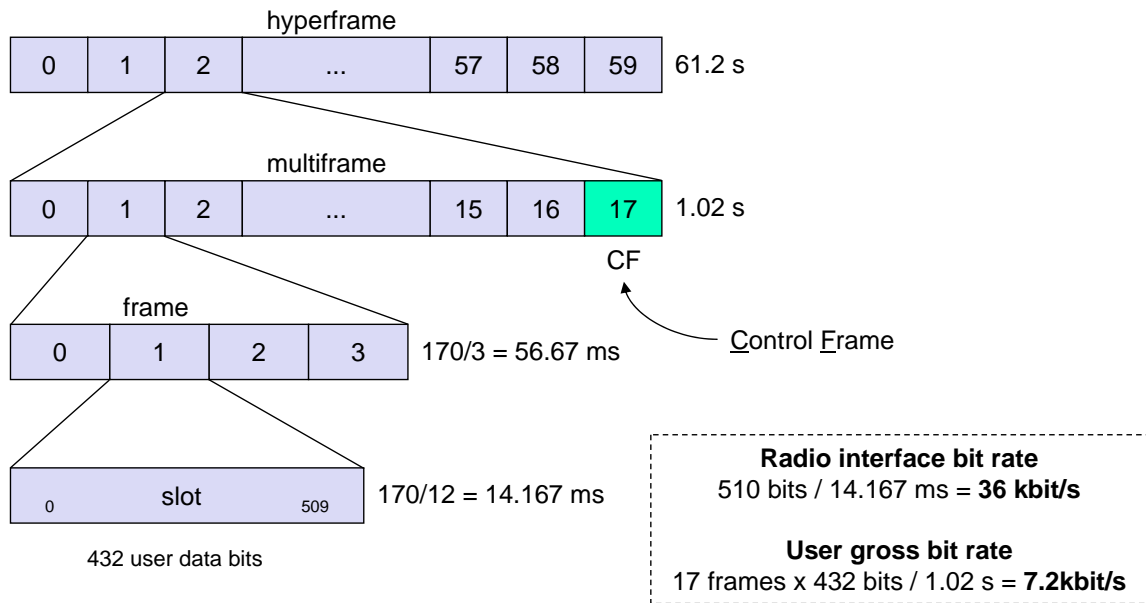
- formerly: Trans European Trunked Radio
- now: Terrestrial Trunked Radio System

### □ Main parameters

Parameter	Value
Frequency bands	Several bands 380 - 460 MHz
Carrier spacing	25 kHz
Duplex method	FDD
Modulation	QPSK
Carrier data rate	36 kbit/s
Access method	TDMA with 4 slots per carrier
User data rate	7.2 kbit/s per time slot (unprotected)
Voice coder rate	ACELP (4.56 kbit/s net, 7.2 kbit/s gross)

# TETRA TDMA

## TDMA structure - Voice+Data (V+D) mode



# TETRA services

## Basic services

Modes	Circuit mode data				Packet mode data		Short Data Service (SDS)
	1 slot	2 slot	3 slot	4 slot	Connection oriented	Connectionless	Up to 254 characters
	2.4 kbit/s 4.8 kbit/s 7.2 kbit/s	4.8 kbit/s 9.6 kbit/s 14.4 kbit/s	7.2 kbit/s 14.4 kbit/s 21.6 kbit/s	9.6 kbit/s 19.2 kbit/s 28.8 kbit/s			
Trunked Mode	•	•	•	•	•	•	•
Direct mode	•						•

Note: data rates apply for high protection, low protection and no protection

## Speech services - clear / encrypted

- individual call (point-to-point)
- group call (point-to-multipoint)
- broadcast call

# TETRA terminals

Vehicular terminal



Portable terminals

