

DSRC Standards for Multiple Applications

- **ETC in Japan**
- **DSRC Multiple Applications**
- **Feature of current DSRC**
- **DSRC Application Sub Layer**
- **Next generation DSRC**
- **Standards related to DSRC**

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OKI Electric Industry, Japan

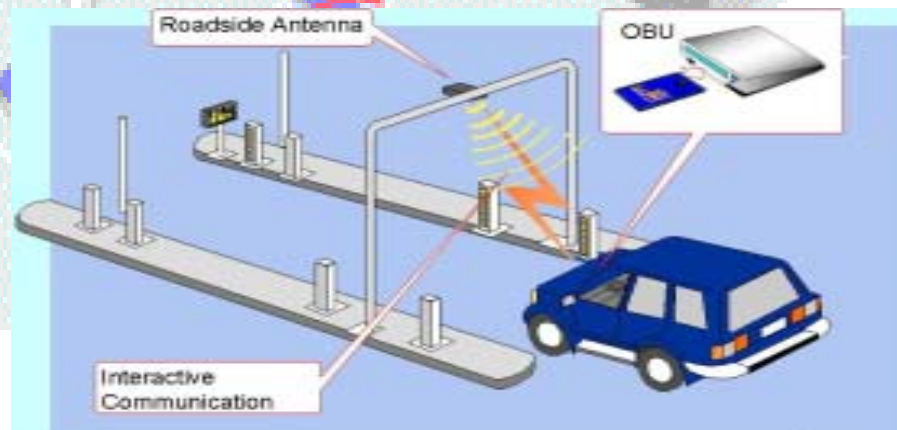
ETC in Japan

- Nationwide Interoperable System

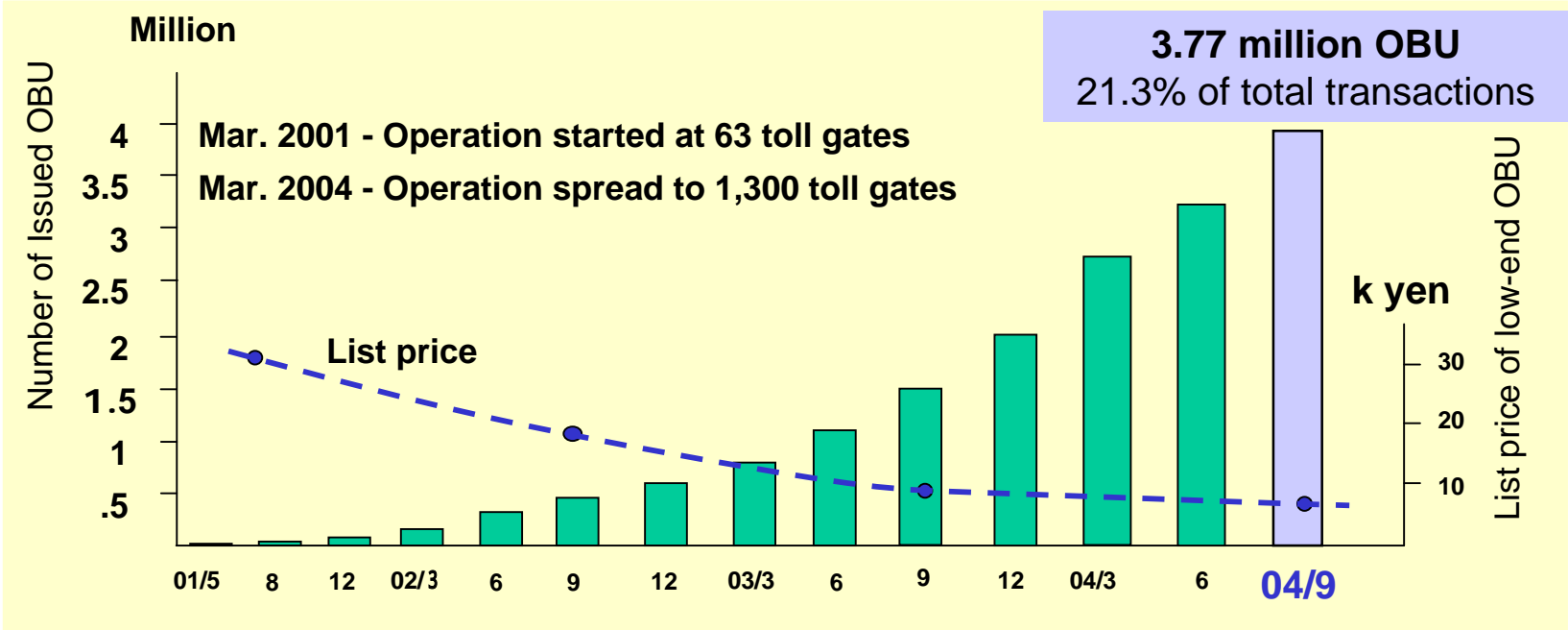
Service Providers: Japan Highways, Metropolitan Express Ways, Hanshin Express Ways, Honshu-Shikoku Bridges, etc.

- **Number of toll gates:** 1,300 as of the end of March 2004.

- **Number of OBU (On Board Unit):** 3.77 million as of the end of September 2004

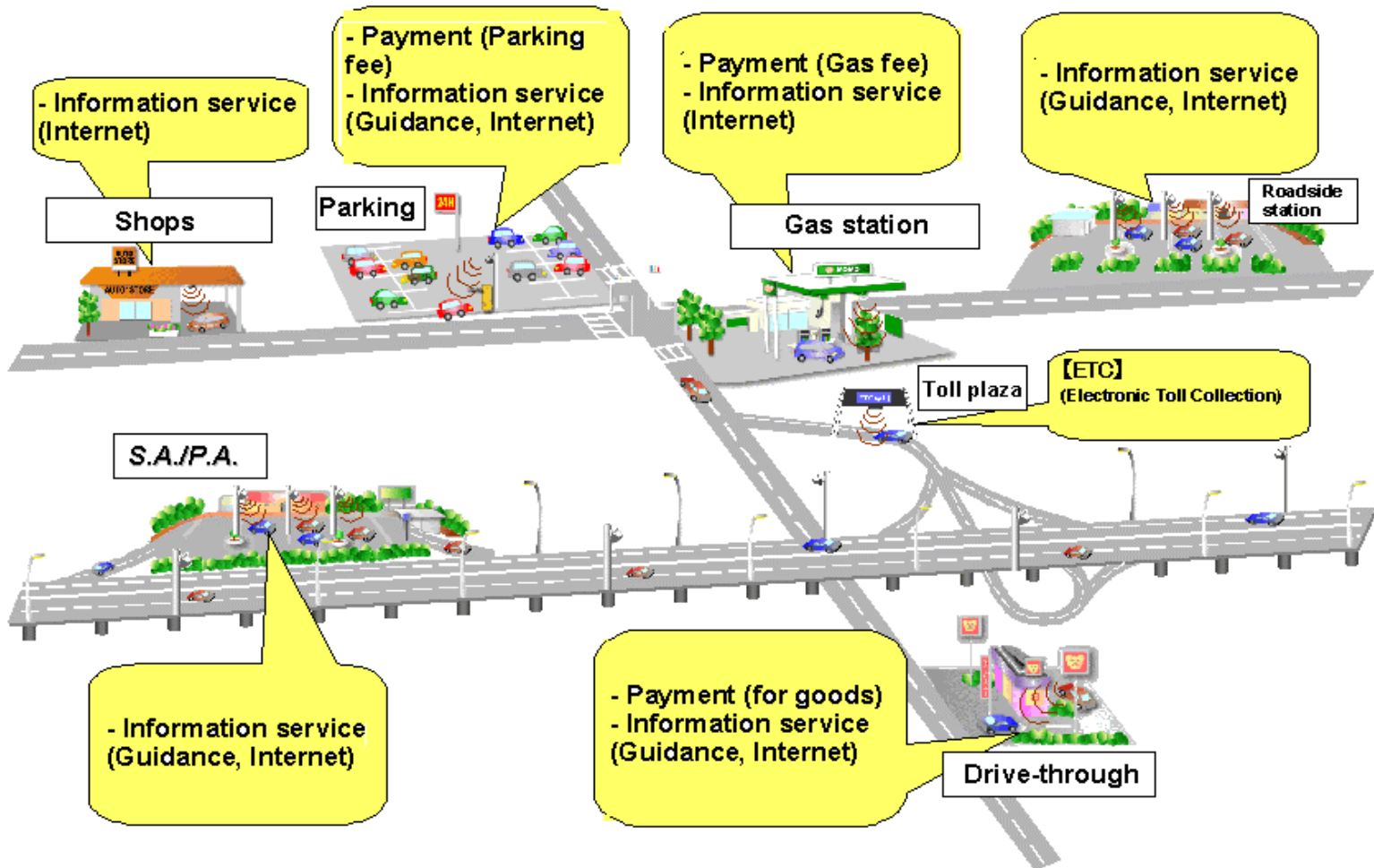


Growth of ETC On Board Units in Japan

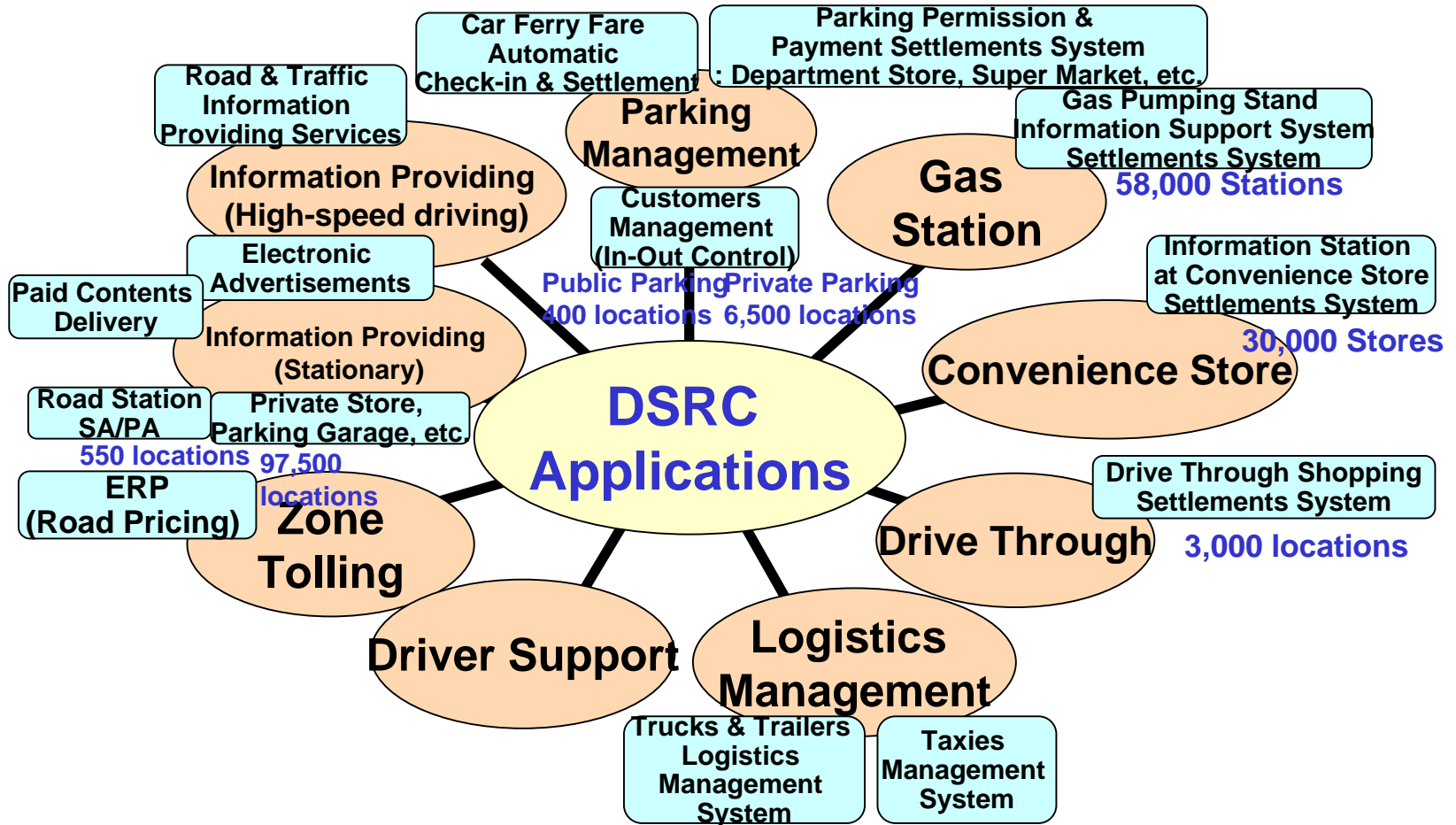


Big potential market by the single standard
 ↓
Rapidly growing OBU (On Board Unit) market
 ↓
OBU Price Down

DSRC Multiple Applications



DSRC Multiple Applications being studied in Japan

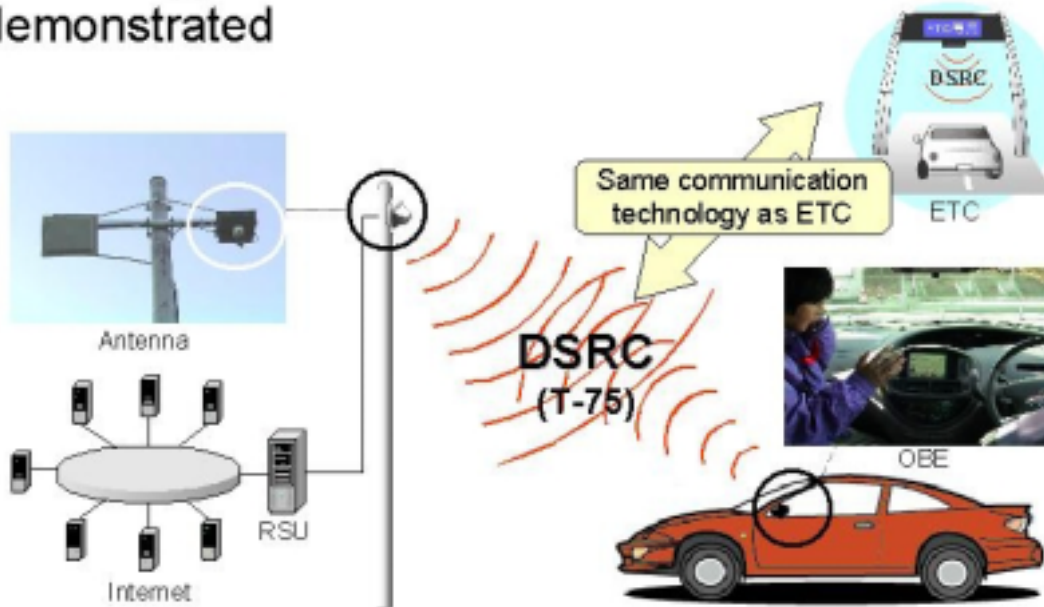


Development of DSRC applications in Japan

- **Smart Gateway** by TAO (Telecommunications Advancement Organizations): Development of a radio hand-over technology and a network hand-over technology over consecutive or discrete communication zones.
- **Smart Communications** by the Ministry of Land, Infrastructure and Transport: ITS Communication Services Platform Using 5.8GHz DSRC.
- **Multiple DSRC Applications Systems at Gas Station** by ITS Research Institute: Trial of multi-application DSRC system at Gas station.
- **Parking Garage Management Systems** by TOYOTA TSUSHO and TOWA Real Estate Group.
Use of DSRC in underground parking garage by Mitsubishi Corp and Mitsubishi Estate Group:

Smart Communications

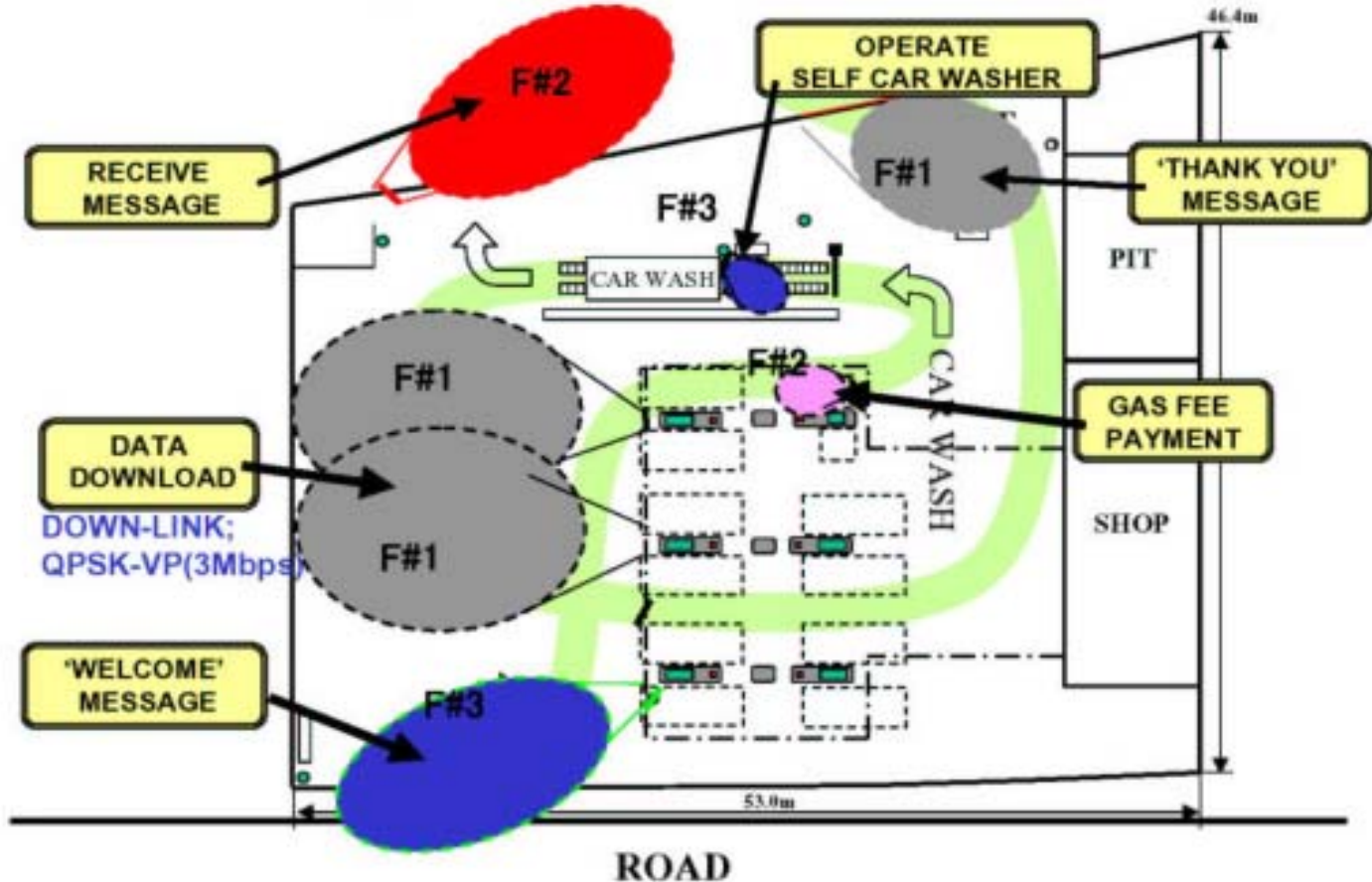
- **IP connection experiment** using ETC communication technology
 - ETC dedicated communication become multipurpose communication through the use of **ASL (Application Sub Layer)**
- Various types of Smart Communication services are demonstrated



Calsonic Kansei Corporation
KDDI Corporation
Sumitomo Electric Industries, Ltd.
DENSO Corporation
TOYOTA MOTOR Corporation
Nissan Motor Co., Ltd.
NEC Corporation
Hitachi, Ltd.
Fujitsu Limited
Matsushita Electric Industrial Co., Ltd.
Mitsubishi Heavy Industries, Ltd.
Mitsubishi Electric Corporation
Yazaki Corporation

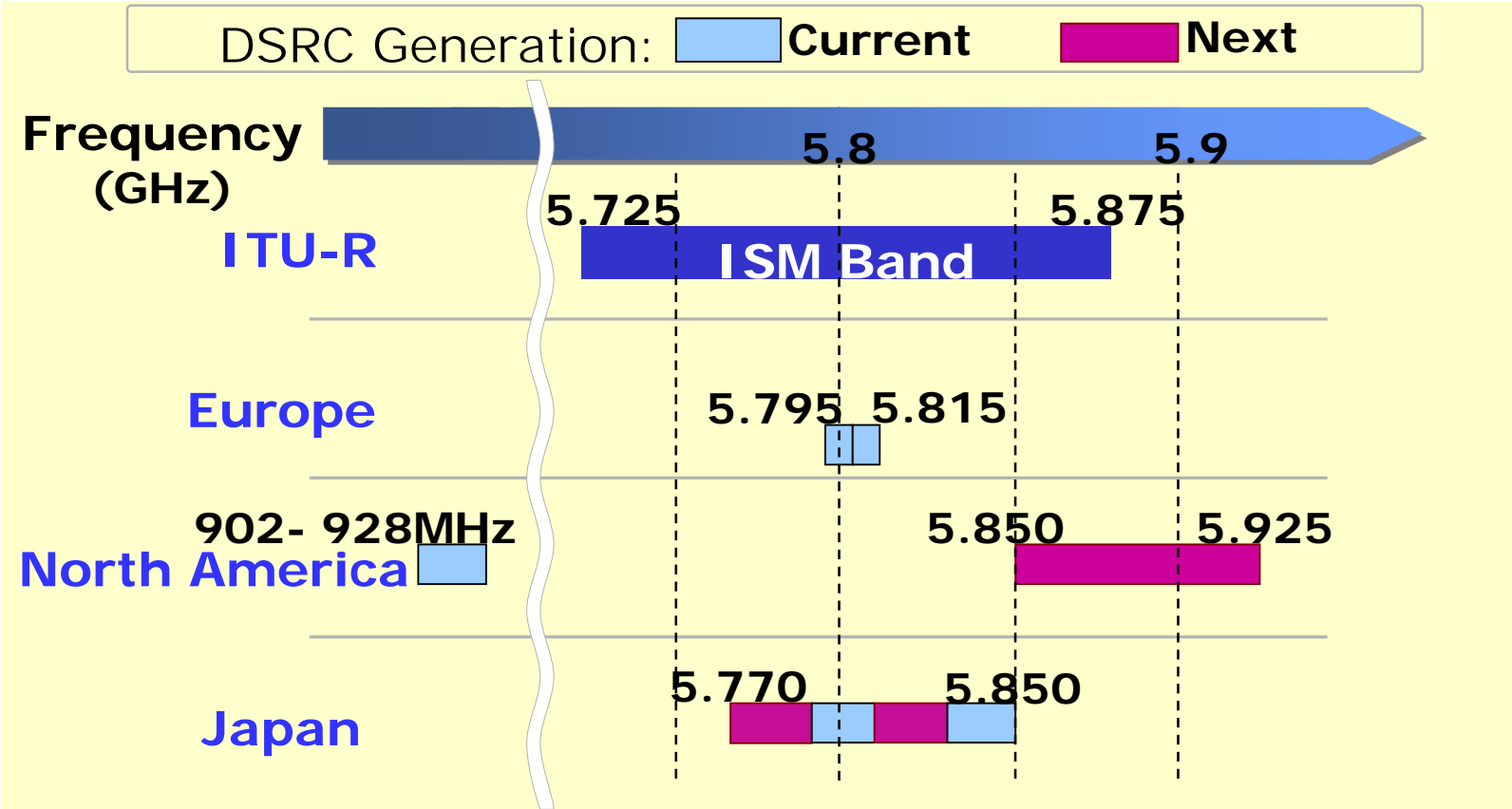
Multiple DSRC Applications System at Gas Station

DSRC multiple application at Gas Station using ASL.



AUTOBACS SEVEN, Tsubasa Systems, OMRON, Panasonic....

Worldwide DSRC Spectrum Allocations

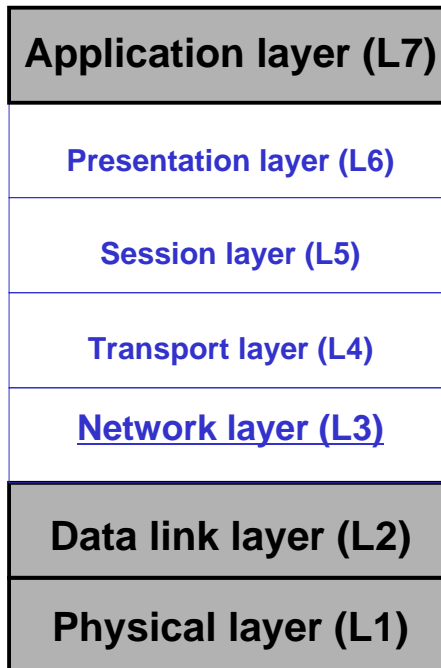


Regional standards for DSRC

Item	Japan (ARIB)	Europe (CEN)	America (ASTM)
Duplex	OBU: Half-duplex RSU: Full-duplex	Half-duplex	Half-duplex
Communication system	Active	Passive	Active
Radio frequency band	5.8GHz band 80MHz bandwidth	5.8GHz band 20MHz bandwidth	5.9GHz band 75MHz bandwidth
Channels	Down-link: 7 Up-link: 7	4	7
Channel separation	5MHz	5MHz	10MHz
Data transmission rate	Down / Uplink: 1 or 4 Mbps	Down-link: 500kbps Up-link: 250kbps	Down / Up-link: 3 - 27Mbps
Coverage	30m	15 - 20m	1,000m (Max)
Modulation	2-ASK (1Mbps) 4-PSK (4Mbps)	RSU: 2-ASK OBU: 2-PSK (Sub-carrier modulation)	OFDM

Characteristic of current DSRC

DSRC protocol stack



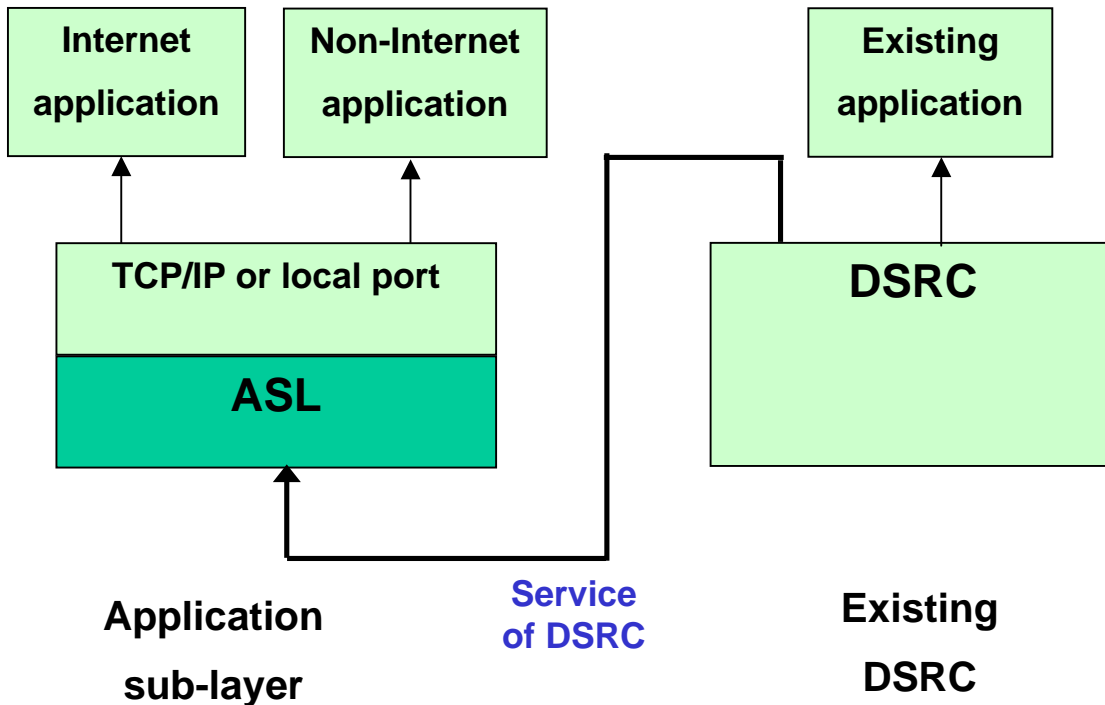
Communication Architecture of current DSRC*

(*Current DSRC: In 1992, standardization for the DSRC started in European Committee for Standardization)

Because of constraints specific to a DSRC link, such as limited transmission capacity, discontinuous coverage, random arrival/exit of the vehicles in the area, current DSRC operations have been limited.

- **Network layer is eliminated**
- Transport layer is eliminated
- Session layer is eliminated
- Presentation layer is eliminated

Concept of application Sub Layer (ASL)



Application Sub Layer (DSRC-ASL)

Developed in ARIB, Japan (ARIB STD-T88) for easy deployment of multi application for the existing DSRC.

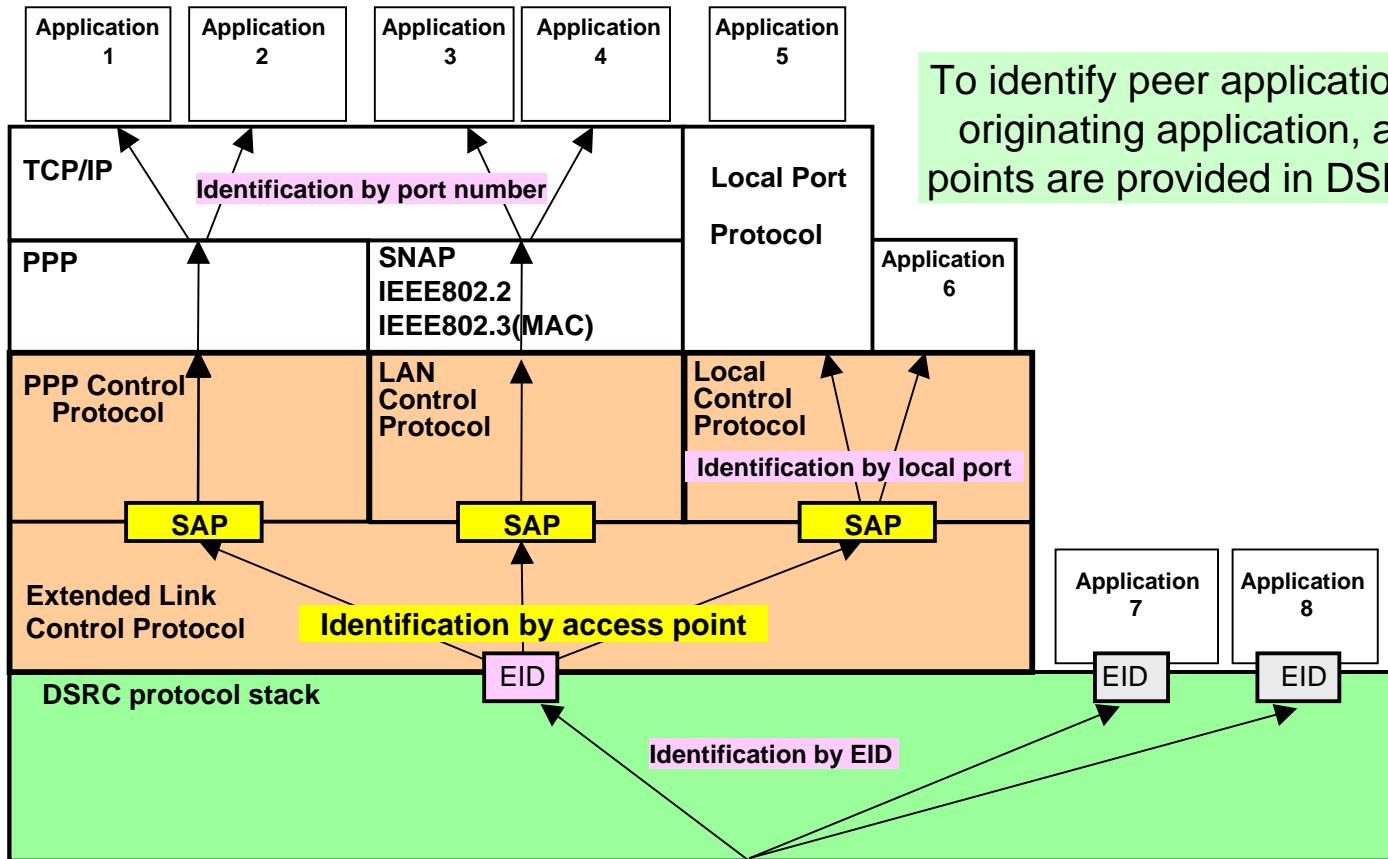
ASL utilizes multi functional service offered by DSRC Layer 7 for client / server type communication control.

Features of Application Sub Layer (ASL)

Application Sub Layer (ASL)

- Extends DSRC applications without modification to the existing DSRC protocol stack
- Realizes PPP (Point-to-Point Protocol) for Internet connection
- Realizes network control protocol for Local Area Network (LAN)
- Realizes local port control protocol for non - networks applications

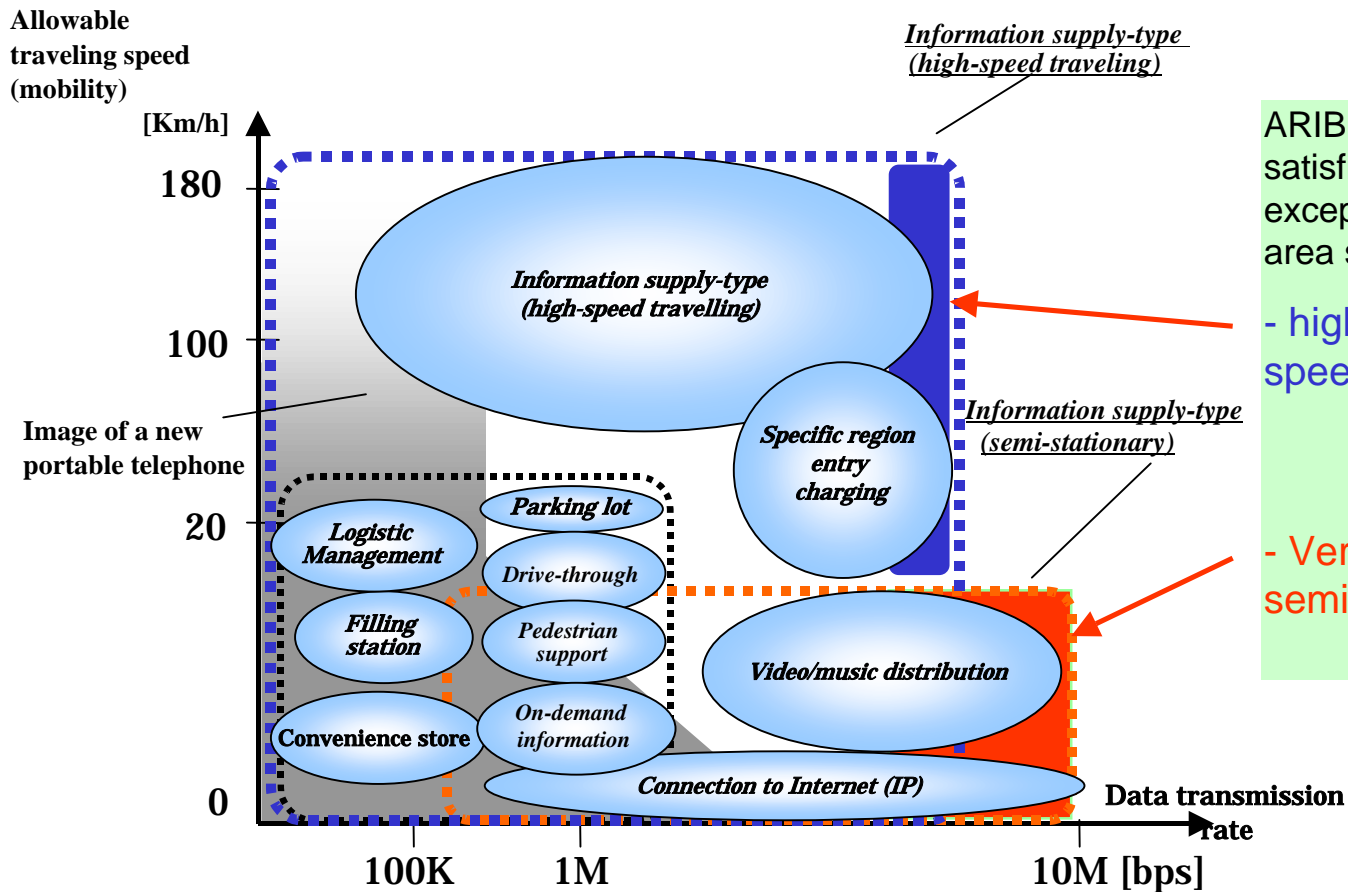
General Structure of DSRC-ASL and concept of connection identification



To identify peer application of the originating application, access points are provided in DSRC-ASL

SAP: Service access point
SNAP: Sub Network access protocol

Requirements for the next generation ITS radio communication



ARIB STD-T75 generally satisfies the requirements except for the very small area shown below.

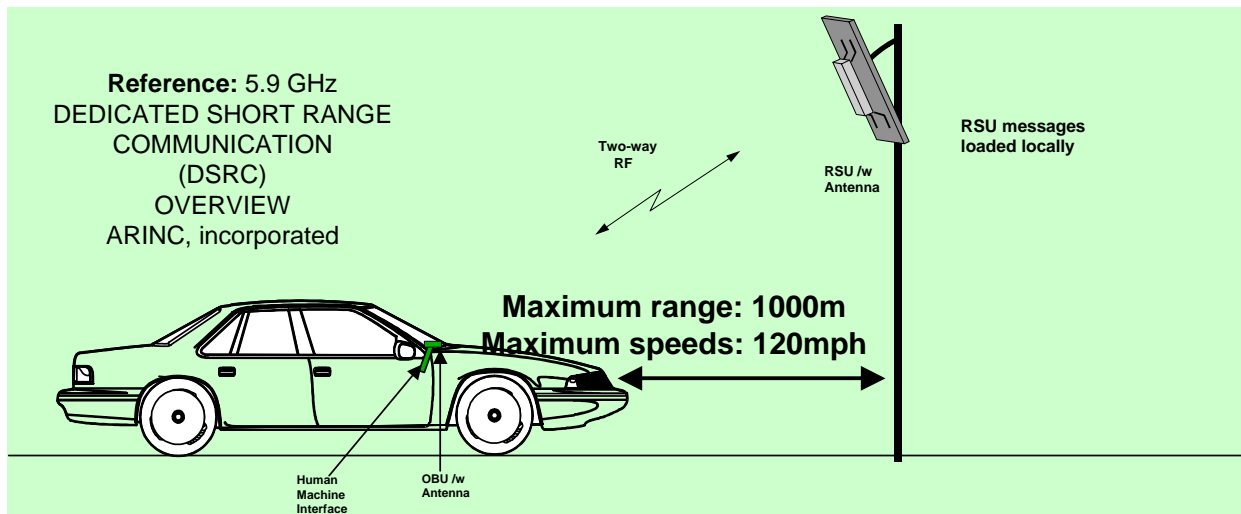
- high data rate high-speed traveling

- Very high data rate semi-stationary

North American ITS radio communication system

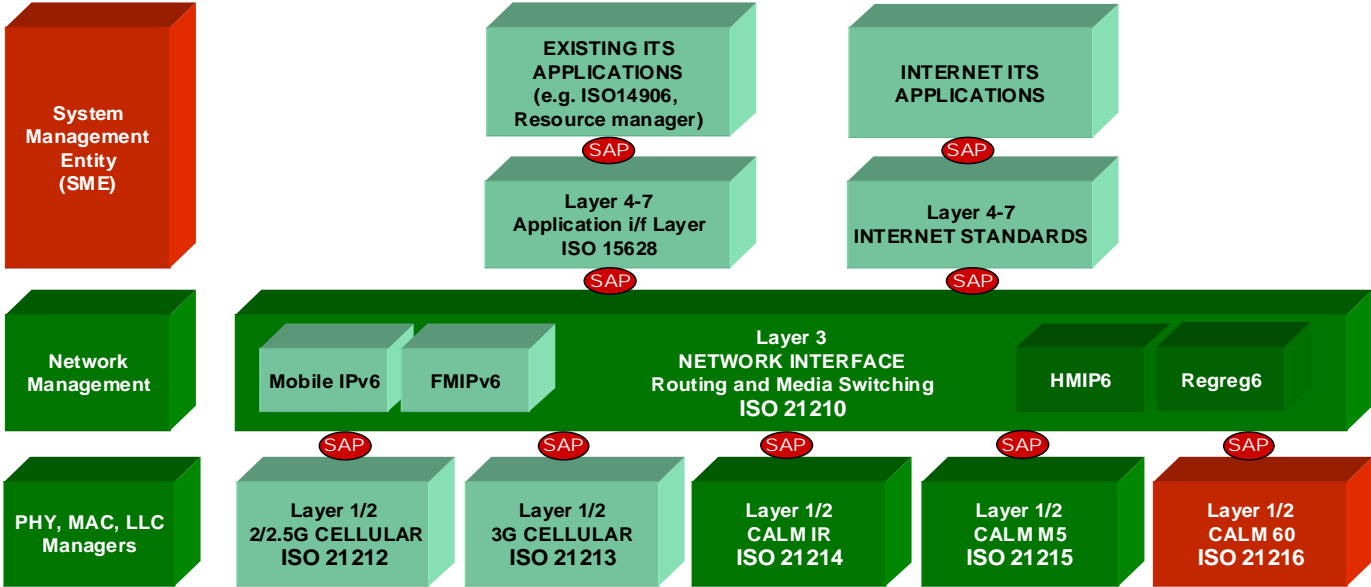
Long communication range and high data rate at high vehicle speed.





MAXIMUM RANGE	1000 m (~ 3000 ft)
Bandwidth	75 MHz (5.850 - 5.925 GHz)
Modulation	QPSK OFDM (with 16QAM and 64QAM options)
Channels	7 channels (optional combinations of 10 and 20 MHz channels)
Data Rate	3, 4, 5, 6, 9, 12, 18, 24, and 27 Mbps with 10 MHz Channels
Packet Error Rate (PER)	At speeds of 200 km/h, less than 10 % for message lengths of 64 bytes.



ISO TC204 WG16 CALM architecture

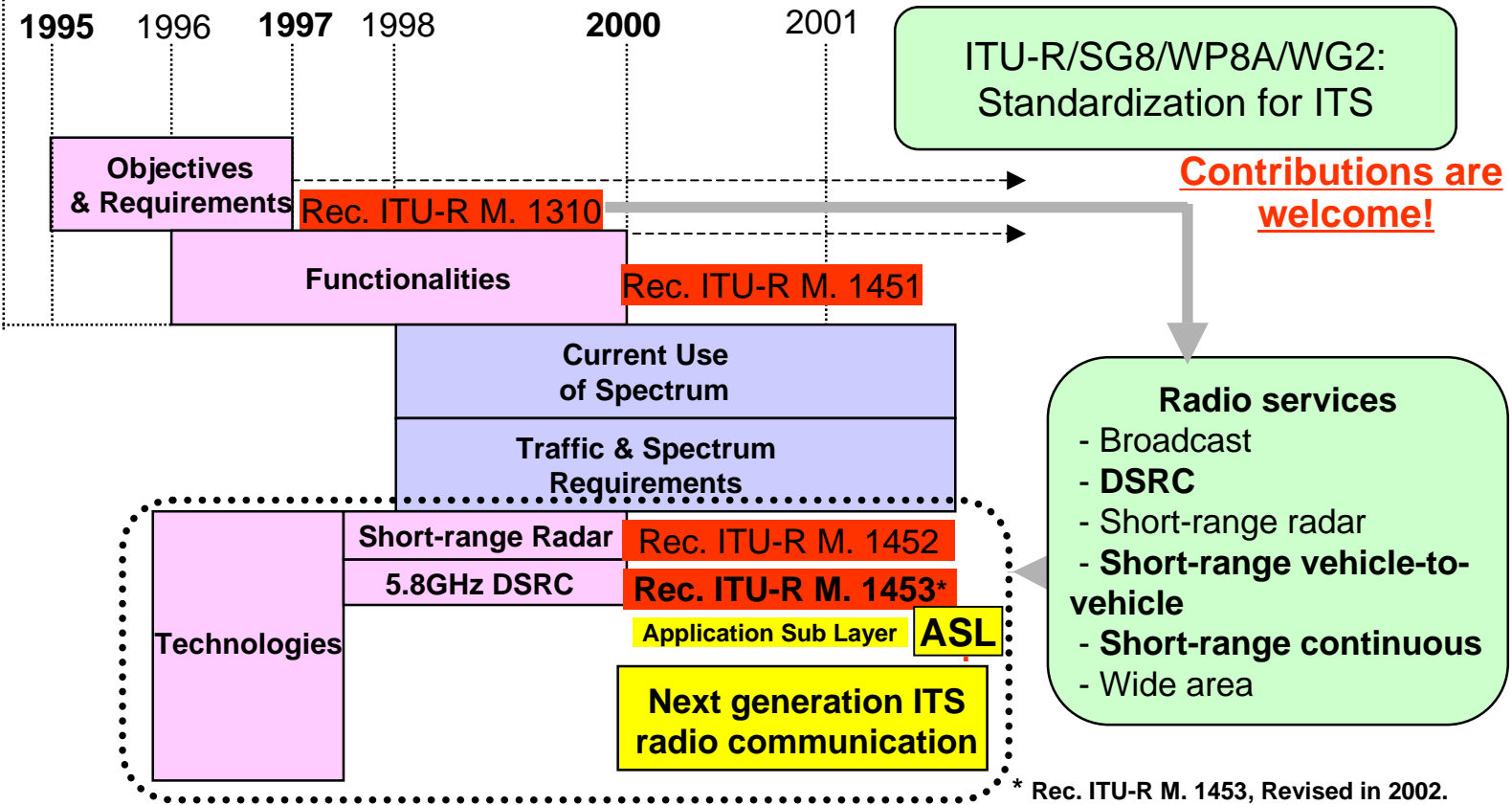
In the CALM Architecture, **Network interface is originally supported.**
 (CALM: Communication Air interface for Long and Medium range)



-  - Standards that must be written
-  - Standards that must be modified or completed
-  - Established Standards and procedures that are referenced or used as necessary
-  - Service Access Point – defined by standard below SAP

Standardization of ITS radio communication in ITU-R

1994, Question on ITS → Recommendations (Answers to the Question)



Standards related to DSRC

ARIB Standards:

- **ARIB STD-T75:** Dedicated Short-Range Communication System
- **ARIB TR-T16:** Dedicated Short-Range Communication System. Test Items and Conditions for Mobile Station Compatibility Confirmation
- **ARIB STD-T88:** Application Sub Layer for DSRC
Submitted to **ITU-R WP8A meeting in Sep. 2004** and adopted as the revision of **ITU-R M.1453-1**

International standards:

- **ITU-R M.1453-1:** Transport information and control systems - Dedicated short range communications at 5.8 GHz
- **ISO FDIS 15628:** Intelligent transport systems - Dedicated Short-Range Communication (DSRC) - DSRC application layer