

# *Communication Technology for Vehicle Safety and Comfort*

V2VCOM 2005

July 21, 2005

CTO & Chief Scientist

Toyota Info Technology Center

# Contents

---

1. Improvement of Traffic Safety
2. Communication Architecture in ITS/Telematics
3. Combination of Radio Technologies for Safety and Comfort

# Contents

1. Improvement of Traffic Safety
2. Communication Architecture in ITS/Telematics
3. Combination of Radio Technologies for Safety and Comfort

# Reduction of casualty

Continuous reduction of annual death since 1970, globally reduced into one third

Passive safety technology

(death prevention after crash)

seat belt, air bag, child seat

Still high number of annual death casualty

US---42000, EU---46000, Japan 8000

Active safety to prevent crash requested for further reduce casualty

# Communication to help Automobile Safety – A CHALLENGE

Current automobile have no communication among automobiles running near by.

Safety is to be improved by sharing intention of drivers.

Smoothness of lane usage

Good relationship

Sharing common interest : congestion ahead

situation at the head of jam

Emergency notice : sudden stop, obstacle ahead

# Communication to Vehicle

## Dreams satisfied in long term

### Remote – Vehicle

Air plane : 1910's

Train : 1960's

Automobile : 1990's

control and operation  
information

Roadside – Vehicle      Mainly automobile : 1990's

Vehicle – Vehicle

Pedestrian - Vehicle      Challenge towards 2010

# History of vehicle communication:

30 year

1970's Early proposals for Vehicle – Roadside communication : early ideas which we call ITS now  
premature communication technology

ultra sonic wave communication

loop coil in the road surface

1990's DSRC for road side to vehicle communication

2000's Use of cellular communication (Telematics)

2005's vehicle to vehicle communication

one hop – multi-hop

$R - V, R - V - V - V$

2010's communication for pedestrian safety

# Contents

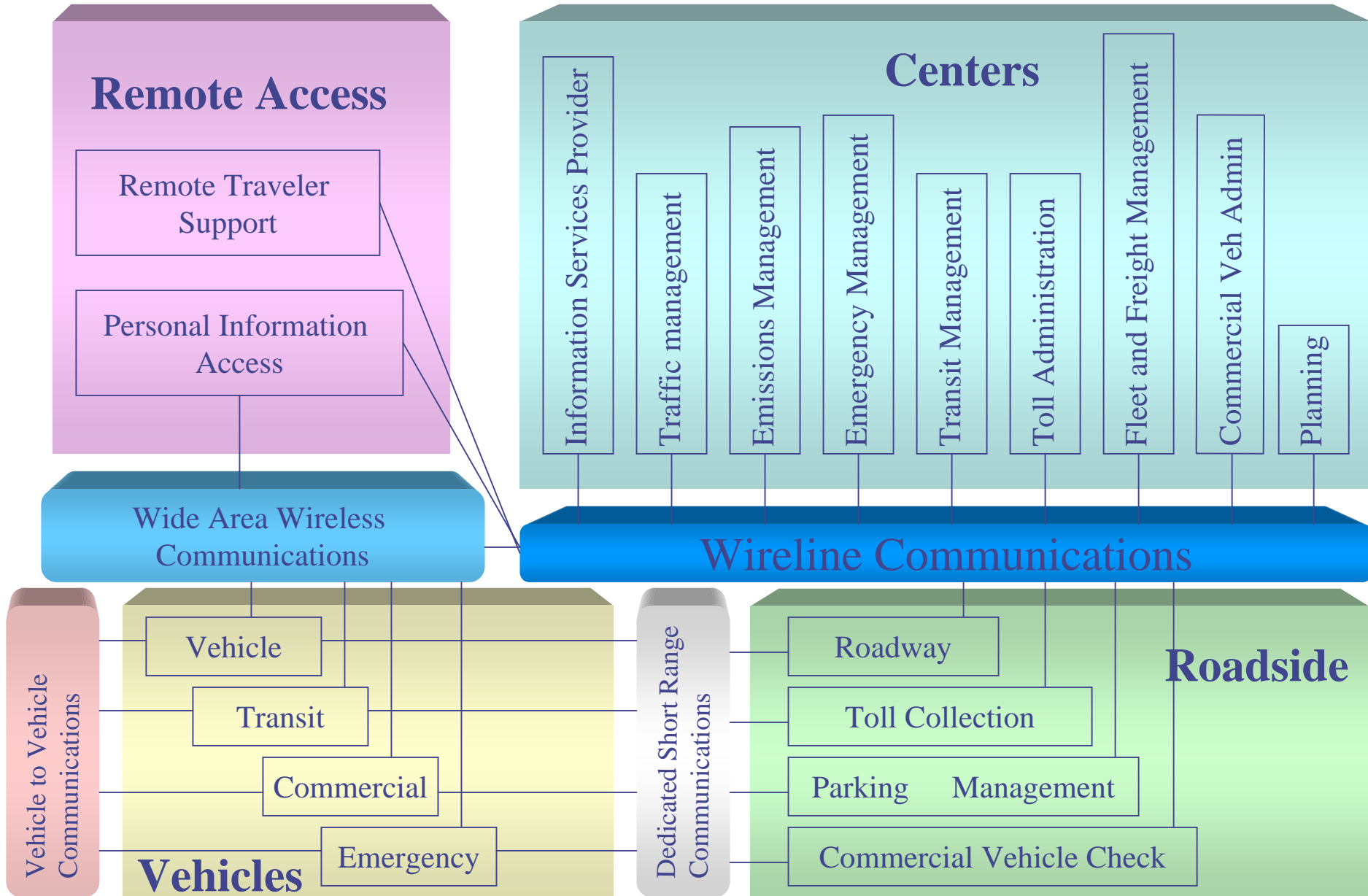
1. Improvement of Traffic Safety
2. Communication Architecture in ITS/Telematics
3. Combination of Radio Technologies for Safety and Comfort

# *Services in ITS-America Architecture*

*1996*

Travel and Transportation Management  
Travel Demand Management  
Public Transportation Operations  
Electronic Payment  
Commercial Vehicle Operations  
Emergency Management  
Advanced Vehicle Control and Safety Systems

# Networks in ITS America Architecture (April 1996)



# Critical Path for ITS : Communication

1995 : Low penetration of cellular

New Roadside communication expected

2000 : More penetration of cellular

Use of long range wireless

2005 : Extensive use of LAN

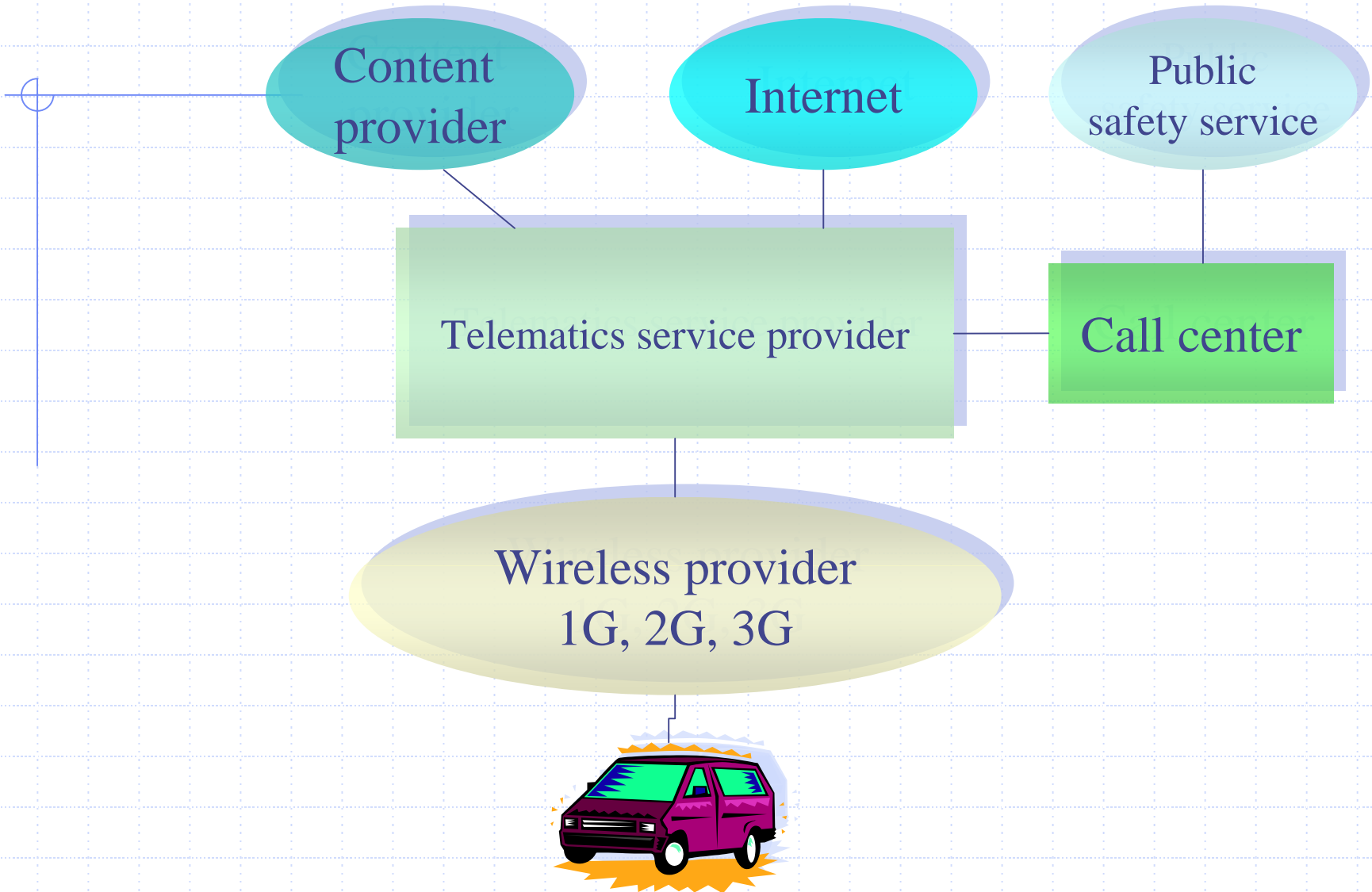
P2P communication to improve safety

2010: WiMax replaces Cellular

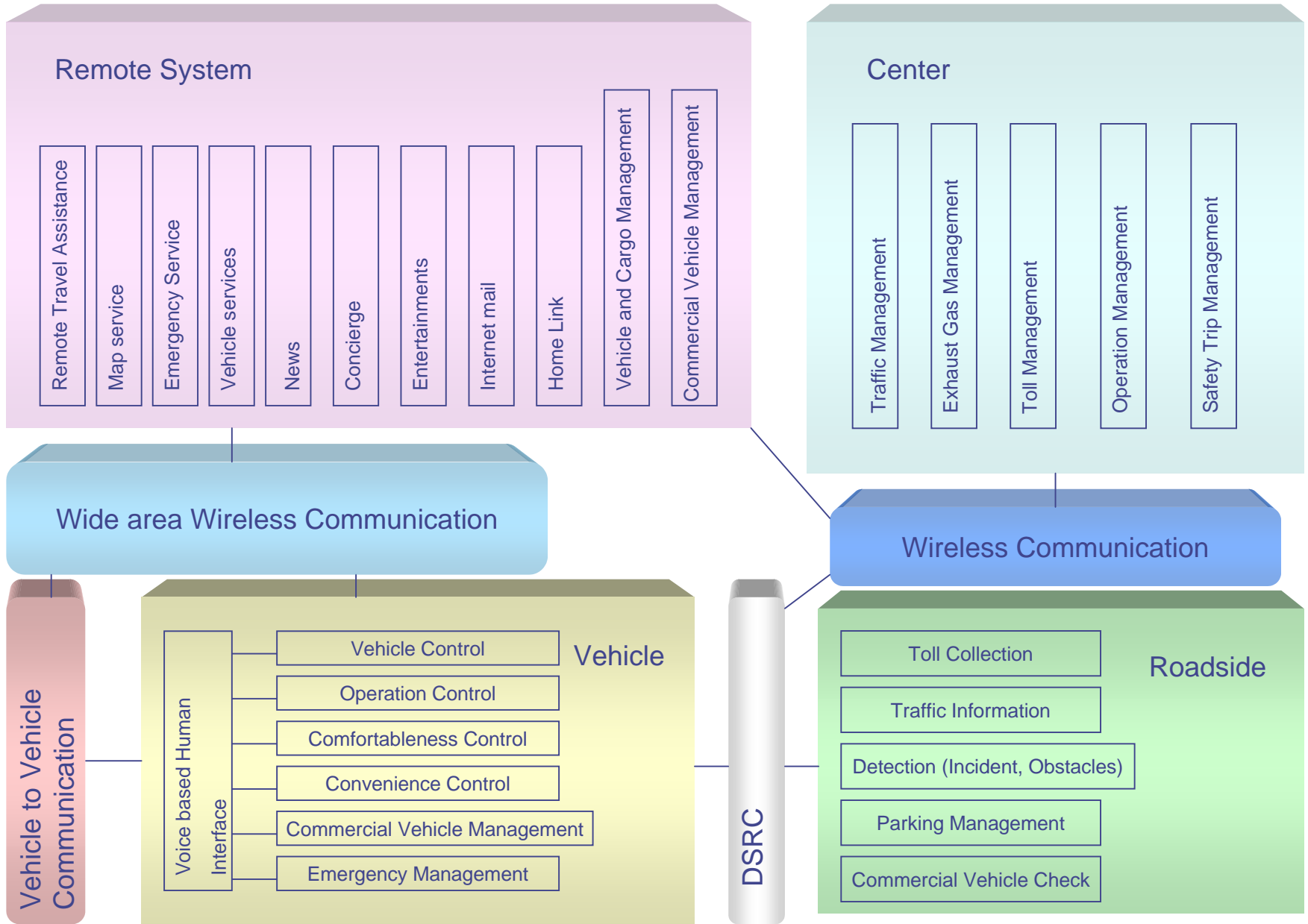
Efficient radio spectrum use by multi-hop

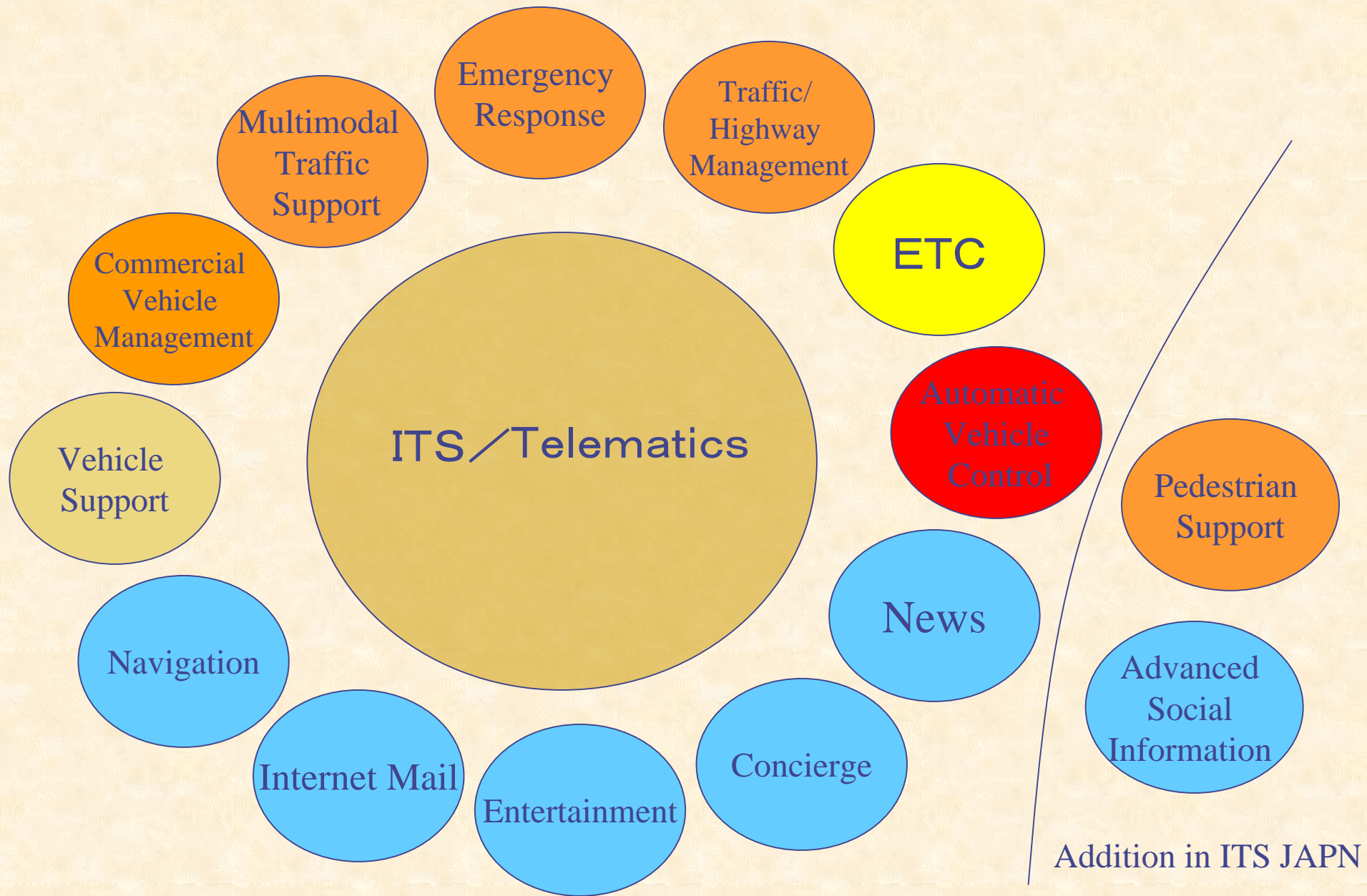
Services depend on nature of communication  
dependability, coverage, penetration

# Telematics concept late 1990s



# ITS Architecture including Telematics





ITS/Telematics

ETC

Automatic  
Vehicle  
Control

Pedestrian  
Support

Advanced  
Social  
Information

Concierge

Entertainment

Internet Mail

Navigation

Vehicle  
Support

Commercial  
Vehicle  
Management

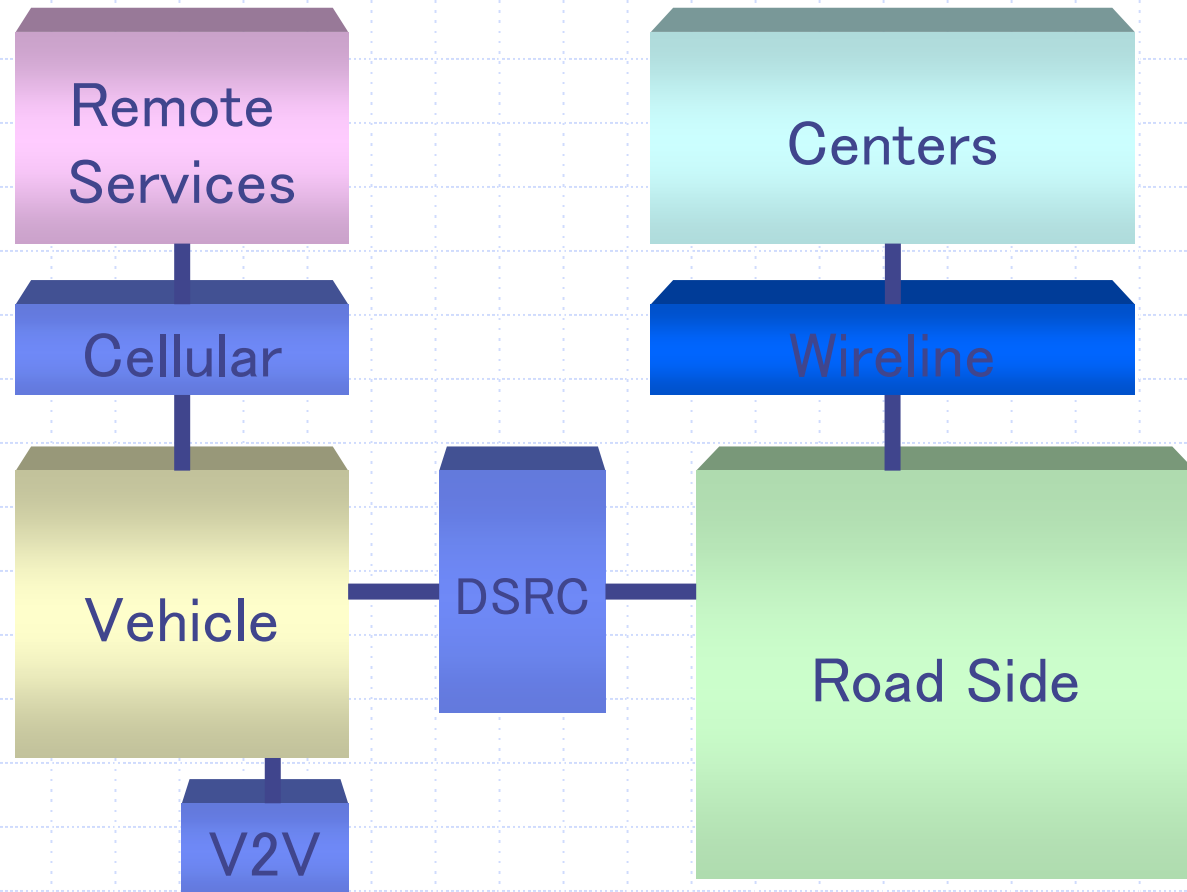
Multimodal  
Traffic  
Support

Emergency  
Response

Traffic/  
Highway  
Management

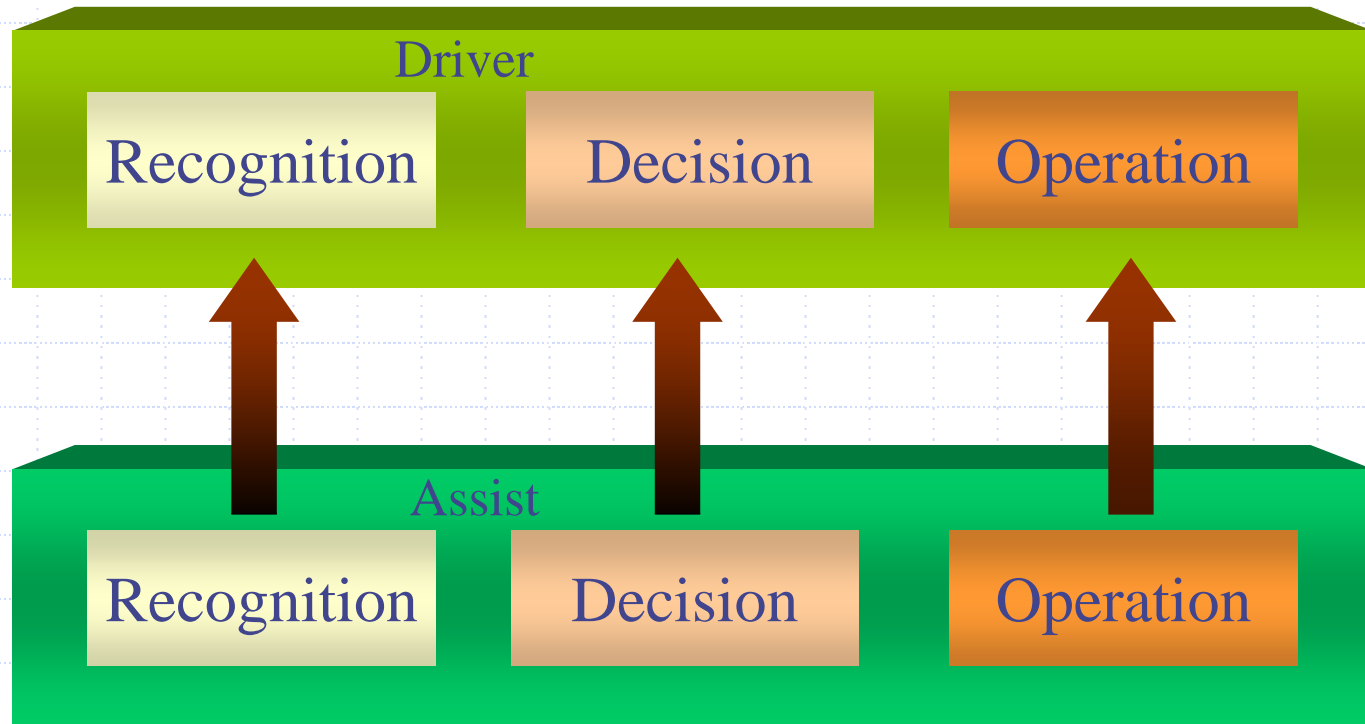
News

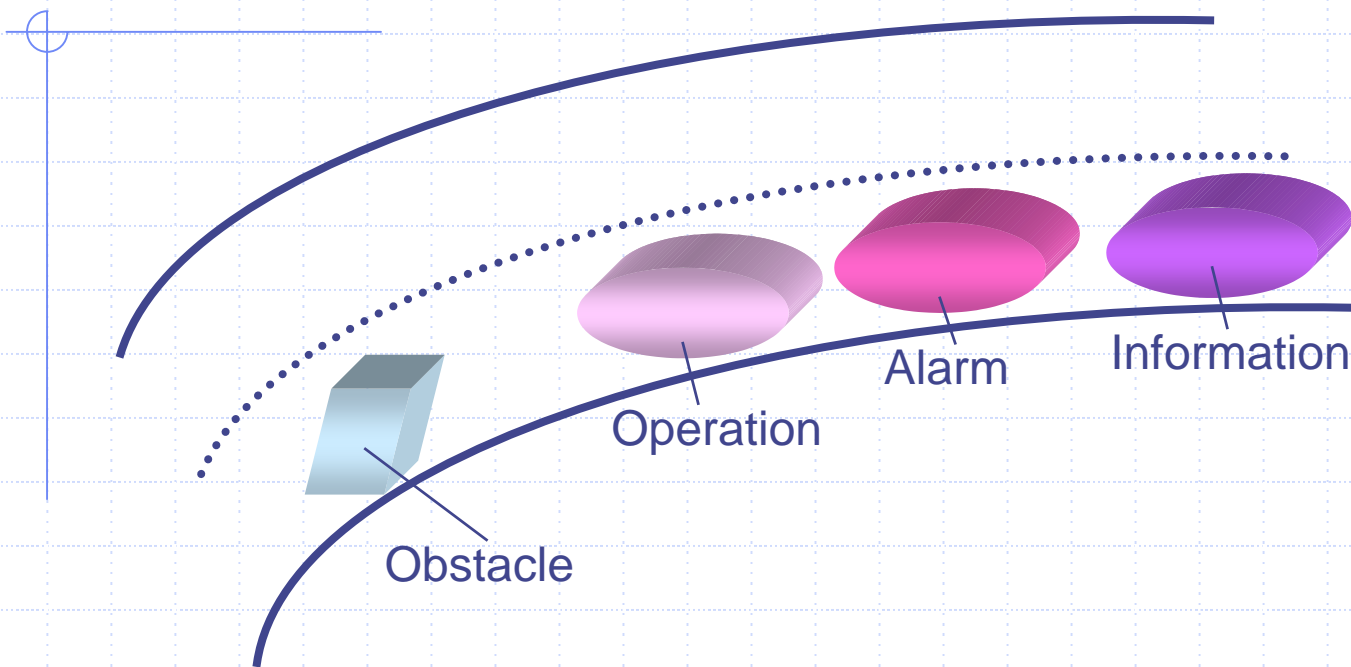
# Communication subsystem including V2V



# Services for Traffic Safety

## AHS activity (Since 1989) (Advanced Cruise-Assist Highway System)





Right recognition 4.1 second before collision will reduce 90% of accident

# First Social Experiment Successful

**Sangubashi Experiment in Tokyo Metropolitan  
Expressway (TMEX)**

**Annual accident reported is 181/year**

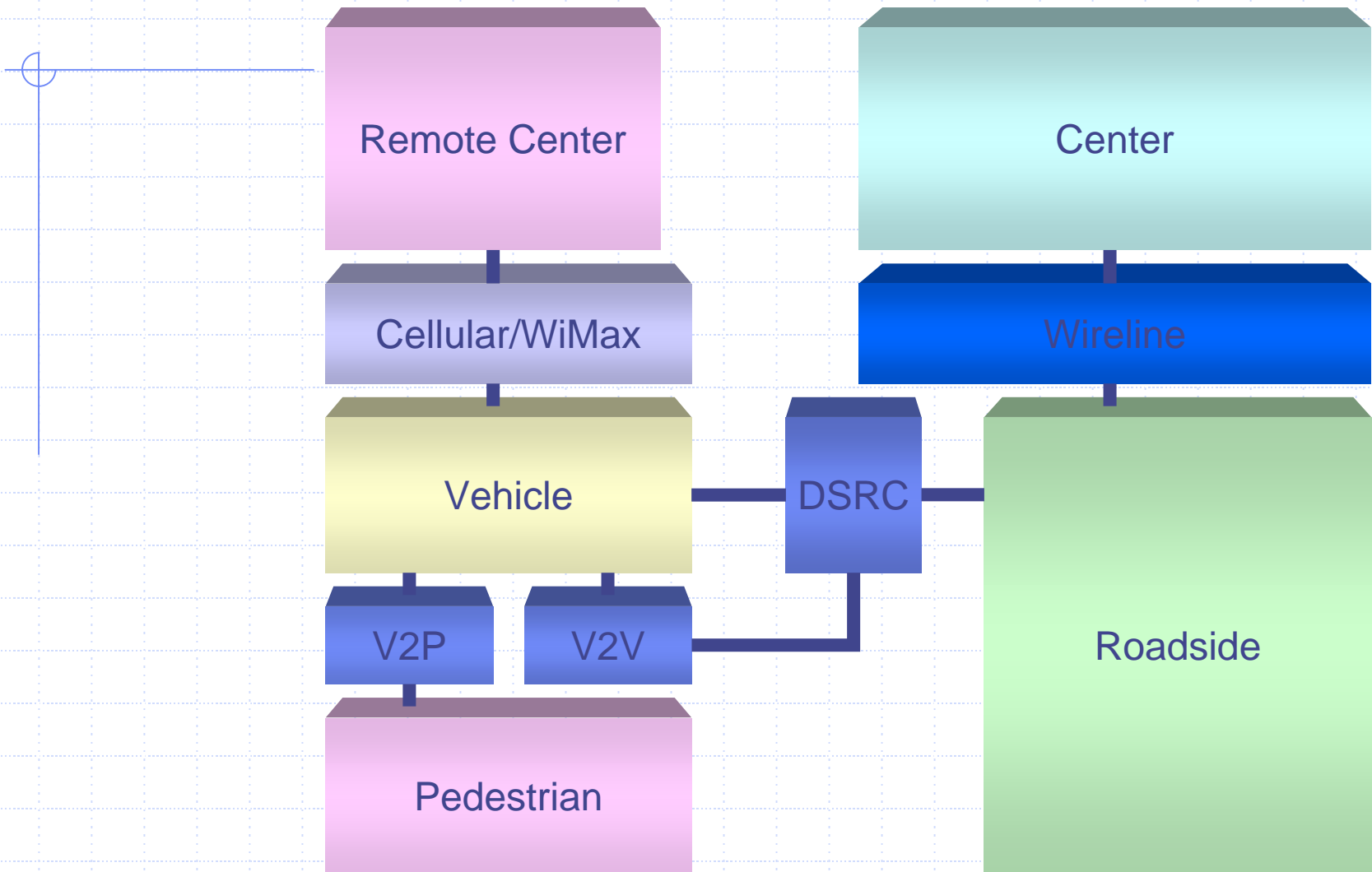
**To notice congestion(obstacle) ahead through radio  
beacon (10% of car in the TMEX have receiver) (VICS)  
(national average is 2%)  
(VICS total : 12 Million about 15%)**

**During experiment (March 1<sup>st</sup> ~ May 31<sup>st</sup> 2005)**

**Number of accident report was halved**

**Government plans to expand the system nationwide after  
2007.**

# Communication Subsystem including Pedestrian



# Contents

1. Improvement of Traffic Safety
2. Communication Architecture in ITS/Telematics
3. Combination of Radio Technologies for Safety and Comfort

# Combination of various radio needed

- ◆ Various request for ITS services
- ◆ Different area coverage
- ◆ Different request for data rate
- ◆ Different request for communication setup time
- ◆ Efficiency for radio spectrum usage

# Vehicle Moves Fast

Vehicle running 65mile / hour = 28m / sec

DSRC covering 30m pass in 1 sec

connection set up

channel selection

physical connection

address exchange or assignment

security confirmation

Continuous connection within car swarm will help for quick notice of emergency

swarm:

prearranged :convoy

not arranged :adhoc peer group

# Multihop wireless connection in car swarm

Single channel

Multi channel

how to control channel selection

how to cope with vehicle without equipment

how to avoid hidden vehicle

# Information Sharing among Industries

Cost of electronics and software in current technology depends on size of market.

Market size of vehicle communication is one order smaller than that of computer

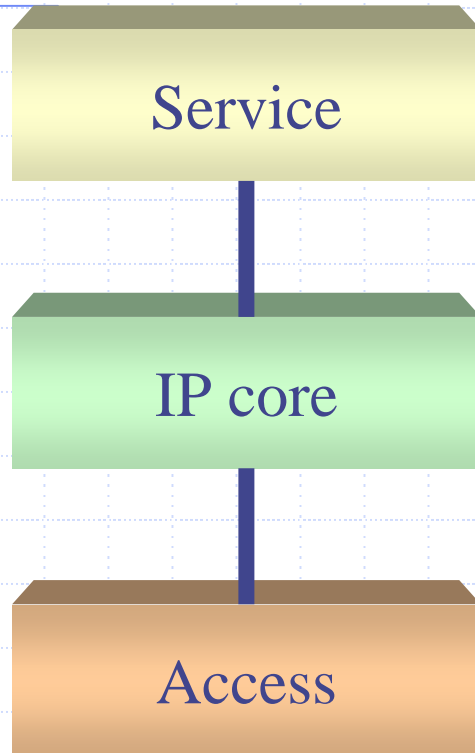
Number of cars and computers in the world is almost same

Life time of car is several times longer

Automobile industry want to use communication standards identical to computer network as much as possible

Sharing of information among different manufactures as well as different industries is important

# Combination of various technology is a common idea

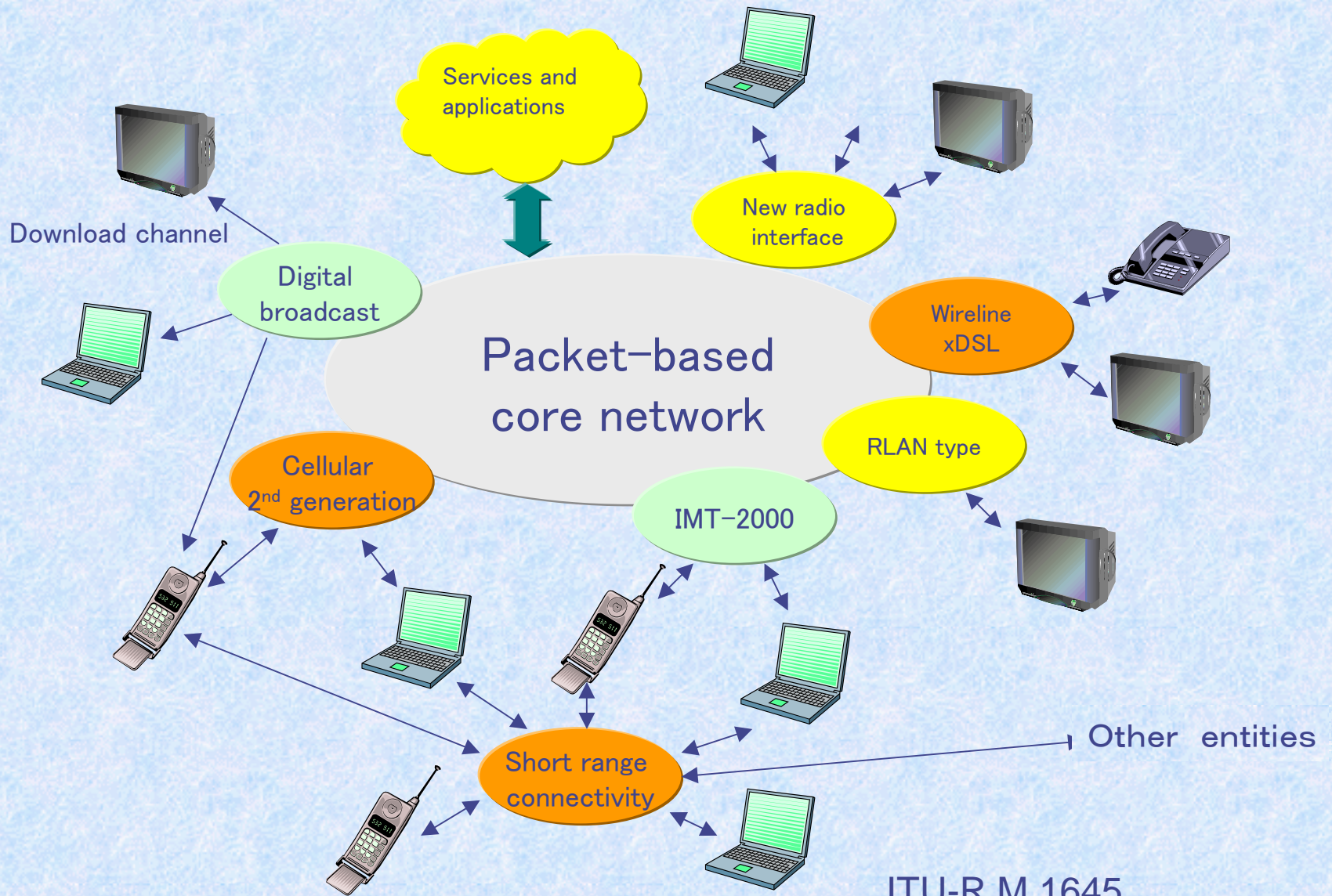


ITU-R: beyond 3G

ITU-T: new generation network

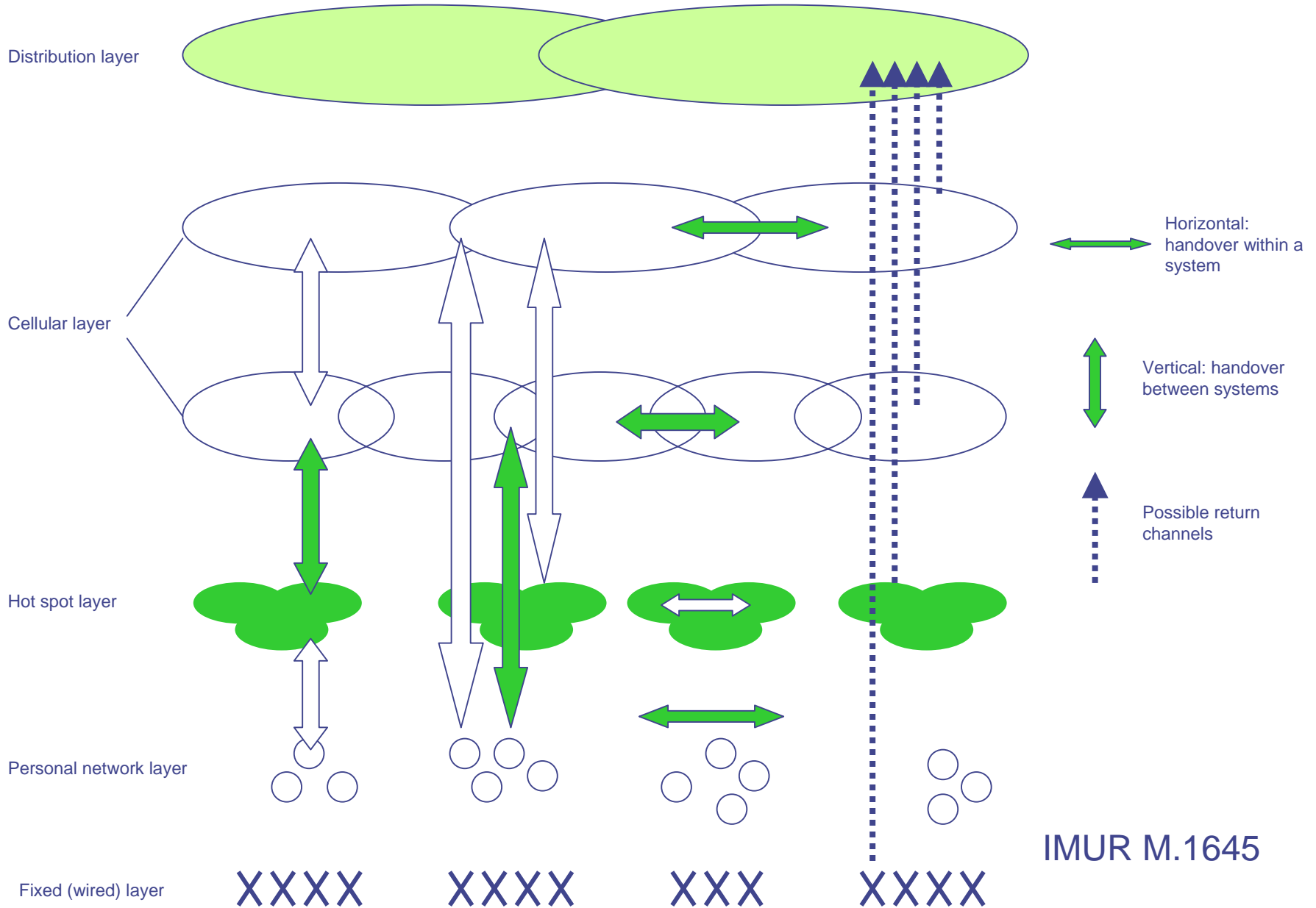
ISO TC204: CALM

# Beyond3G Concept



ITU-R M.1645

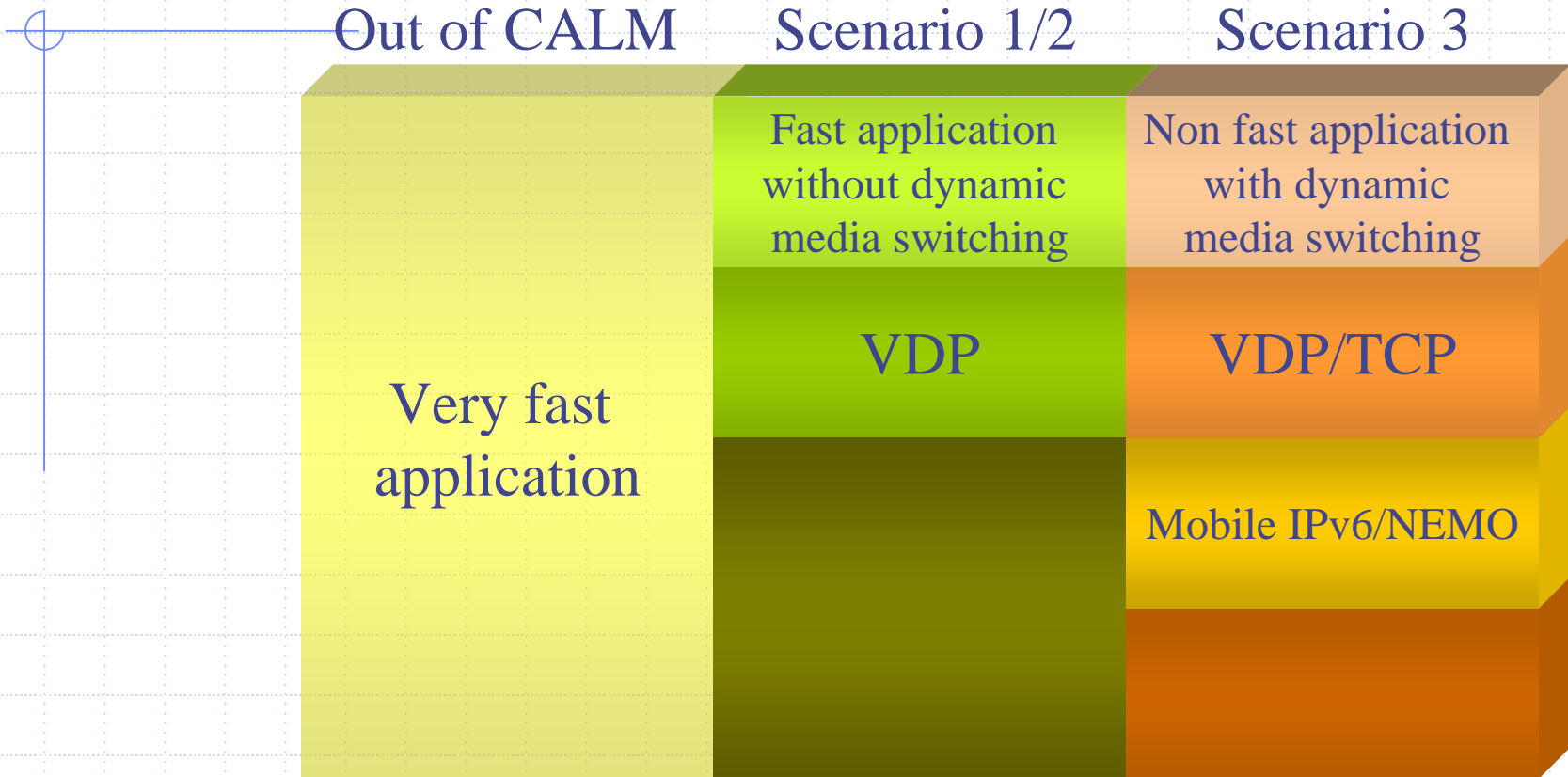
# Handover among different radio



# CALM Architecture



# Communication Scenario in CALM



Scenario 1 : without internet

Scenario 2,3 : with internet