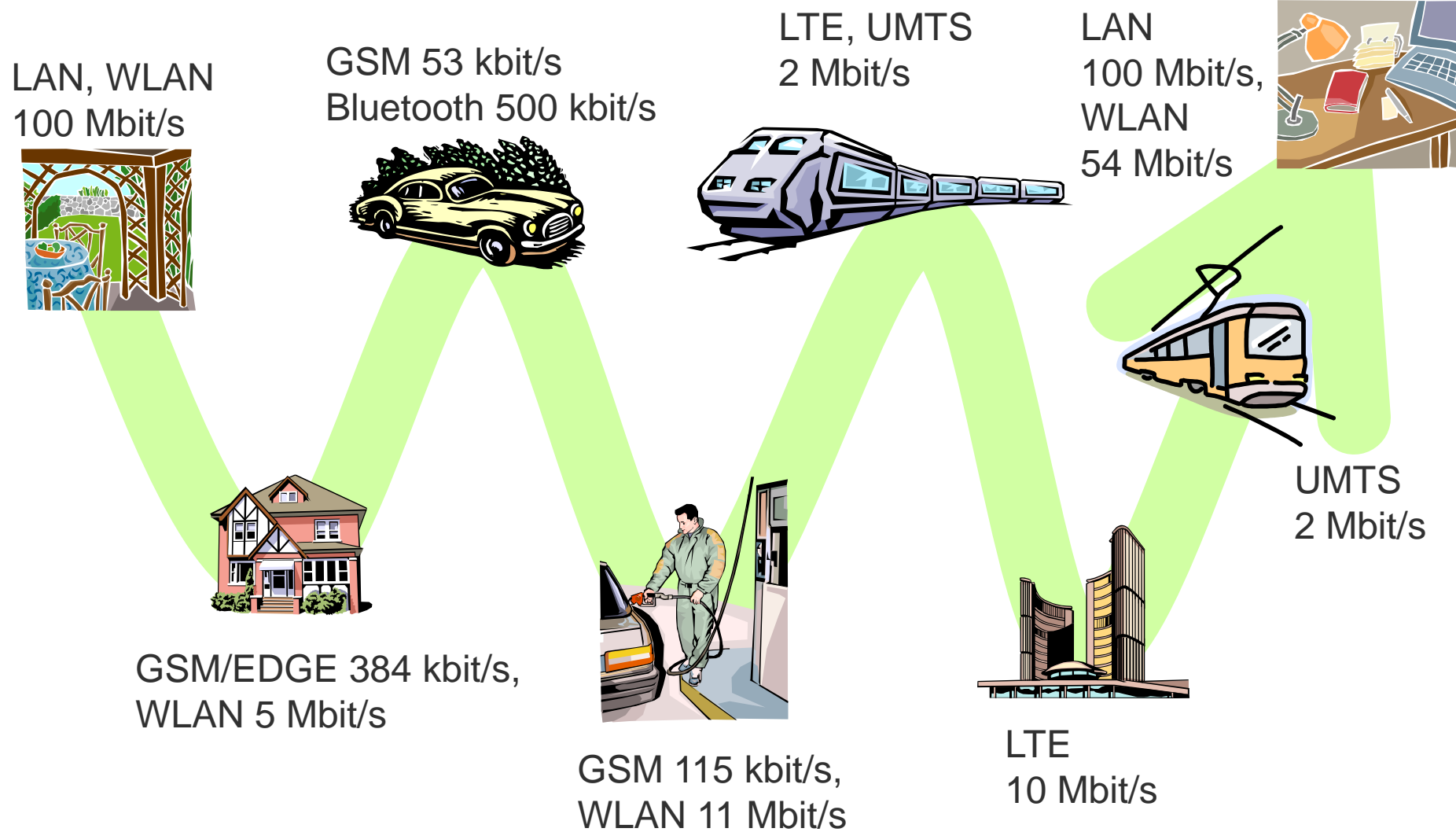


# Mobile Communications

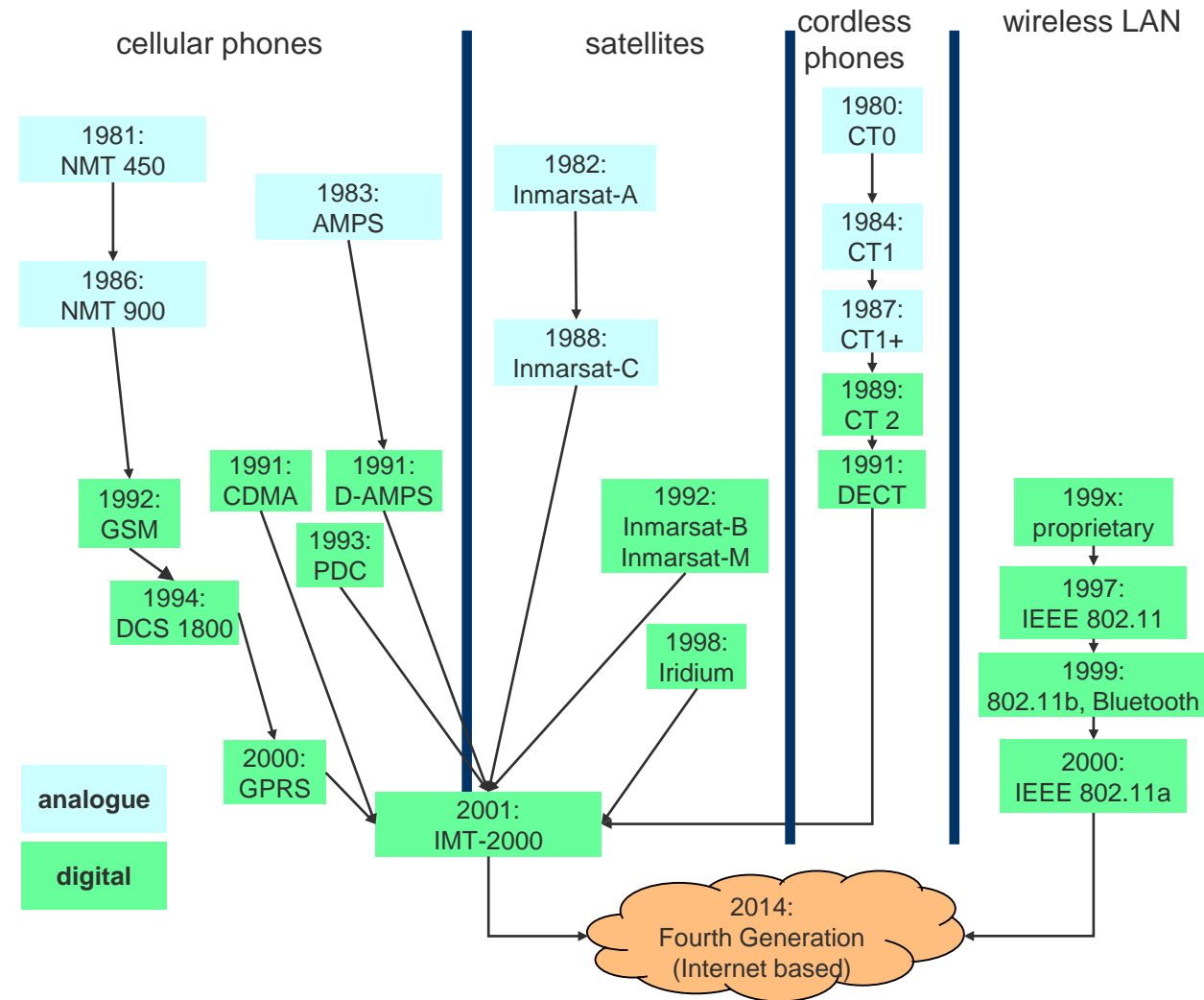
## Chapter 11 : Outlook

**The future of mobile and wireless networks – Is it 5G? All IP? Licensed? Public? Private?**

# Mobile and wireless services – Always Best Connected



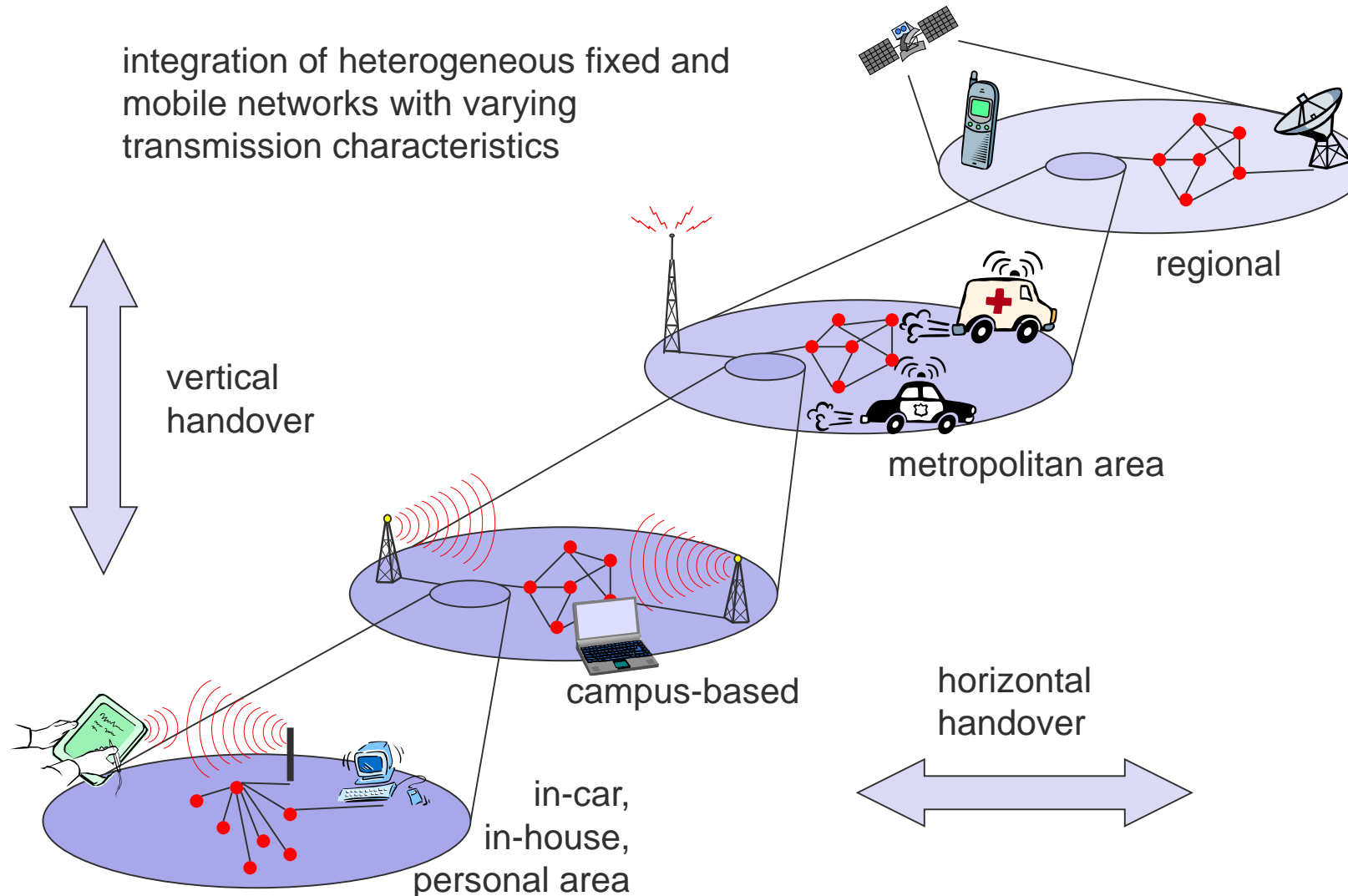
# Wireless systems: overview of the development



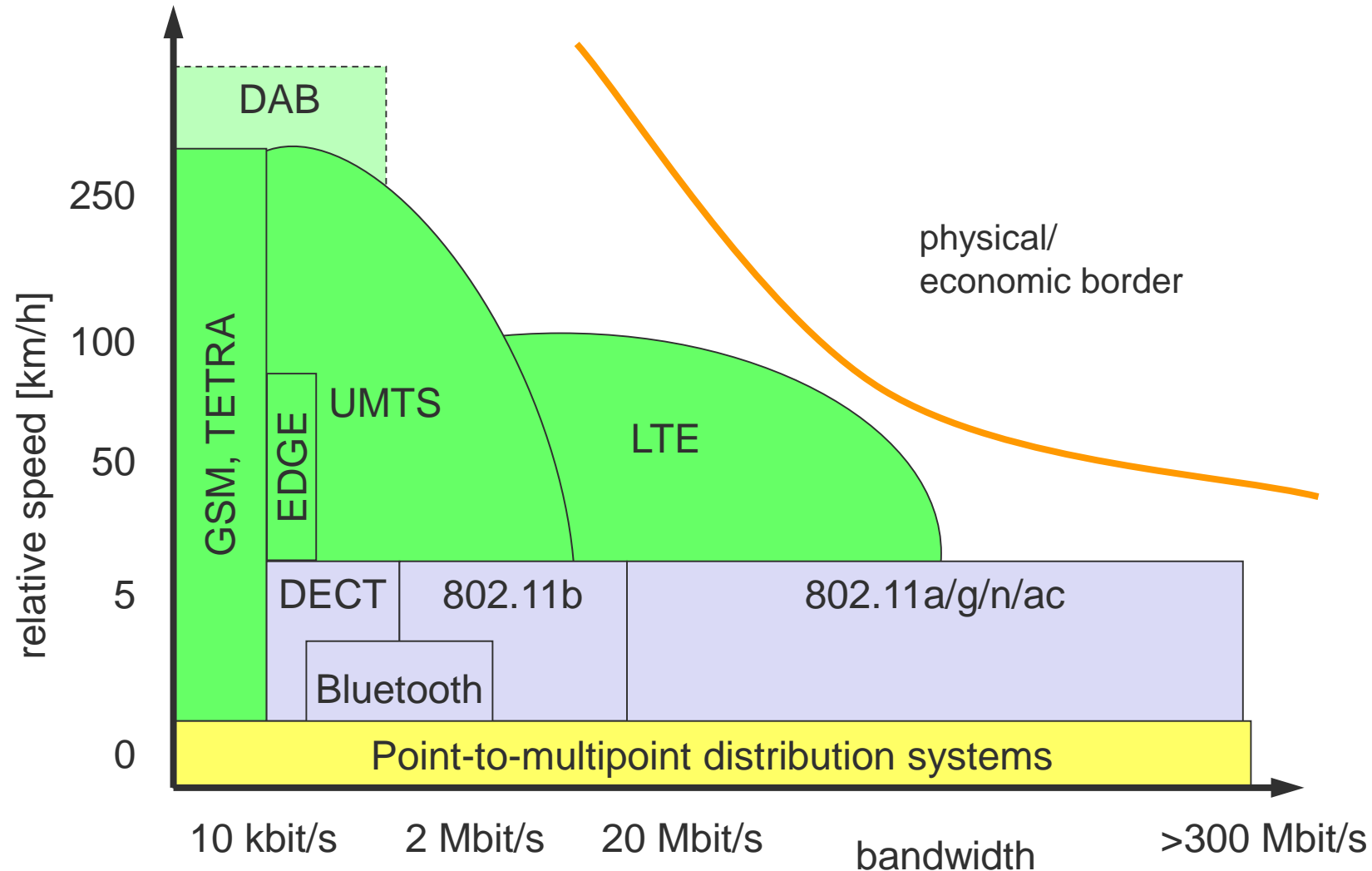
4...4.5...5G – fourth to fifth generation: when and how?  
 Currently rather 3.9 to 4G

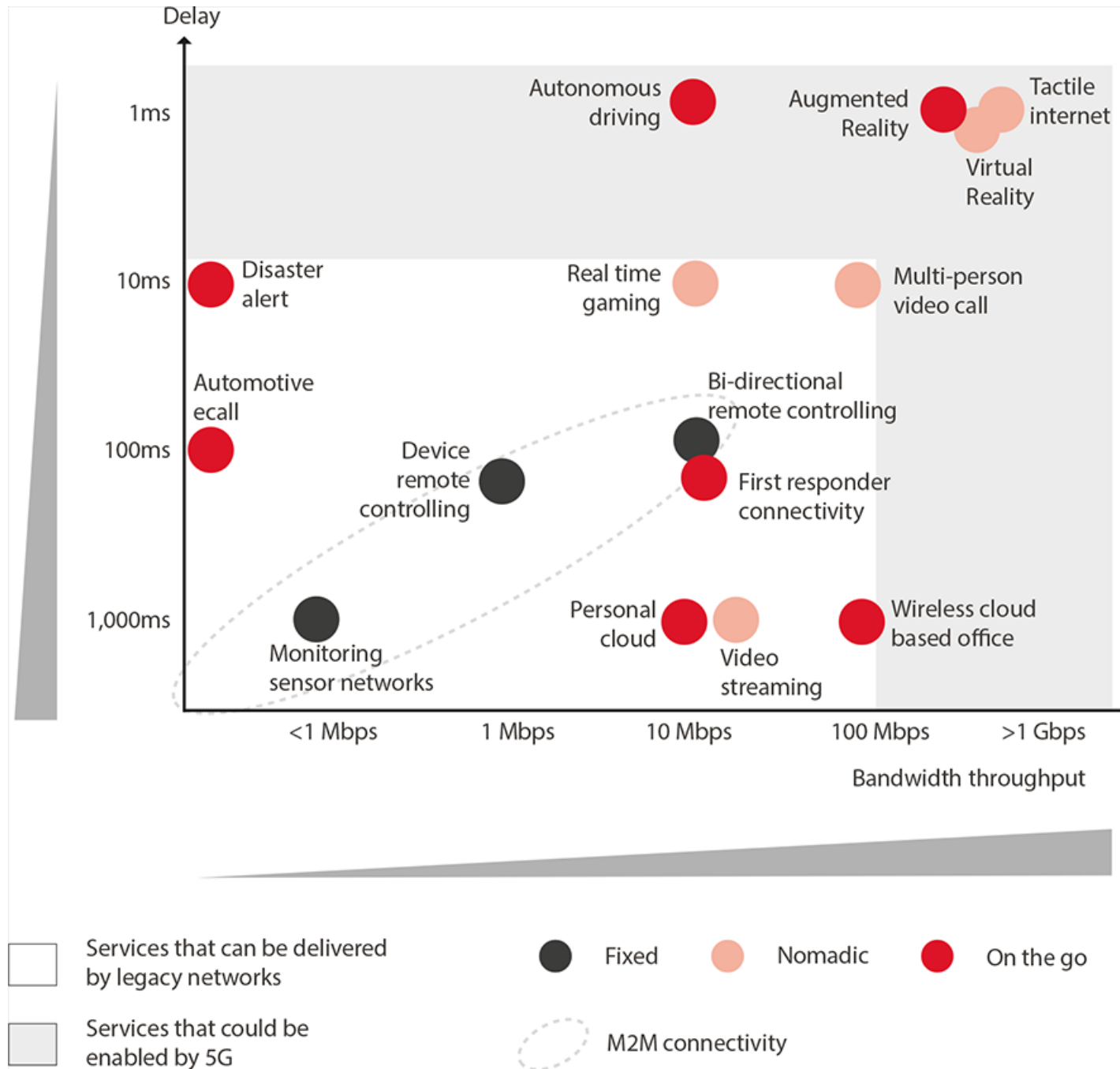
# Overlay Networks - the global goal

integration of heterogeneous fixed and mobile networks with varying transmission characteristics



# Wireless access technologies





Source: GSMA Intelligence

# Key features of future mobile and wireless networks

## Improved radio technology and antennas

- smart antennas, beam forming, multiple-input multiple-output (MIMO) – see LTE, 802.11ac
  - space division multiplex to increase capacity, benefit from multipath
- software defined radios (SDR)
  - use of different air interfaces, download new modulation/coding/...
  - requires a lot of processing power (UMTS RF 10000 GIPS)
- dynamic spectrum allocation
  - spectrum on demand results in higher overall capacity

## Core network convergence

- IP-based, quality of service, mobile IP

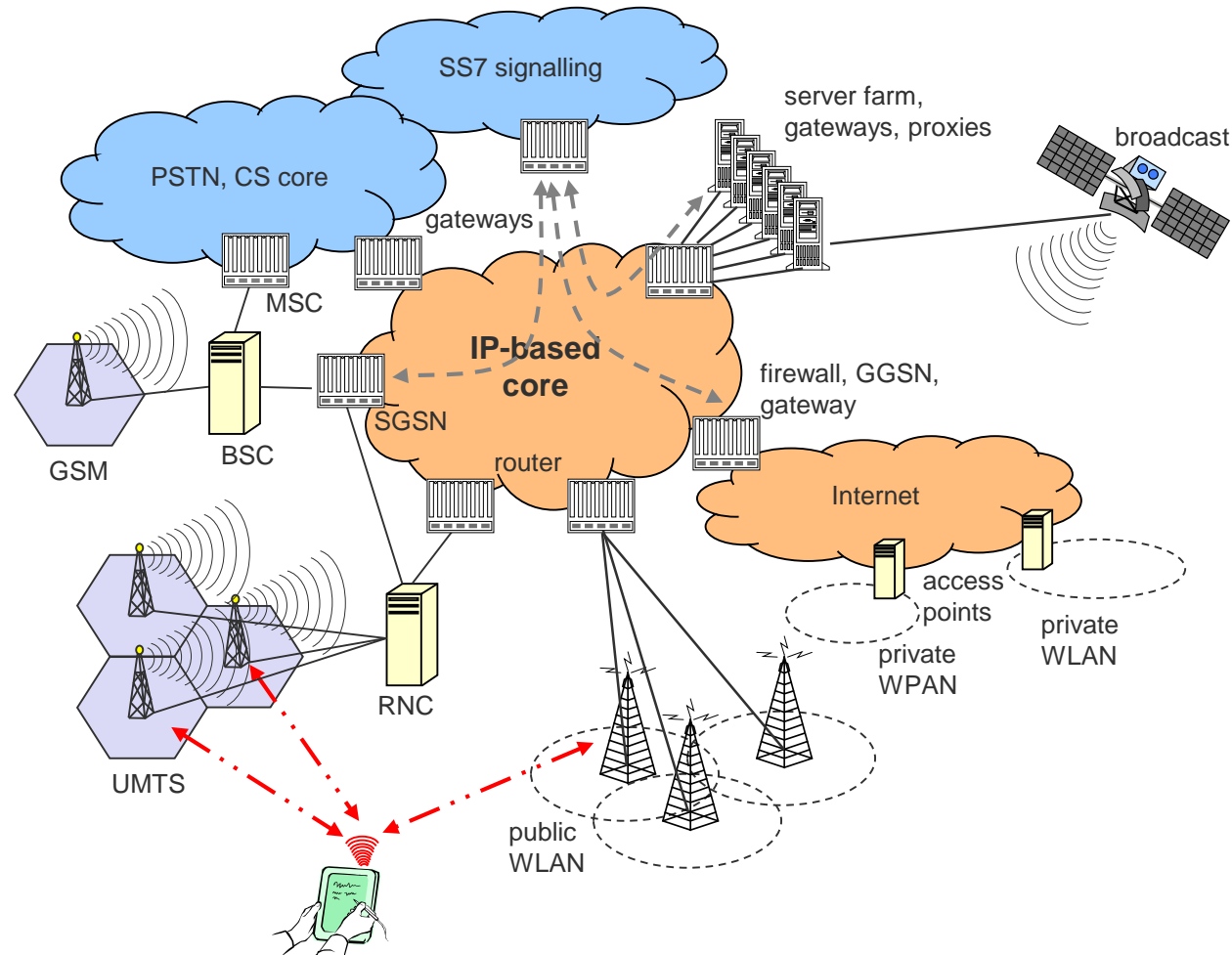
## Ad-hoc technologies

- spontaneous communication, power saving, redundancy

## Simple and open service platform

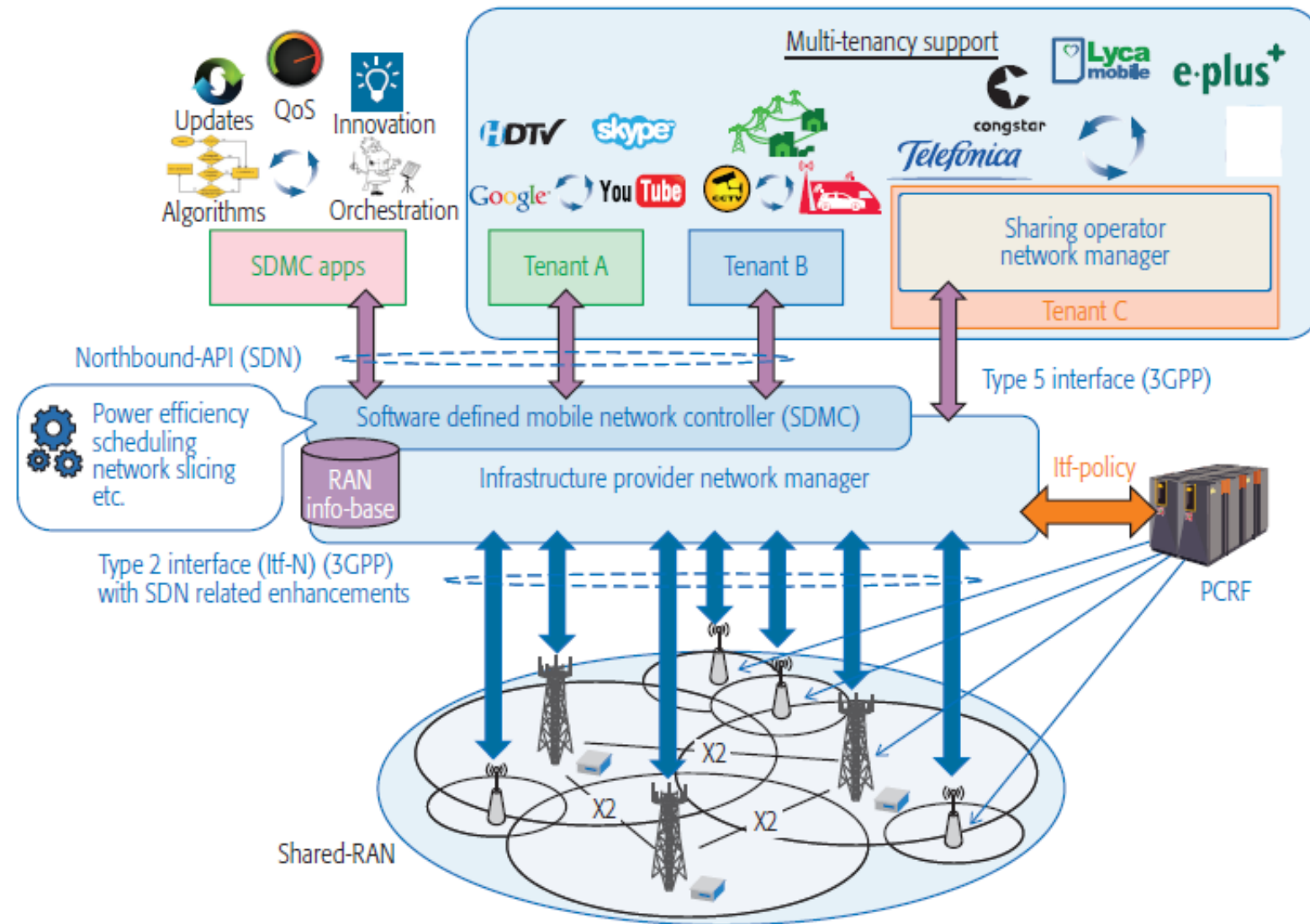
- intelligence at the edge, not in the network (as with IN)
- more service providers, not network operators only

# Example IP-based 4G/Next G/... network



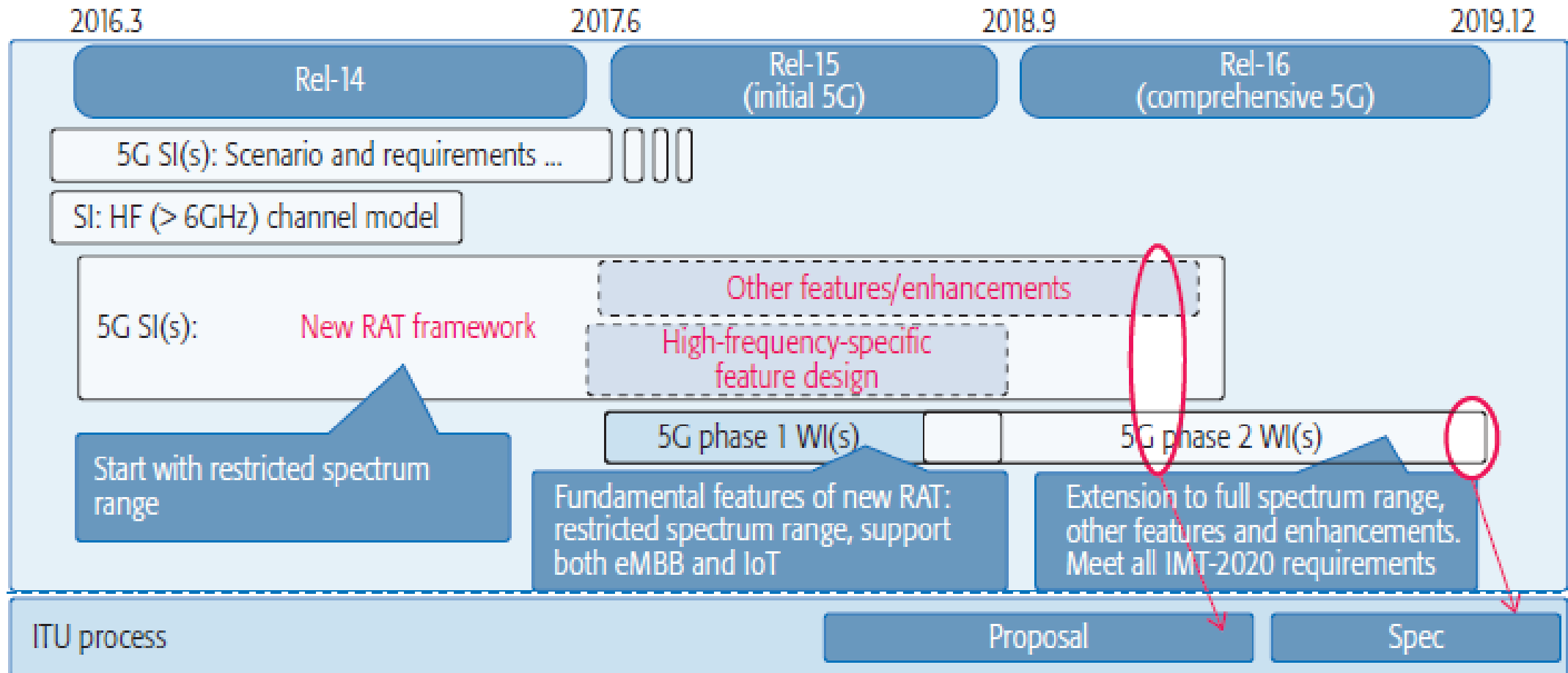


# Software Defined Mobile network Controller



Source: Rost et. Al, Mobile Network Architecture Evolution toward 5G, IEEE Communications Magazine, vol. 54, no. 5, 2016

# 3GPP LTE standardization roadmap toward 5G



Source: Rost et. Al, Mobile Network Architecture Evolution toward 5G, IEEE Communications Magazine, vol. 54, no. 5, 2016

## Potential problems

### Quality of service

- Today's Internet is best-effort
- Integrated services did not work out
- Differentiated services have to prove scalability and manageability
- What about the simplicity of the Internet? DoS attacks on QoS?

### Internet protocols are well known...

- ...also to attackers, hackers, intruders
  - security by obscurity does not really work, however, closed systems provide some protection

### Reliability, maintenance

- Open question if Internet technology is really cheaper as soon as high reliability (99.9999%) is required plus all features are integrated

### Missing charging models

- Charging by technical parameters (volume, time) is not reasonable
- Pay-per-application may make much more sense

### **Killer application? There is no single killer application!**

- Choice of services and (almost) seamless access to networks determine the success

# Thanks, take care – and have fun with Mobile Communications!



Source: Ed Jones/AFP, Seoul, Südkorea,, 22.06.2016