RUN, Go Round, STOP and CONNECT

Enhance the added value of the car through the 4 connections

- People
- Vehicles and Roads
- Community
- Society
The vehicle will become a trusted partner through close communication with the driver.
As telematics become more sophisticated, the number of vehicles equipped with such systems and the volume of data they handle has increased dramatically.
Interactive voice response service

Vehicle settings (e.g., air conditioner, locking and unlocking doors, lamps)

- Set the air conditioner remotely
- Recognize individuals
- Remote operations
T-Probe traffic information
(Congestion status shown in colored segments on the map)

Map of traveled routes, information on facilities, and contributions
(Past traveled routes and volume of traffic shown in colored segments on the map)
- **Look-ahead information guidance services**

- **Data carried over when changing to a new vehicle**

- **Repair and maintenance (including malfunction prediction) service**

  - **Owner**
  - **Dealer**

  - Inquiry
  - Advice

  - Automatic malfunction Diagnostics Maintenance reminders
Roadside sensors can detect oncoming vehicles hidden from sight or crossing pedestrian drivers often fail to notice and alert the vehicle.

Safer driving based on the mutual exchange of information such as location and speed between vehicles.

Transmit information such as when the traffic signal will change to vehicles.

Toward the realization of Toyota’s ultimate goal: Zero casualties from traffic accident
Cannot be fully handled by autonomous systems alone → Covered by cooperative ITS

Handed by autonomous systems

• Toyota Safety Sense
• Lexus Safety System+, and others

2014 traffic accident data (National Police Agency)

Roadside-to-vehicle cooperative systems

Vehicle-to-vehicle cooperative system
**VICS** : Vehicle Information and Communication System

**ETC** : Electronic Toll Collection
Safe and Secure
Next generation ITS
“ITS Connect”
ITS専用周波数で通信し安全運転をサポート。

Commercialized in October 1, 2015.

ITS Connectは、誰もが安全・安心な運転ができる「交通死傷者ゼロ」の社会を願って、開発された技術です。クルマに搭載したセンサーでは捉えられない見通し外のクルマや人の存在、信号情報を、道路とクルマ、あるいはクルマ同士が直接通信して取得し、ドライバーに知らせることで安全運転を支援します。

Commercialized in October 22, 2015.

http://toyota.jp/technology/safety/itsconnect/
Signal change starting support

Red light warning

Cooperative adaptive Radar Cruise Control

Approaching Emergency vehicle Notification

Installed in approx. 50 Nagoya ambulances (2014, 2015)

Vehicle-to-Infrastructure communication

Vehicle-to-Vehicle communication

Right turn collision prevention

Vehicle-to-Vehicle communication

Vehicle-to-Infrastructure communication

Vehicle-to-Infrastructure communication

Vehicle-to-Infrastructure communication

Vehicle-to-Infrastructure communication

Vehicle-to-Infrastructure communication
Increasing sophistication of PTPS*

(*Public Transportation Priority System)

Ensuring rapid and on-schedule mass transit

Detecting route buses
Approaching buses identified through V2I communications.

Detecting route buses
On roads with several signalized intersections, predict when the bus will pass through to facilitate its travel.

Shorter red lights
Priority request transmitted

Longer green lights
Remaining traffic signal time transmitted
Improvement of decision-making technology to enhance safety and support automated driving.

Wireless communication is particularly well-suited to situations in which it is difficult to detect hazards with on-board systems alone.

Control systems
Detection, accident prevention and mitigation

Wireless communication helps smooth Automated driving

Look-ahead information from wireless communication helps smooth Automated driving

Roadside look-ahead information:
◆ Information that cannot be detected by autonomous sensors
◆ Coming Traffic signal information
When merging into the main, the system performs a look-ahead of the position and speed of vehicles running in the main lane, as well as the traffic conditions at the merging point, and then plots a course that includes the merging speed and location.
Look-Ahead of traffic signal information is important for safe and smooth crossing

【Go straight at the intersection only with Autonomous sensors】

Recognize only real-time traffic signal information
→ cannot make judgments on the Dilemma zone

【Go straight at the intersection with Wireless communication】

Receive traffic signal cycle information of which the car reach stop line
→ Avoid entering the dilemma zone
Opened on April, 2014 (1.55ha)

Urban Food Production

Hogaraka House
: Supporting local production for local consumption

Smart House
Homes Connecting with Car

Hydrogen Station

FC bus

Smart Mobility Park

Let’s experience cutting edge environmental technology!

(Based on ecoful town HP)
Harmonious Mobility Network

A transit system, which is people, city, and community friendly,
Designed to optimally integrate private cars and personal mobility
with public transportation

**Information service to support low-carbon, seamless transport**

**Ha:mo RIDE:** A self-service car sharing system which complements public transportation by utilizing ultra-compact electric vehicles. Suitable for short-distance trip in towns at user’s convenience

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**COMS**
Produced by TOYOTA Auto Motor
Ultra-compact EV

**PAS**
Produced by Yamaha Motor
Electrically-power assisted bicycle
Big data

Insurance → Marketing → Car sharing → Maintenance...

Creating new businesses
Entry of new participants

Telematics

Wideband wireless communication (static data)

Linking with smartphones

3G □ 4G □ ?

Automated driving

DCM

On-board electronic platform

ITS connect

ITS communication

V2I, V2V, V2P

Quasi-dynamic data

Dynamic data

760MHz □ ?

Area requiring high reliability
*Delay times must be guaranteed

Autonomous sensors
(real-time data)
Methods

<Static data>
- Map downloads
- Destination setting
- Route planning
- Route information

<Quasi-dynamic data>
- Look-ahead information (e.g., congestion, traffic restrictions, construction, obstructions)
- Information on changes in the route such as construction zones
- Incremental map update

<Dynamic data>
- Support for smooth merging and lane changes
- Information on vehicles or pedestrians outside visible range
- Ordinary road intersection information

<Sensor data>
- Route verification while driving
- Responding to sudden events such as children rushing into the vehicle’s path
- Object avoidance

Use case

- Big data analysis (making use of AI and the cloud)
- Occupant entertainment systems

Requirements

- Making use of 5G and related technologies
- High-volume transmission
- Making use of the cloud
- Suitable setup locations
- Information on a per lane basis
- High reliability (no disconnections)
- Guaranteed frequency band
- Guaranteed delay time
- Information, comfort
- Safety
- High accuracy
- High quality
- (resistant to dirt or changes in temperature, high durability)

Interval before a self-driving vehicle uses the data
- Short
✓ Connected cars are bound to evolve even further.
✓ Applications and requirements for communications used in connected cars are diverse.
✓ 5G is regarded as a promising technology for future infrastructure communications.
✓ However, satisfying the stringent demands imposed on connected car communications requires breaking with the past to develop new technologies and reinvent systems.

We look forward to ideas that will have automakers saying

“We want in!”
Thank you for your attention

Rewarded with a smile
by exceeding your expectations

TOYOTA