



Private Mobile Radio Systems



Systems and Frequencies

SyFr (1/8)

- There are private mobile communications networks that are for exclusive use of their owners.
- Users are:
 - security forces;
 - emergency services;
 - military;
 - transport companies;
 - ...



Systems and Frequencies

SyFr (2/8)

- Some examples of private mobile radio systems:

| System | Country |
|---------------|----------------|
| LTR | USA |
| MPT1327 | UK |
| Motorola | USA |
| Ericsson | S |
| ... | ... |
| EDACS | S |
| GSM-R | EU |
| APCO | USA |
| iDEN | USA |
| TETRAPOL | F |
| TETRA | EU |
| CDMA450 | USA |
| ... | ... |



Systems and Frequencies

SyFr (3/8)

- Initially, there were only pure private systems, characterised by:
 - using analogue technology;
 - serving only the licence holder;
 - enabling only the voice service;
 - being proprietary solutions;
 - not establishing links to the public network;
 - having relatively small coverage areas;
 - leading to spectrum saturation.



Systems and Frequencies

SyFr (4/8)

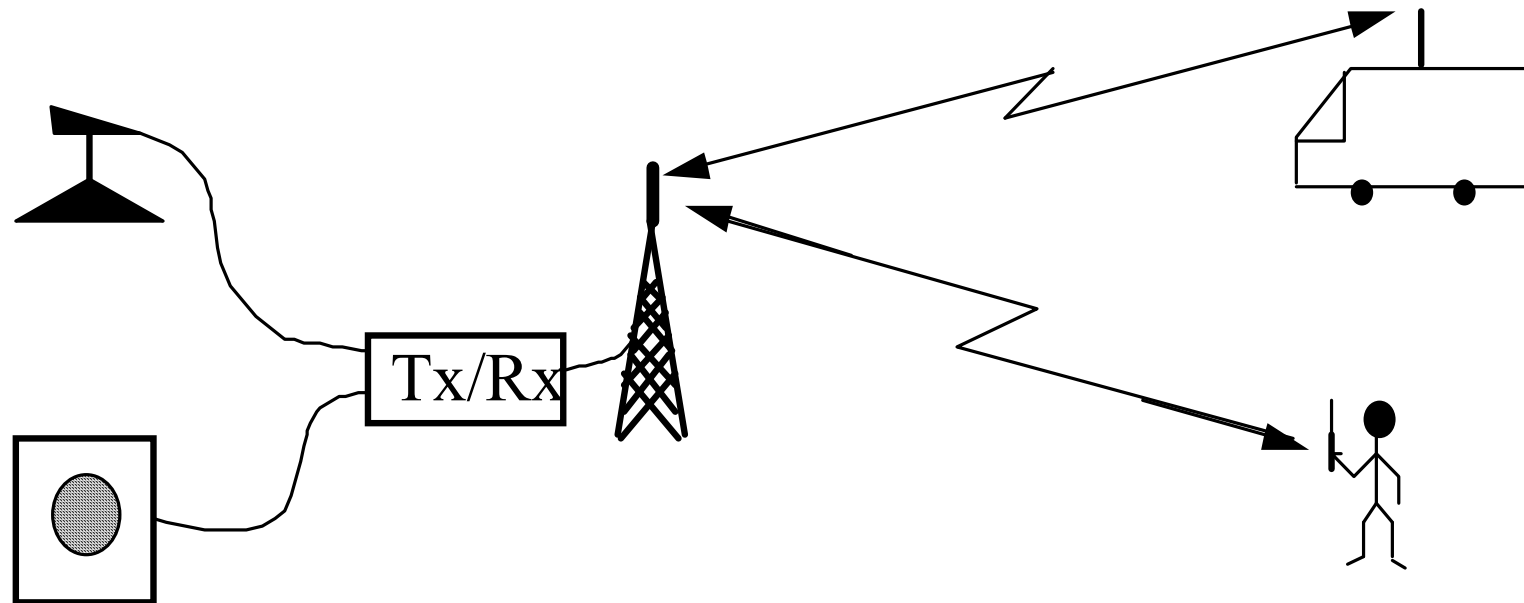
- Trunking systems do present many benefits, by:
 - serving closed groups of users;
 - low installation and maintenance costs;
 - establishing links to the public network;
 - having a coverage area at the national scale;
 - offering a better quality of service to users;
 - using spectrum in a very efficient way.



Systems and Frequencies

SyFr (5/8)

- In a typical system, the control centre communicates with MTs, via a single BS.

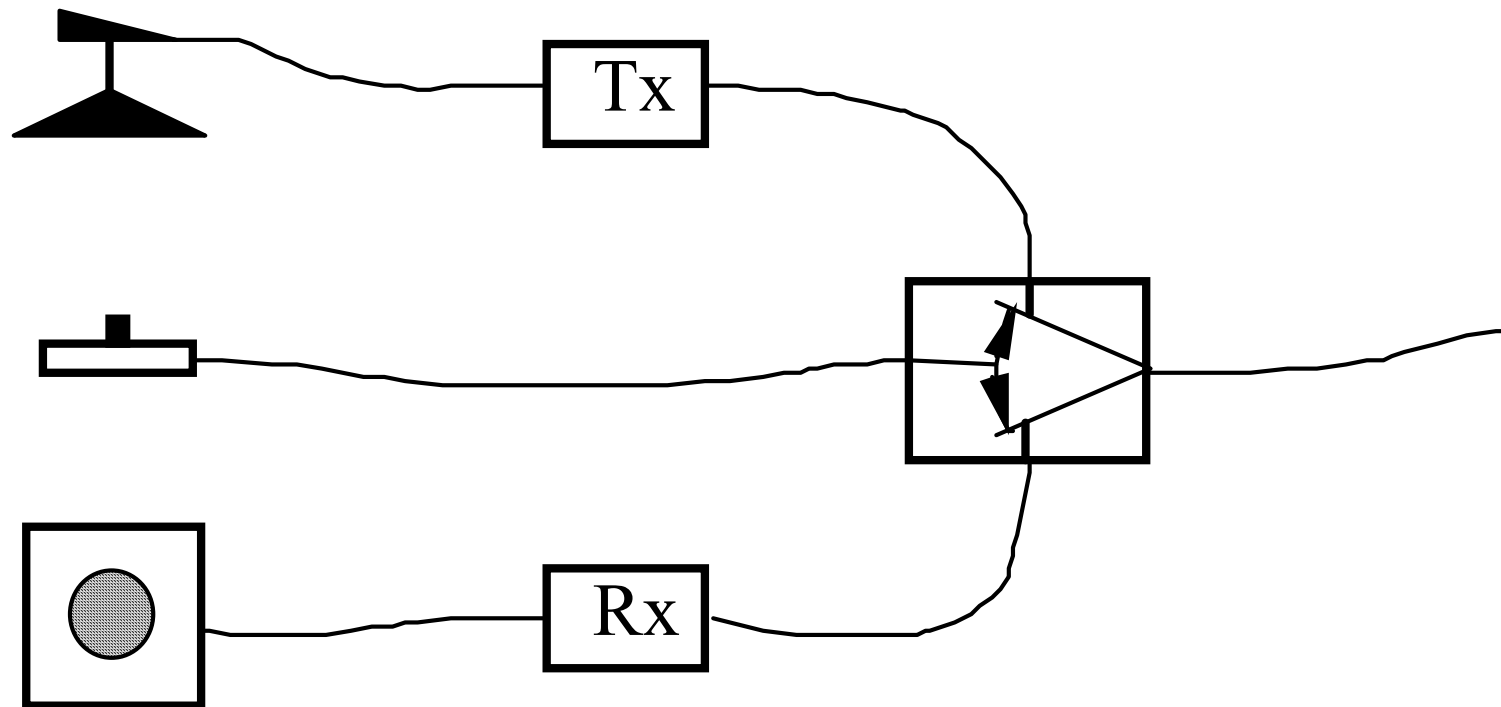




Systems and Frequencies

SyFr (6/8)

- These systems do not use full duplex, hence, a switch is required.





Systems and Frequencies

SyFr (7/8)

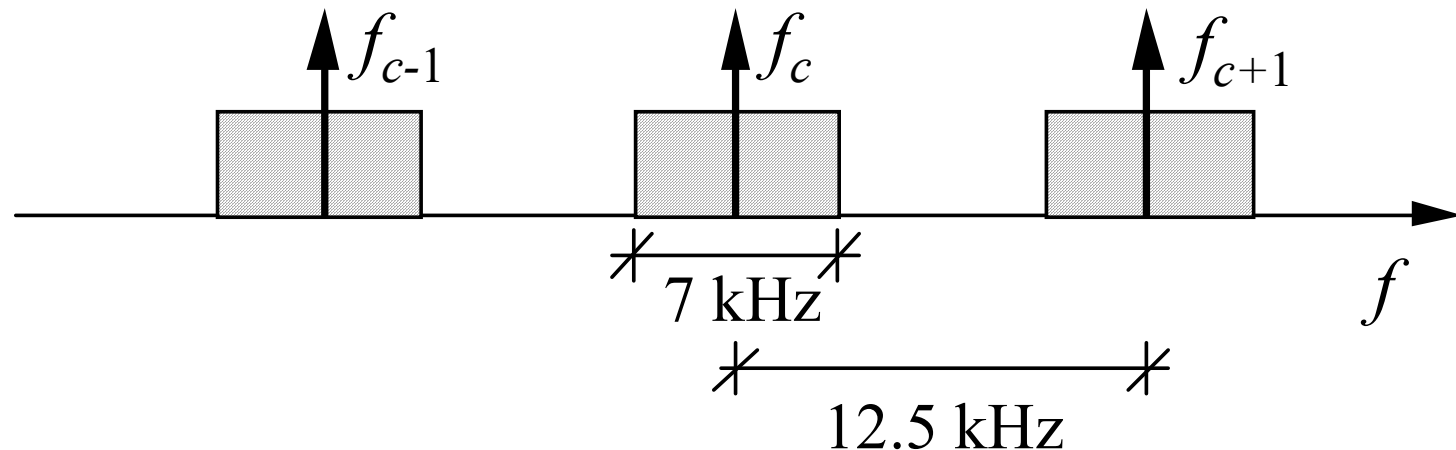
- The available frequency bands are:
 - [70, 87] MHz
 - [148, 174] MHz
 - [380, 470] MHz
 - [870, 923] MHz
- The allocations of a given frequency depends on:
 - spectrum availability;
 - intended coverage area.



Systems and Frequencies

SyFr (8/8)

- Analogue systems use:
 - AM or FM in VHF;
 - FM in UHF;
 - one single channel per carrier, typically with a bandwidth of 12.5 kHz.





TETRA

TETRA (1/4)

- There is a standard (in Europe) for trunking, TETRA (Terrestrial Trunked Radio), using:
 - FDD
 - UL [380, 390] \cup DL [390, 400] MHz
 - UL [410, 420] \cup DL [420, 430] MHz
 - UL [450, 460] \cup DL [460, 470] MHz
 - UL [870, 878] \cup DL [915, 923] MHz
 - TDMA, with carriers with a bandwidth of 25 kHz, and 4 time-slots per frame;
 - $\pi/4$ -DQPSK modulation;



TETRA

TETRA (2/4)

- a minimum C/I of a 19 dB;
- a receiver sensitivity of -103 dBm;
- a maximum cell range of 60 km;
- handover;
- a user bit rate of 19.2 kbit/s, corresponding to a global one of 36 kbit/s;
- a call set up time less than 1 s;
- CS for voice and PS for data;
- a variety of services larger than that of analogue systems.



TETRA

TETRA (3/4)

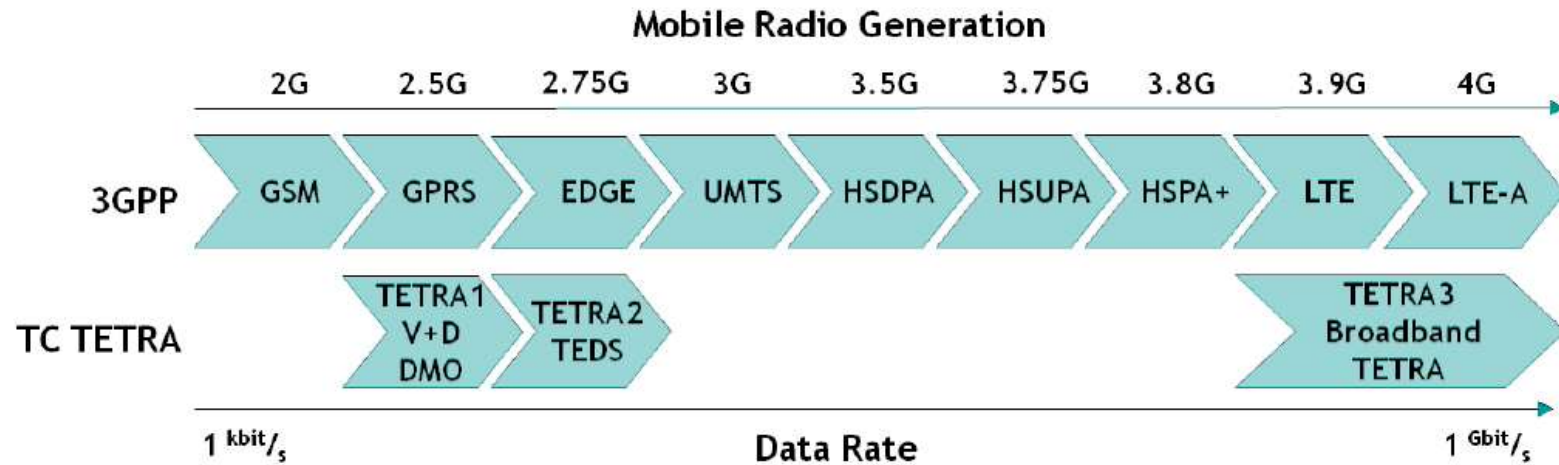
- The main features are:
 - fast call set up;
 - trunking (TMO) and direct (DMO) modes operation, the latter with relay;
 - group calls;
 - access to public networks;
 - one-to-one, one-to-many and many-to-many calls;
 - emergency calls with priority;
 - higher level of encryption in communications.



TETRA

TETRA (4/4)

- TETRA has evolved:

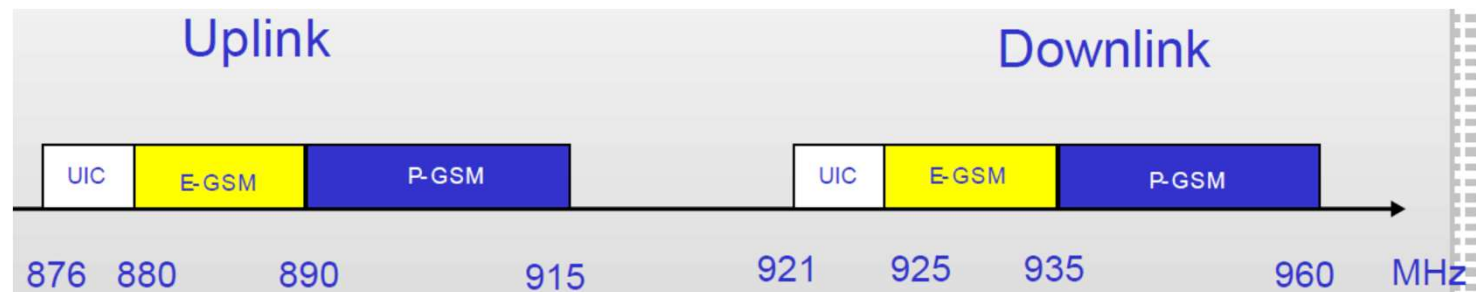




GSM-R

GSMR (1/3)

- GSM-R is a standard (in Europe) for railway communications, being based on GSM, with additional features.
- GSM-R uses a band adjacent to GSM900:
 - UL [876, 880] MHz
 - DL [921, 925] MHz



[Source: SYSTRA, 2006]



GSM-R

GSMR (2/3)

- The main features are:
 - MT speeds up to 500 km/h;
 - data via GPRS;
 - customised applications, e.g., train control,
 - functional addressing, i.e., calling a user by a function rather than by a number,
 - location-dependent addressing,
 - voice group call service,
 - voice broadcast service,
 - priority calls.



GSM-R

GSMR (3/3)

- The network architecture requires additional nodes, corresponding to the additional features.
- Cellular planning is mainly of the linear type.
- Coverage requirements are strict.



LTE-x

LTE_x (1/1)

- LTE is evolving to accommodate several different versions, in order to accommodate the requirements from previous Private Mobile Radio communications systems.
- The following versions are under development:
 - LTE-MCC (Mission Critical Communications)
 - LTE-R (Railways)
 - LTE-IoT (Internet of Things)
 - LTE-LAA (License Assisted Access)



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