Communications in transportation systems

Public transportations:
- **CBTC** (Communications-Based Train Control) for automatic driving
- **CCTV** surveillance
- **Driver connectivity**

Private transportations:
- **V2V** communications for traffic safety
- **V2I** communications for infotainment and navigation

Standard: **TETRA** (TErrestrial Trunked RAdio)

Objective: convergence of **DSRC** and **PMR** to **LTE-A**

LTE for vehicular applications

Commercial ITS or M2M communications

Limits:
- **Bottleneck**
- Single point of failure
- Delay
- Large number of simultaneous handovers

Vehicle-to-Vehicle LTE-Advanced

**LTE-A VEHICLE-TO-VEHICLE**

Features:
- Vehicles are equipped with mobile Relay Stations (static relay stations are in LTE rel. 10)
- RS are connected via **X2 interface** (LTE specifications: X2 interface connects eNodeBs)
- **CBTC communications** between vehicles over LTE relay
- **CCTV** and commercial traffic can be relayed (e.g. in absence of coverage)

Challenges:
- Wireless X2 interface (typically cabled and static)
- Mobility of relay stations

Limits:
- Still relies on the LTE network infrastructure

**LTE-A DEVICE-TO-DEVICE**

Features:
- All communications are direct device to device
- Proximity discovery (awareness)
- Infrastructure independent

D2D communications are in LTE rel. 12, however:
- not safety-oriented
- discovery relies on network infrastructure
- discovery delay
- unicast D2D transmissions

Challenges:
- Dynamic resources allocation
- Infrastructure-less proximity discovery
- Broadcast direct transmissions

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