Hybrid cognitive radio networks for command & control in public safety

Frank Brouwer

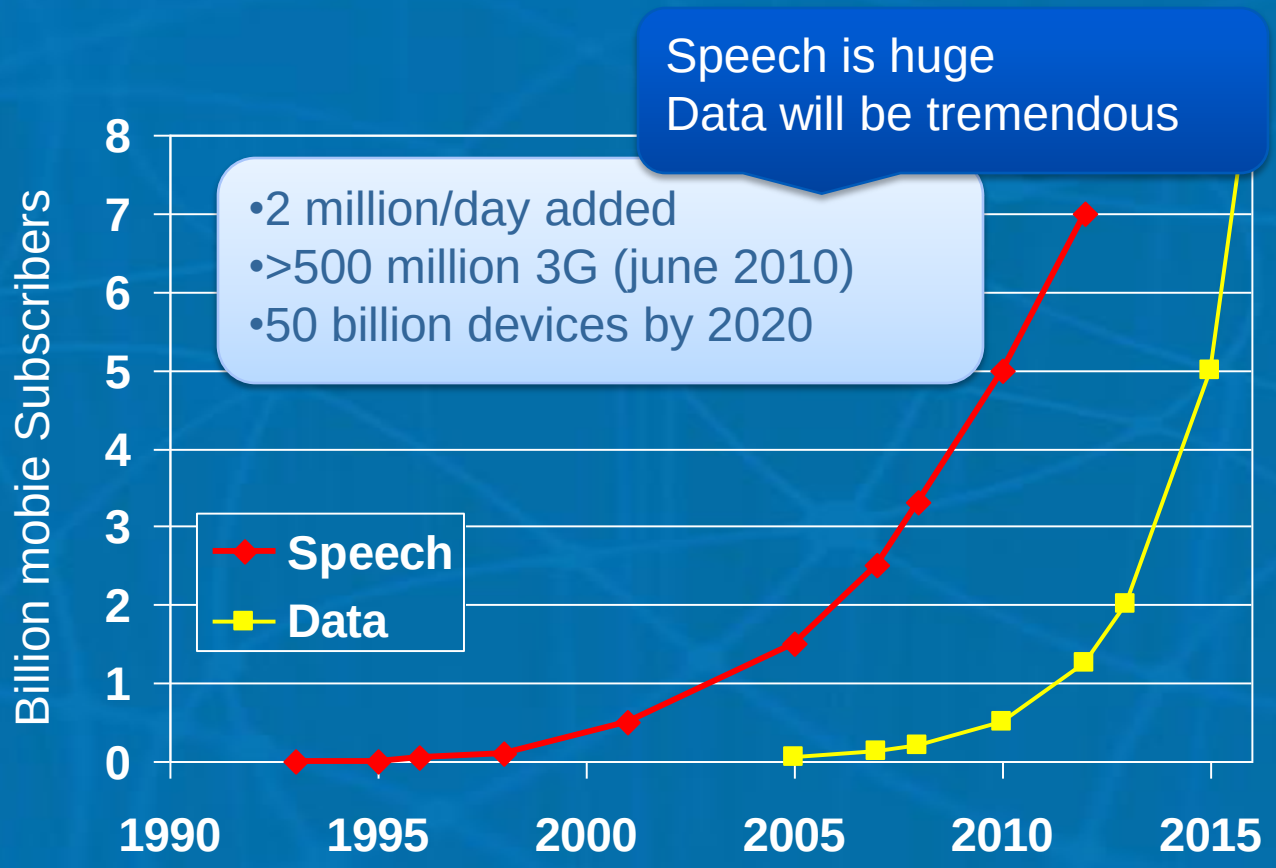
CR Workshop TU Delft

December 9th 2010

Trends in mobile communication

Public mobile subscribers

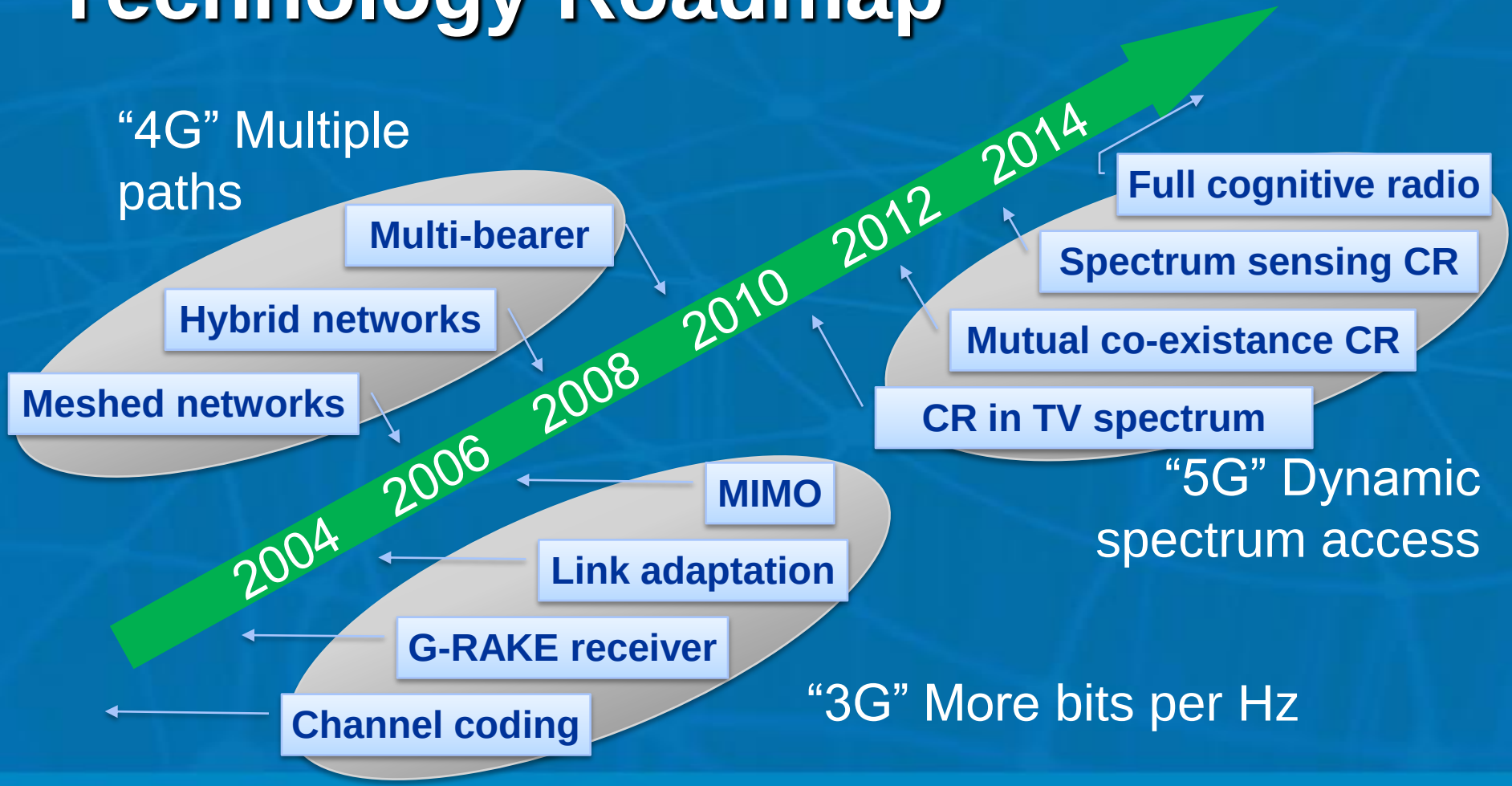
Source: GSMA



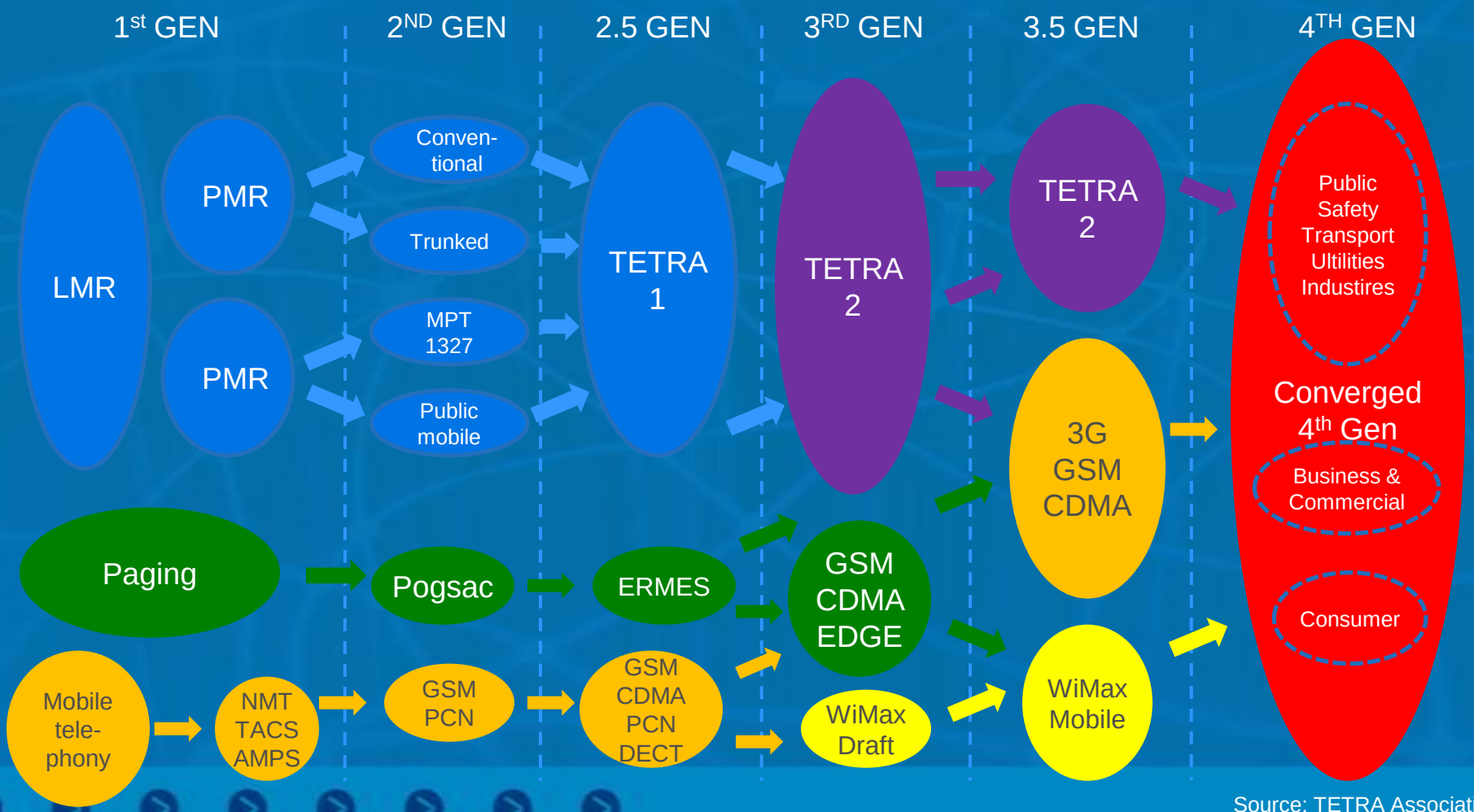
How generations are used

- 1G: Mobile Communications (NMT)
- 2G: Always On (GSM)
- 3G: Always connected (UMTS)
- 4G: Always Best Connected (Multi standard)

Technology Roadmap



Roadmap according TETRA



Source: TETRA Association

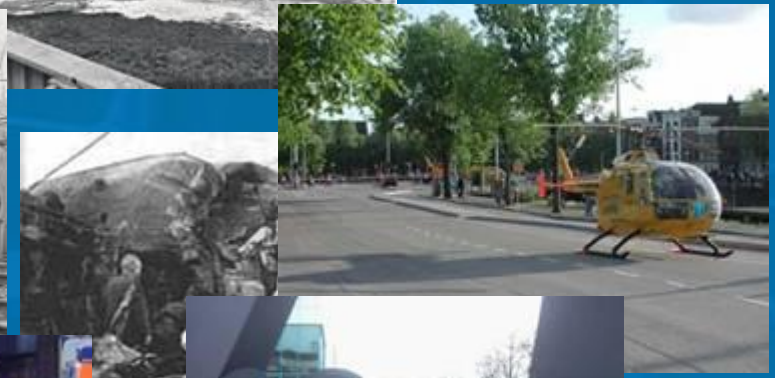
Requirements PPDR communication

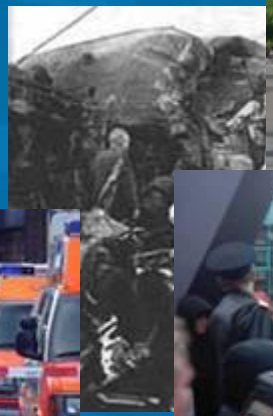
Source: projectmesa

Large-scale train accident

- High speed train and a freight train with propane and hydrochloric acid run on parallel tracks.
- In the stadium next to the tracks a game is taking place.
- The freight train derails, and the passenger train crashes into it.


efs.com





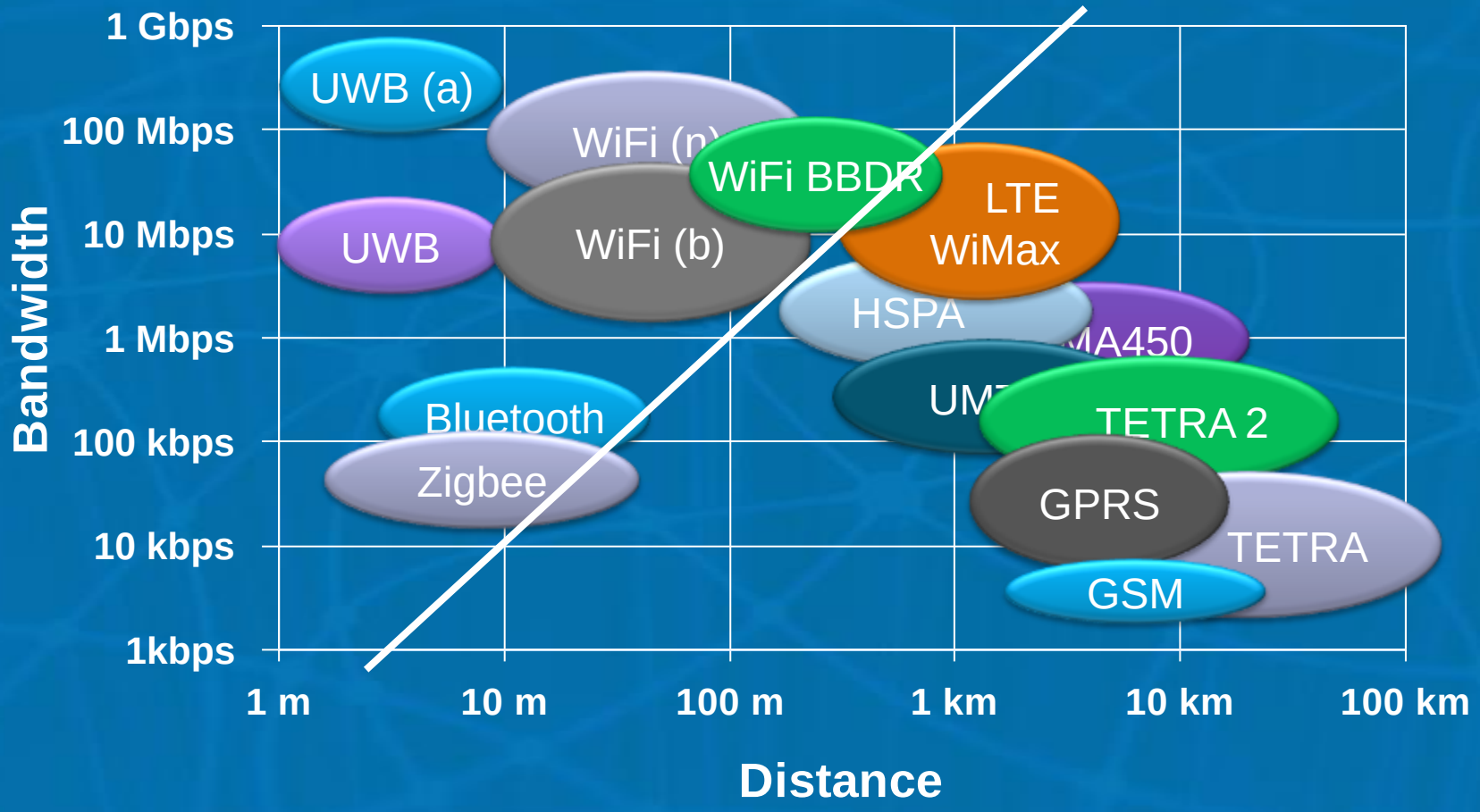
Source: projectmesa

PPDR bandwidth estimate

- Fire fighters
- Para-medical personnel
- Police
- Hazmat experts
- Other rescue workers
- Fire trucks
- Ambulances
- Command vehicles
- Robots for inspection
- Helicopter for observation

Crisis management requires 100 Mbps on site for information exchange.

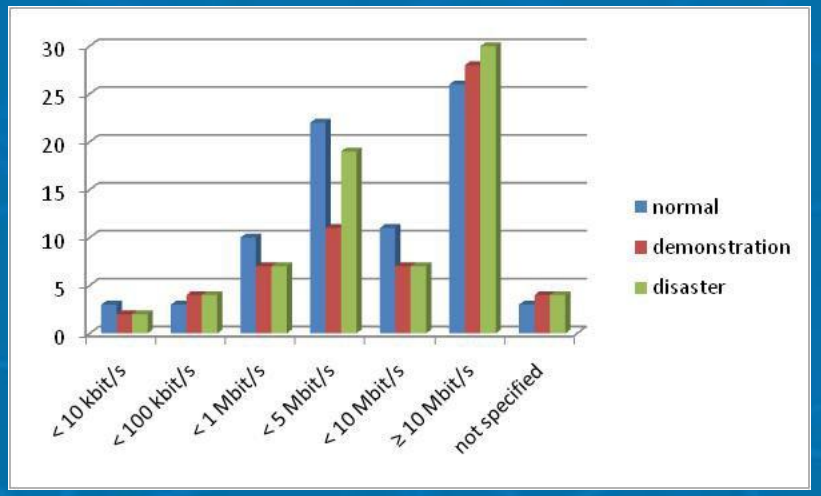
Distance vs bandwidth



Source: IABG

German PPDR requirements

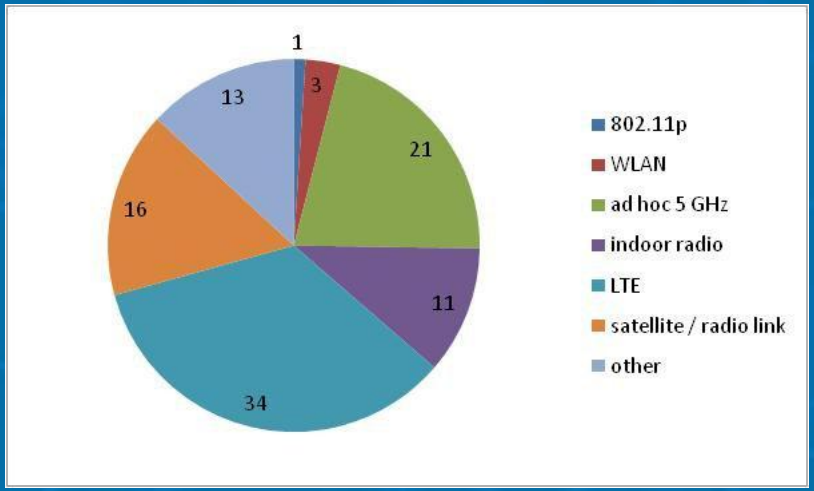
- TETRA: speech/ narrowband data
- > 60% of the scenarios is mission critical
- > 90% of the scenarios require high availability
- 65% > 1 Mbps, 40% > 10 Mbps

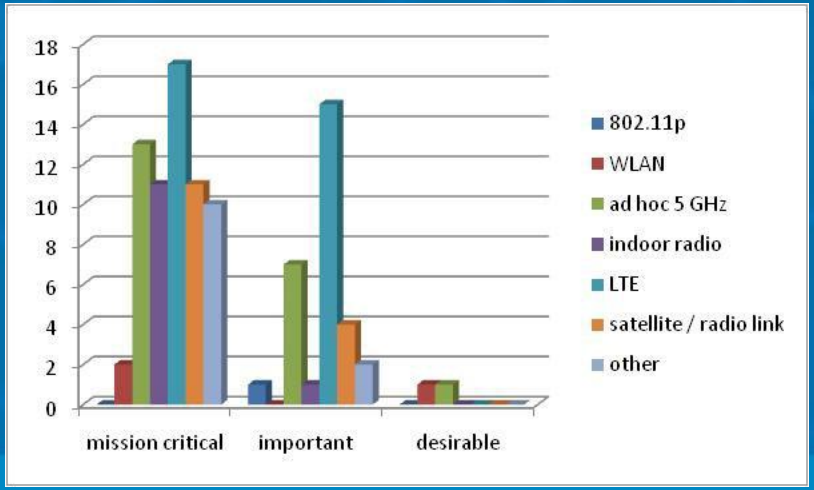


Source: IABG

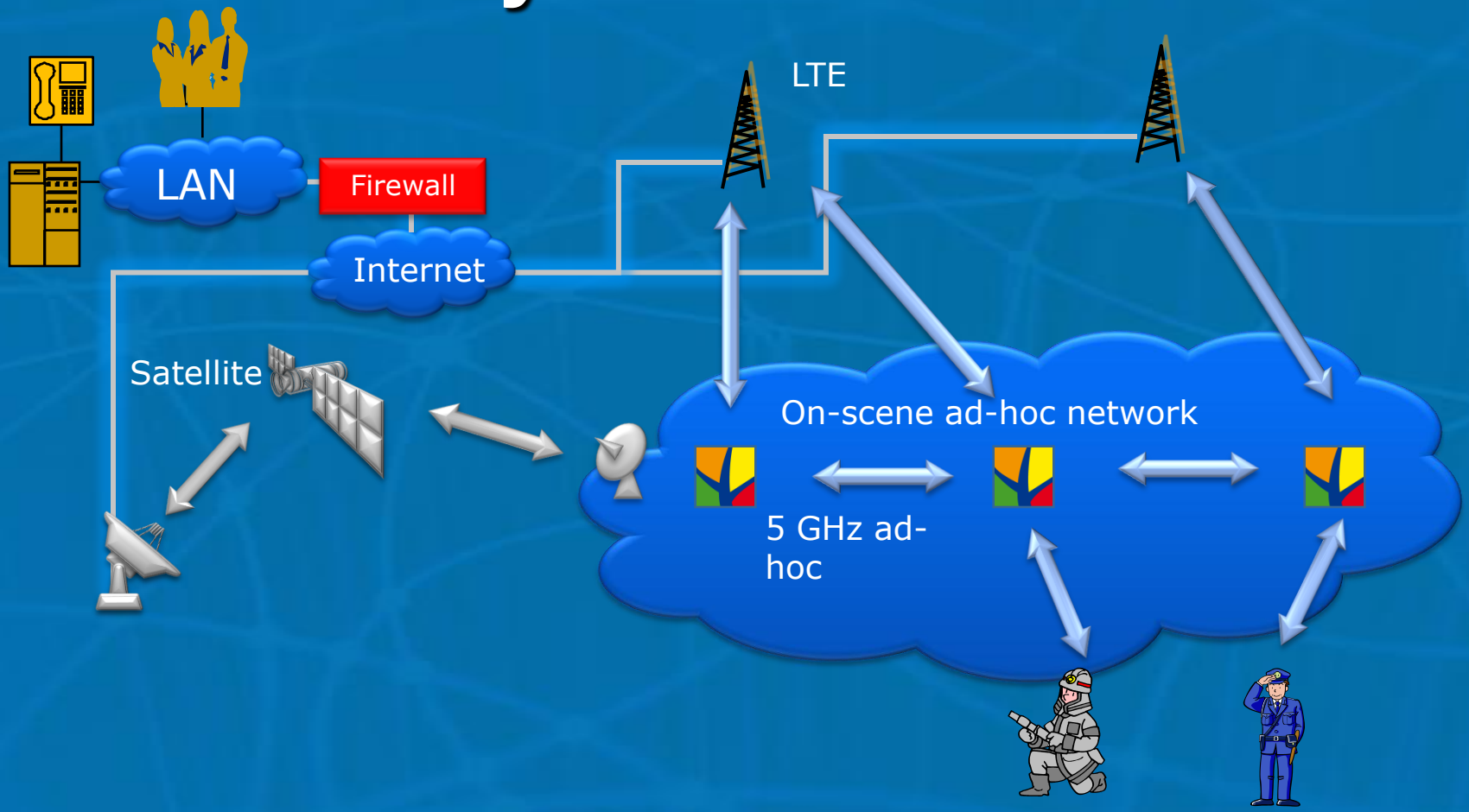
Combining technologies

- The overall scenario can only be fulfilled by combining technologies
- Key technologies
  - LTE for wide area
  - Ad-hoc 5 GHz for on scene
  - Satellite in remote areas
  - Indoor

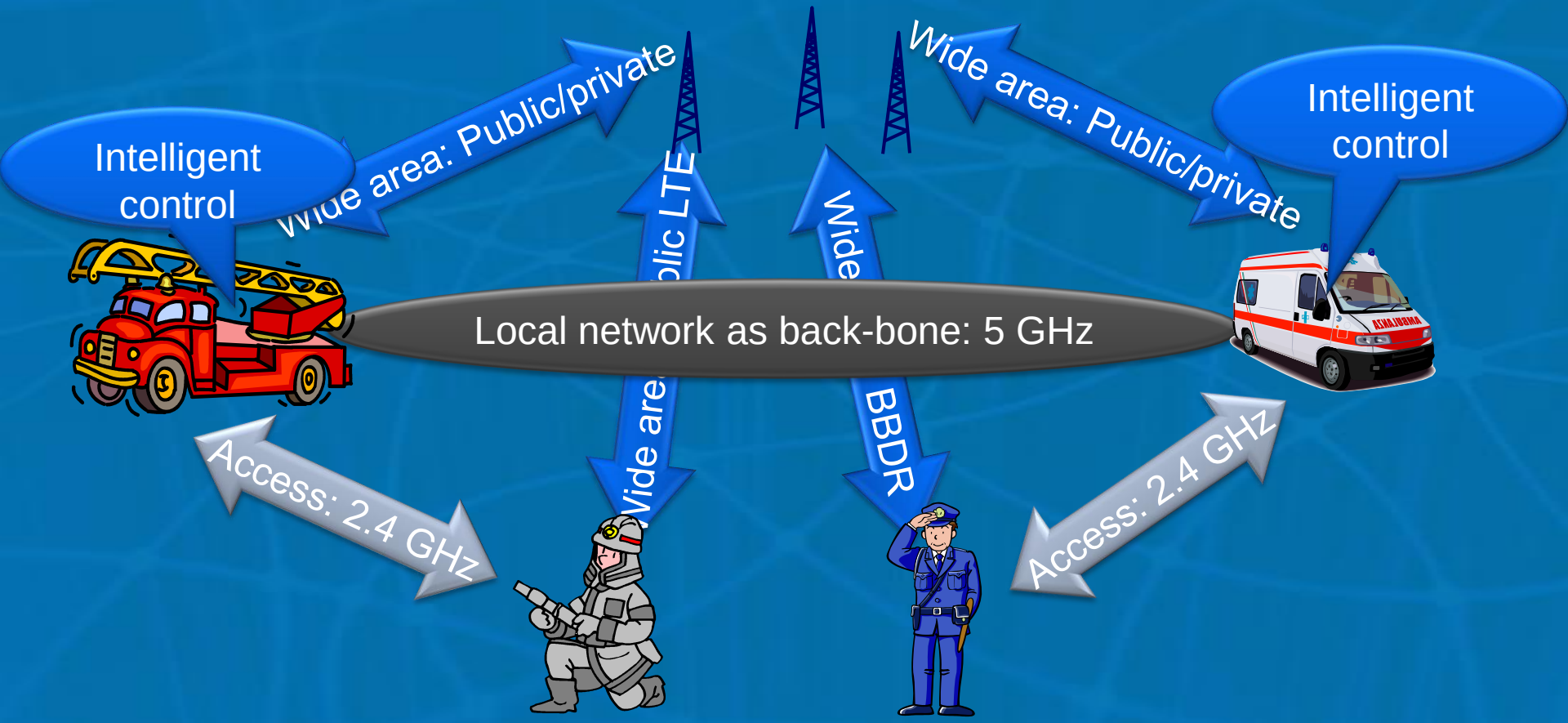




FIGO : Hybrid network



FIGO : Multi tier communication

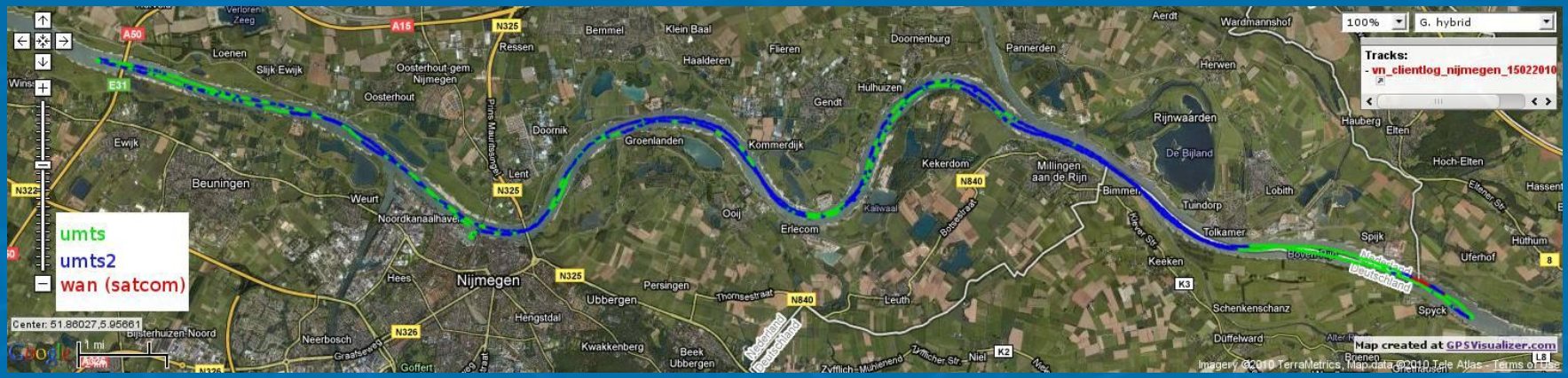


FIGO: Robust by multiple paths

Example deployments in the Netherlands

- Port of Rotterdam
  - Harbor management
- Kennemerland
  - Sail 2010
- Gelderland Midden
  - Forest fire control

Hybrid radio KLPD Waal/Rein



- UMTS1: 84.3%
- UMTS2: 95.1%
- UMTS1+2: 99.5%
- UMTS1+2+Satcom:100%

Data applications reliably usable

SAIL 2010

- UMTS1: 90.5% available
- UMTS2: 97.4% available
- UMTS1+2: 99.4% available
- UMTS1+2+Satcom:100% (0.6% used)

Conclusion

- Public safety requires a combinations of radio communication
- Cognitive platforms automatically select the best technologies for the situation
- First systems are already operational, showing the potential