5G 기반 자동차/교통 산업 혁신

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The growing pressure on transportation

- Increasing transportation demands around the world

- Driver supply cannot cater for increased demand – 50k shortage in US alone

- Transportation accounts for 21% of global emissions

- Fragmented solutions to connect and optimize vehicle fleets
C A R E

Connected
Connected vehicles sit at the center of the transportation ecosystem

Automated
Self-driving vehicles are changing our cities and societies

Redefined
Business models are being created – now’s your chance to act

Electric
Cleaner energy leads to cleaner transportation and cleaner cities
Connectivity in automotive

More Communication

With vehicles …

With Pedestrians …

With road infra …

And the other worlds …

Connected driving
— C-ITS (Basic/Advanced)
— Autonomous Vehicle

Traffic management
— Transportation
— Fleet management

Infotainment

Cellular IoT
— LTE-V2X
— 5G
3GPP LTE based V2X services

— 3GPP specifies 27 use cases in V2V, V2I, V2P and V2N at TR22.885

— **V2V use cases:** Forward collision warning, Control loss warning, Emergency vehicle warning, Emergency stop, Cooperative Adaptive Cruise Control (CACC), Wrong way driving warning, V2X message transfer under MNO control, Pre-crash sensing warning, V2X areas outside network coverage, V2X by UE-type RSU, Privacy in the V2V communication environment

— **V2I use cases:** Emergency stop, Queue warning, Road safety services, Automated parking system, V2X Road safety service via infrastructure, Curve speed warning, Remote diagnosis and just in time repair notification

— **V2P use cases:** Pedestrian collision warning, Vulnerable Road User (VRU) safety, Pedestrian road safety via V2P awareness messages

— **V2N use cases:** V2N traffic flow optimisation (virtual traffic lights), V2X minimum QoS, Use case for V2X access when roaming, Mixed use traffic management, Enhancing positional precision for traffic participants, V2N use case to provide overview to road traffic participants and interested parties
3GPP 5G based V2X services

- 3GPP specifies 25 use cases at TR22.886
- **General use cases**: Communication between vehicles of different 3GPP RATs, Multi-PLMN environment, Use case on Multi-RAT, Use case out of 5G coverage, Dynamic ride sharing, Tethering via vehicle, Proposal for secure software update for electronic control unit
- **Platooning use cases**: eV2X support for vehicle platooning, Information exchange within platooning, Automated cooperative driving for short distance grouping, Information sharing for limited automated platooning, Information sharing for full automated platooning, Changing driving-mode
- **Advanced driving use cases**: Cooperative Collision Avoidance (CoCA), Information sharing for limited automated driving, Information sharing or full automated driving, Emergency trajectory alignment, Intersection information provisioning for urban driving, Cooperative lane change (CLC) of automated vehicles, 3D video composition for V2X scenario
- **Remote driving use cases**: eV2X support for remote driving, Teleoperated support (TeSo)
- **Extended sensors**: Automotive: sensor and state map sharing, Collective perception of environment, Video data sharing for automated Driving (VaD)
Predictive Mobility
Cellular IoT evolution and segments

Commercial – Growth

Massive IoT

Broadband IoT

Critical IoT

Industrial Automation IoT

One network – multiple use cases and industries

Low cost devices, low energy
Small data volumes
Massive numbers
NB-IoT/Cat-M1 (LTE and NR)

High throughput
Low latency
Large data volume
LTE + NR

Ultra reliability
Ultra low latency
Very high availability
NR

Ultra reliability
Ultra low latency
Very high availability
NR

Industrial protocols
Time sensitive networks
Precise indoor positioning
NR

LTE-V2X (PC5)

5G-V2X (PC5)

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Cellular IoT for Connected vehicle

- Broadband IoT
  - Managing fleets
  - Sensor sharing
  - Telematics
  - Software upgrades
  - Infotainment
  - HD maps
  - Remote processing
  - Co-operative maneuvers
  - Remote driving
  - Co-operative safety
  - Autonomous driving

- Massive IoT

- Critical IoT
Critical IoT — for ultra reliability, low latency

- **5G NR**
- **URLLC**
- 99.999% reliability
- 1ms one-way
- Local area/Wide area
- Automotive
- Utilities
- Smart Manufacturing
- in industry campus

- Autonomous vehicles
- Deeper integration with C-ITS systems
- Platooning

- Utilities – Smart Grids
- Renewables integrated into Grid
- Real time control

- Real time control of industrial systems
- Fully immersive AR/VR
### Critical IoT — use cases and spectrum bands

<table>
<thead>
<tr>
<th>Wide area use cases</th>
<th>Local area use cases</th>
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<td><img src="image1" alt="Icons" /></td>
<td><img src="image2" alt="Icons" /></td>
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#### High bands (24GHz – 40GHz)
- Extremely low latency
- Ultra-high reliability
- High capacity
- Limited coverage

#### Mid bands (1GHz – 6GHz)
- Extremely low latency (with FDD/latency favorable TDD)
- Ultra-high reliability
- Decent coverage & capacity

#### Low bands (sub-1GHz)
- Extremely low latency
- Ultra-high reliability
- Wide area coverage
- Limited capacity
Critical IoT evaluation in 3GPP

— ITU requires 99.999% reliability within 1ms UL/DL for a 32byte message
— 3GPP concluded its feasibility in Rel-15
— In Rel-16, 3GPP is evaluating various combinations of reliability (99.9 – 99.9999%), latency (1-7ms), and throughput (up to Mbps)
LTE-V2X supports two communication paths

V2N (NW) over LTE cellular interface with enhanced multi-cast for local distribution

V2V/V2P over enhanced LTE device-to-device PC5 interface (sidelink)

V2P (Pedestrian) over optimized LTE cellular Uu interface (up- / down-link)

V2I (Roadside Infrastructure) over enhanced LTE device-to-device PC5 interface (sidelink)
### Communication paths

<table>
<thead>
<tr>
<th>Direct (short range)</th>
<th>Indirect (via NW)</th>
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<tr>
<td><strong>V2N Vehicle to Network</strong></td>
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<tr>
<td><strong>V2V Vehicle to Vehicle</strong></td>
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<tr>
<td><strong>V2I Vehicle to Infrastructure</strong></td>
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<tr>
<td><strong>V2P Vehicle to Pedestrian</strong></td>
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5G - One network for multiple use case and industries

- 10-100x End-user data rates
- 1000x Mobile data volumes
- 5x Lower latency
- 100x More devices

- Low cost Device cost reduction
- 5x NW energy efficiency
- 3x Spectral efficiency

Network slicing

- Enhanced MBB
- Massive IoT
- Broadband IoT
- Critical IoT
- Industrial Automation IoT
- Enterprise and Industry
Distributed Cloud

- Autonomous driving
- Remote driving
- HD maps
- Co-operative safety
- Infotainment
- Managing Fleets

Any workload: Anywhere in the network: End-2-end orchestrated
Distributed Cloud – enabling technologies

- Dynamic orchestration of workloads and NW slices
- Programmable application interfaces
- Flexible network applications (vRAN, vEPC)
- Scalable execution environments
- Robust server hardware for central offices
- Security for distributed applications

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Dynamic Orchestration

- VIM/Container orchestration
- Network work-load orchestration
- Application interface exposure
- Application orchestration
- Service/Slice orchestration

Distributed Edge Data Center

Centralized Data Center

3-4 ms

Distributed Cloud – enabling technologies

Policy & Charging

Central Applications (e.g. IMS)

vEPC CP

Centralized Data Center

Internet Applications

Distributed Edge Data Center

Critical Traffic

vRAN

vEPC UP (CN UPF)

vEPC UP (CN UPF)

Local Application (VR/Robot)

vEPC UP (CN UPF)
3GPP support for edge computing

3GPP functions for Edge Computing

› UP Selection and reselection
› Local routing and traffic steering
› AF influence on traffic routing and UPF selection
› SSC mode
› Network Capability exposure
Automotive Edge Computing Consortium

Getting the Infrastructure Ready for Future Automotive BIG DATA

Future Automotive Service

1~10 EB/month Network Traffic

High Definition Map
Intelligent Driving

✓ Huge amount of data
✓ More capacity
✓ Improved coverage

100M Connected Cars

Define use cases and requirements

Focus on Vehicle-to-Cloud

Formulate a roadmap to bridge gaps

Network and Computing for BIG DATA

Our Work Stream

Address capacity and efficiency issues

Global Standardization

Collaborate with relevant communities
Mobile (r)evolution

— The telecoms industry was upended in 2008 by the launch of a new smartphone marketplace for apps.

— Allowing third-party developers to use programmable SDKs and APIs to develop new apps for the handset provided a platform for programmers to reach potentially millions of customers, and accelerated the opening up of the mobile operating system.

— 5G promises even more of an upset in programmability. If opening the OS of a mobile phone to external developers was a revolution, just think what is possible by opening up a whole mobile network.
The 5G Core network uses NEF to create and expose standard APIs to the internal and/or external developer ecosystem, which will result in new use cases.

Exposure enables:
— hiding the complexity of the underlying network
— secure/controlled access of the network to external AFs
— monetization of the network capabilities
Connected Traffic Tower
A holistic approach to connected automated transportation
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A holistic approach to connected automated transportation

The connected Traffic Tower integrates management of networks with fleet management, enabling orchestration of connected and automated fleets with high connectivity needs.
The Ericsson Connected Traffic Tower

The Ericsson Connected Traffic Tower provides a holistic approach to the remote management and orchestration of automated fleets, enabling:

**Network Management**
- Network performance data
- Connectivity Management

**Management of fleets and connected services**
- Connected fleet management
- Vehicle and asset management
- Rules and alert management (geo-fencing)
- Remote drive capabilities
- Reporting and analytics
- Orchestration of other connected services
Connected Traffic Tower
A holistic approach to connected automated transportation

Reliable network technology, connecting massive numbers of vehicles, as well as vehicle fleets with extreme connectivity needs
A new generation of network infrastructure

**LTE, 5G**
Ultra-low latency and high-bandwidth connectivity for more intense data load

**Network slicing**
Intelligent resource allocation for specific application needs

**Beyond edge computing**
Reduced data volume with distributed cloud local server architecture

**Connectivity management**
Cloud based IoT connectivity management, to control connected devices and networked assets
Connected Traffic Tower
A holistic approach to connected automated transportation

The Ericsson Connected Vehicle Cloud captures the full potential of connected vehicles, by orchestrating connected services efficiently.
The Ericsson Connected Vehicle Cloud captures the full potential of connected vehicles by orchestrating connected services efficiently.

- Fleet management
- C-V2X
- Autonomous Drive / Advanced Driver Assistance Systems
- Software and device management
- Connectivity optimization
Connectivity made easy for self driving trucks

Transportation challenges

— Increased transportation demand around the world
— Transportation accounts for 21% of global emission
— Driver supply cannot cater for increased demand – 50k driver shortage in US alone

Connected Automated Transportation solution for DB Schenker

— A complete connected autonomous transportation service
— The world’s first operational fully autonomous electric truck on public road
— Ecosystem partnership essential for success - Einride, Ericsson, Telia and DB Schenker

Ericsson brings value from
5G connectivity and Connected Vehicle Cloud capabilities

Expected Result
Reducing CO2 by 90%*
Reduced operations cost by 60%

* Einride estimates the CO2 reduction potential per pallet of freight when transitioning from diesel to electricity to be 90% for calculations with low-carbon electricity in Sweden. It will also reduce emissions of harmful NOx and ultrafine soot particles.
Managing complexity for Volvo Cars

— Partnership built on trust

— Volvo Cars leads in providing innovative digital services. Enabled by Ericsson Connected Vehicle Cloud since 2012.

— New five-year contract to further enable Volvo Cars next-generation digital vehicle services in more than 120 markets worldwide.

— The deal will enable Volvo car owners and drivers to benefit from the latest developments and increased performance in telematics, infotainment, navigation, automation, and fleet management.
Enabling innovation with Veoneer

— Partnership – unique combined capabilities

— The mission of automotive safety electronics company Veoneer is to build trust in mobility. As Veoneer expands offerings related to advanced driver assistance systems (ADAS) and Autonomous Driving (AD) capabilities, vehicle connectivity becomes an essential part of the recipe for safer mobility.

— Veoneer offerings are enabled and enhanced by Ericsson’s connectivity and cloud capabilities.

Value Ericsson brings:

— Robust “5G ready” connectivity for Veoneer ADAS & AD solutions

— Trusted “V2X ready” cloud platform for Veoneer services and offerings
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