# ITU-T Kaleidoscope 2010
# Beyond the Internet? - Innovations for future networks and services

## *Requests for communication performance from connected vehicle of the future*

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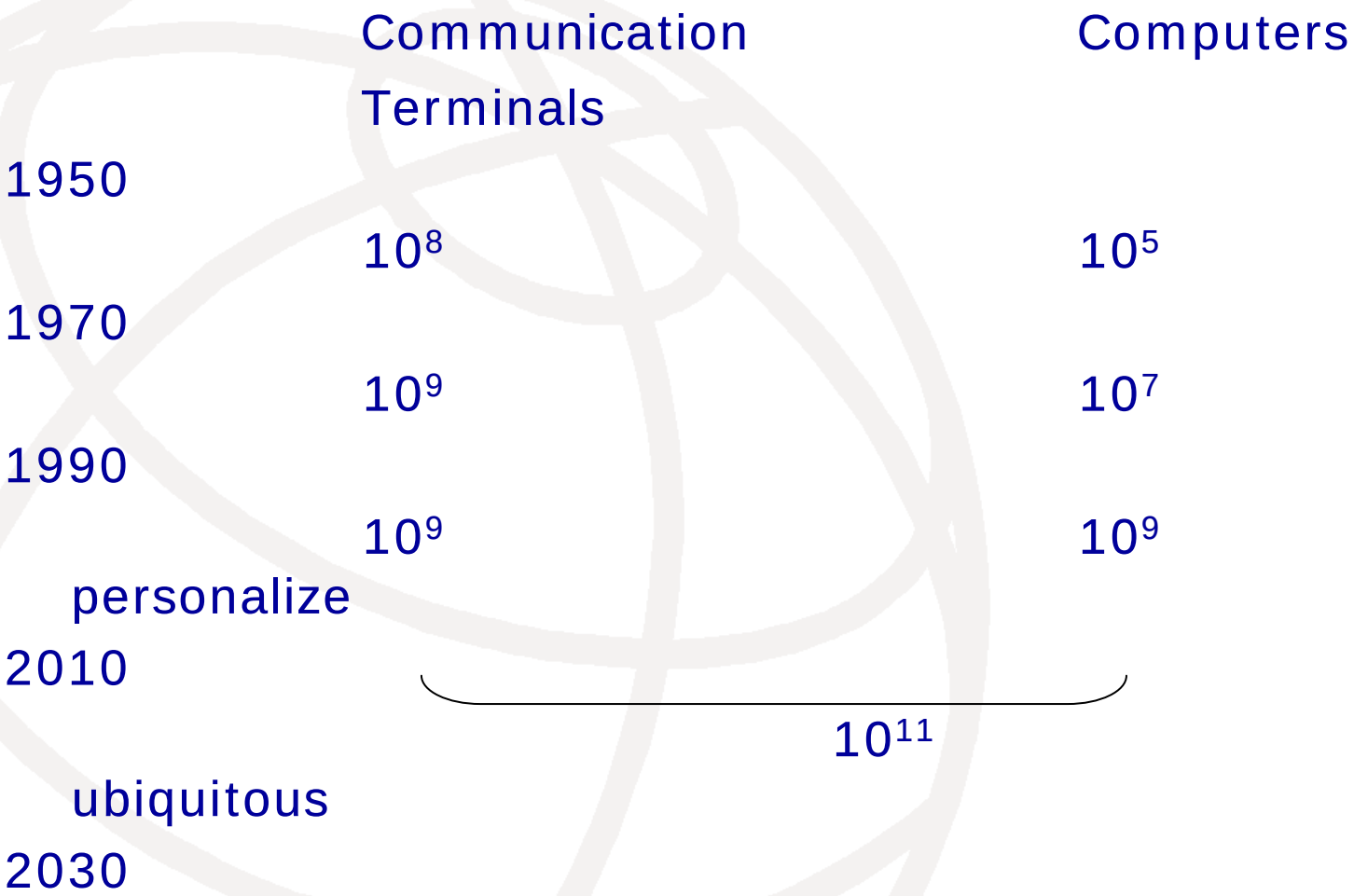
# Market Back Ground for Future Communication

- Global telecommunication market is apparently saturated after rapid expansion of recent 20 years
  - Global penetration of communication equipment
  - Cost reduction of hardware.
  - Saturation of demand in traditional human use.
- New market replacing Human to Human communication is needed to realize further growth.
  - Creation of Machine to Machine communication market having a size equivalent to human communication market.
- Vehicle communication have been studied in recent 15 years
- Home networking is also a candidate for M2M communication.
- Recently Smart Grid attract interest as new market for machine to machine communication

# Saturation of IT Market



# contents

- Changes in IT environments
- Communication Services for vehicles
- Market Growth through M2M communication

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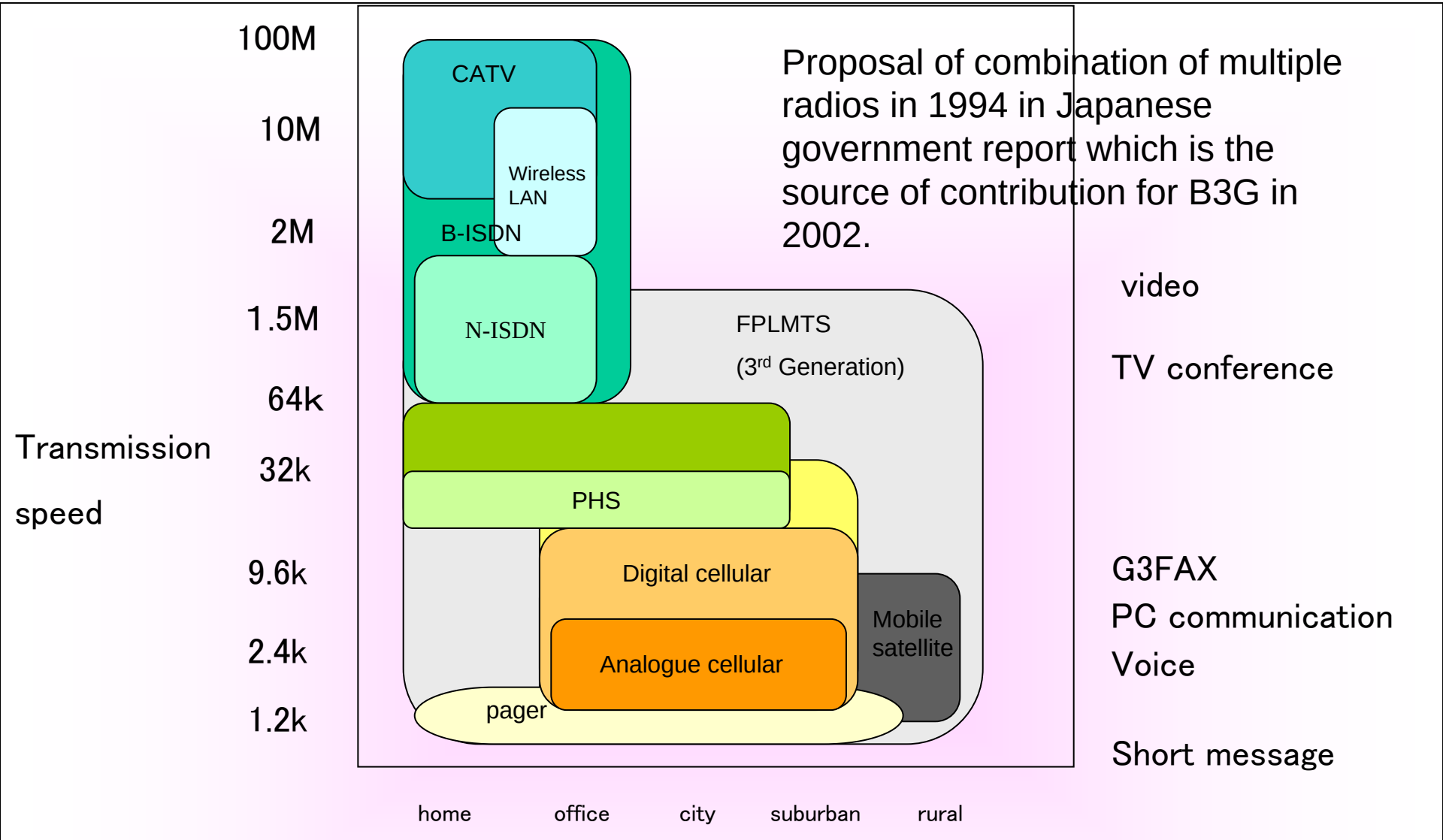
# Traditional technology developments

- Communication technology has been developed starting from human communication in early stage.
- A lot of efforts are paid for improvement of performance and cost reduction.
- Multimedia applications for human market
- Broadband communication wirless and wireline
- Extension of range without repeater.
- Mobility management of human speed.
- Security to keep network
- Recent requests for low carbon systems

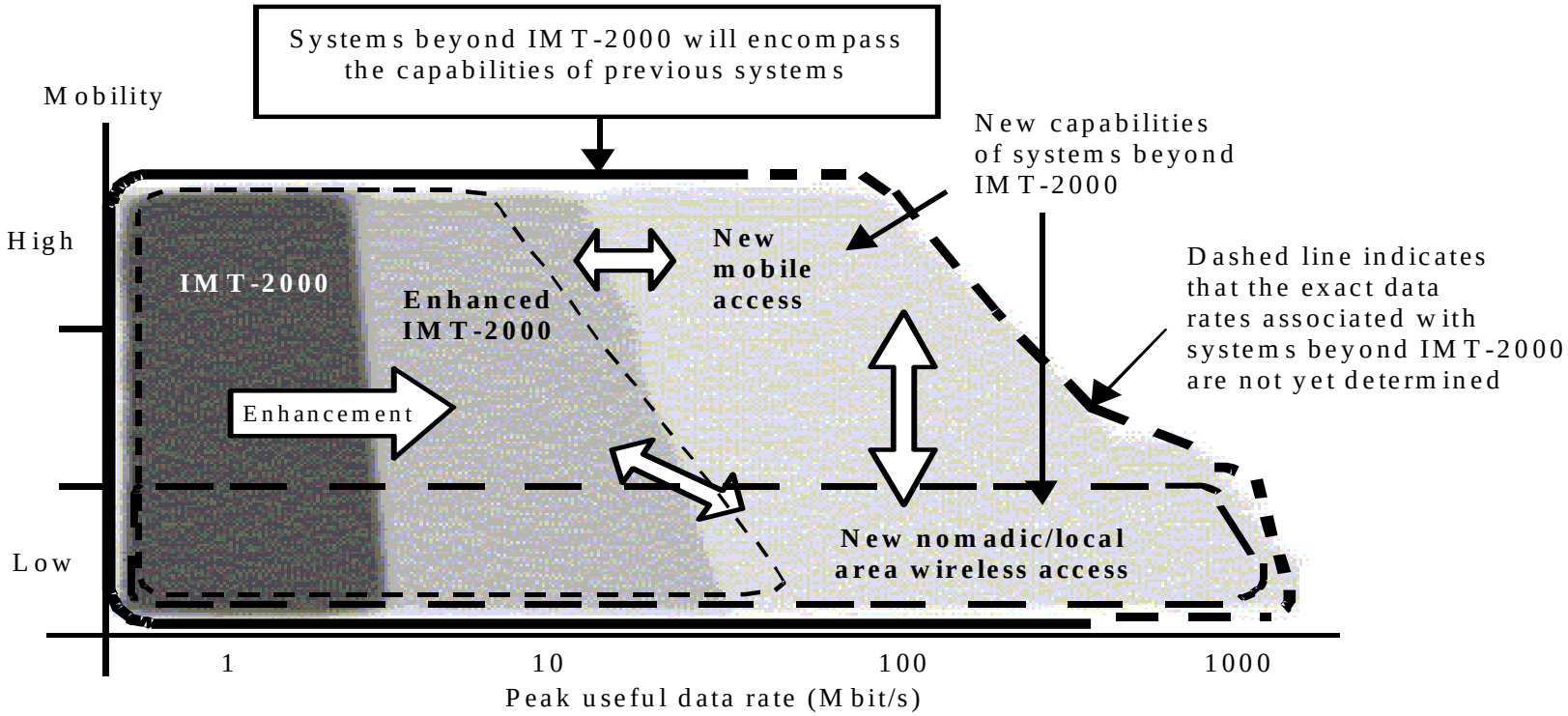



A book titled Radio multimedia of year 2000 published May 1995 in Japanese

- As a result of effort a lot of communication systems having different performance ware developed
- Different systems have been developed mainly from seeds driven ideas.
- Users are requested to cope with coexistence of different systems.
- Use of combinations of different systems are responsibility of users.
- Cognitive adaptation of user terminal is needed for smooth use of multiple systems, however this technology is far from reality.

FIGURE 2

**Illustration of capabilities of IMT-2000 and systems beyond IMT-2000**




⟺ Denotes interconnection between systems via networks, which allows flexible use in any environment without making users aware of constituent systems

Nomadic/local area access systems

Digital broadcast systems

ITU—R vandiagram（2002）

Dark shading indicates existing capabilities, medium shading indicates enhancements to IMT-2000, and the lighter shading indicates new capabilities of systems beyond IMT-2000.

The degree of mobility as used in this Figure is described as follows: low mobility covers pedestrian speed, and high mobility covers high speed on highways or fast trains (60 km/h to ~250 km/h, or more).

Temp 8/110-02
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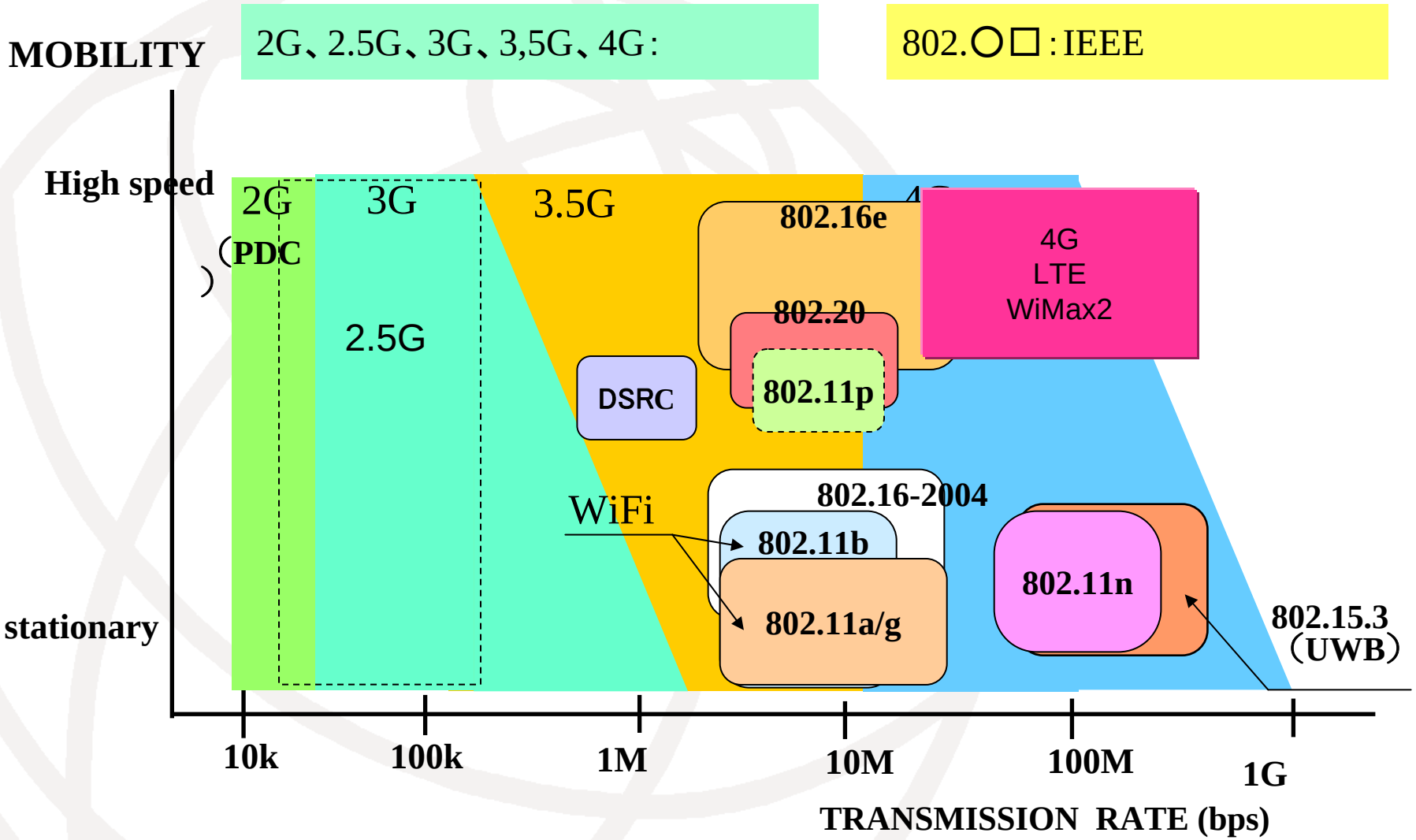
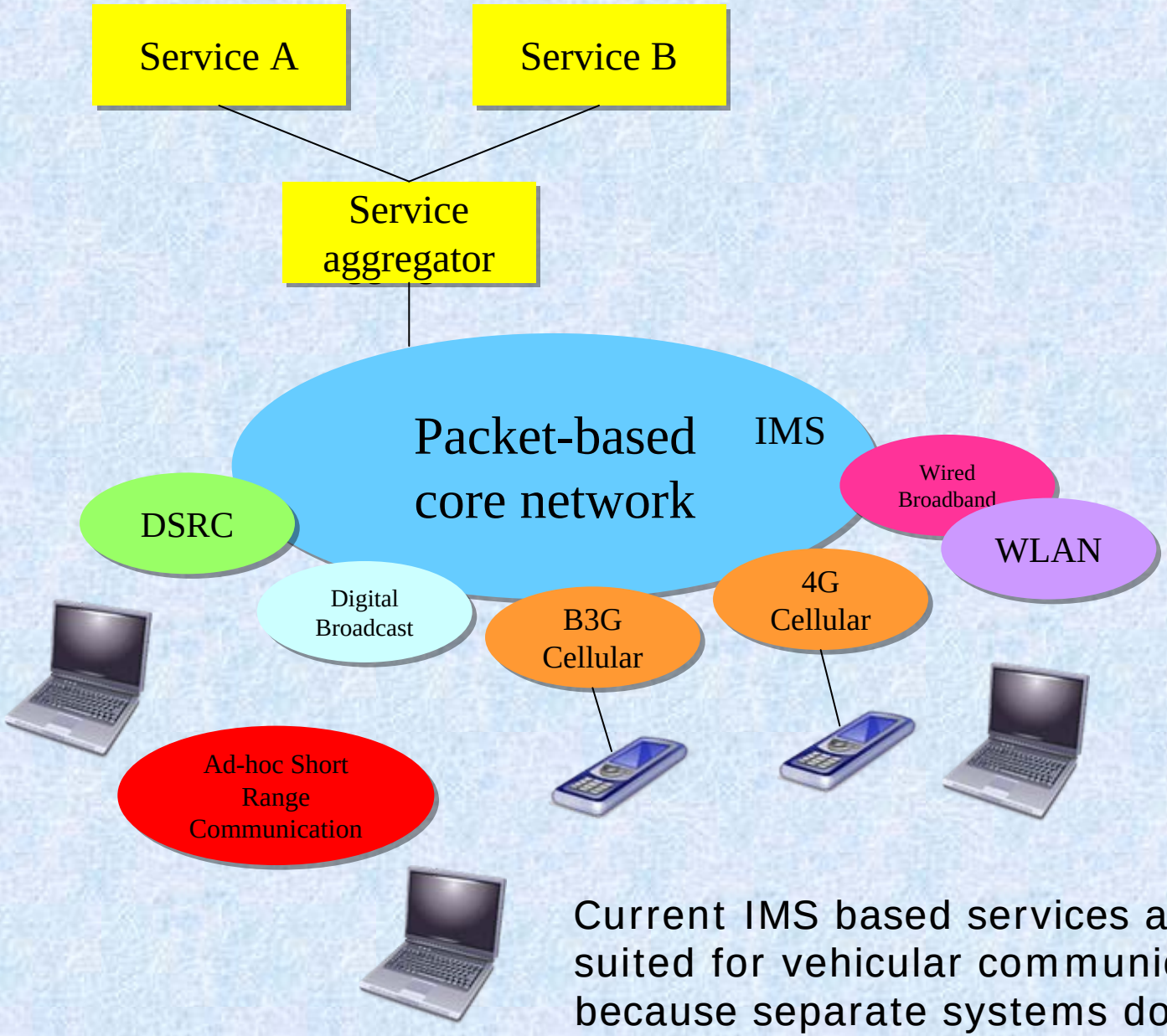
# VAN diagram


MOBILITY
2G、2.5G、3G、3,5G、4G:
802.○□:IEEE
High speed
2G
(PDC)
3G
2.5G
3.5G
802.16e
802.20
4G
LTE
WiMax2
DSRC
802.11p
WiFi
802.16-2004
802.11b
802.11a/g
802.11n
802.15.3
(UWB)
stationary
10k
100k
1M
10M
100M
1G
TRANSMISSION RATE (bps)




Current IMS based services are not suited for vehicular communication because separate systems do not have adequate coordination.

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# Advances in recent 10 years in ICT application for automobile

Traditionally ICT improved many aspects of vehicles including emission reduction and stability control.

In recent 10 years, contribution of ICT in vehicle technology expanded fast.

Vehicle Stability Control
Radar Cruise Control (ACC)
Back Monitor
Tire Pressure Monitor
On Demand Information
Shift Control based on Map

Autonomous→Networked
Interests for Communication,
V2I and V2V

# Communication based services for safe smooth convenient operation

1970's Signal control

1980's Major improvements build in electronics for vehicle

1990's DSRC for Infrastructure-Vehicle communication

- Traffic Data
- Toll Collection
  - Congestion Charge

2000's Transport Telematics

- Remote Vehicle Support system
- Map updating
- Music distribution
- eCall, e911

2005's Vehicle Safety Systems

- Collision avoidance

# ITS Vehicle services

- Traffic management

probing, dynamic fee management, emission management

- Public transport management

transit vehicle tracking, multimodal coordination

- Traveler information

personal route guidance, provider based route guidance,dynamic rideshare

- Vehicle safety

intersection safety warning, intersection collision avoidance, automated highway

- Commercial vehicle operation

fleet administration, freight administration, electronic clearance, weigh-in- motion

- Emergency management

stolen vehicle tracking, stolen vehicle control, emergency response, mayday support

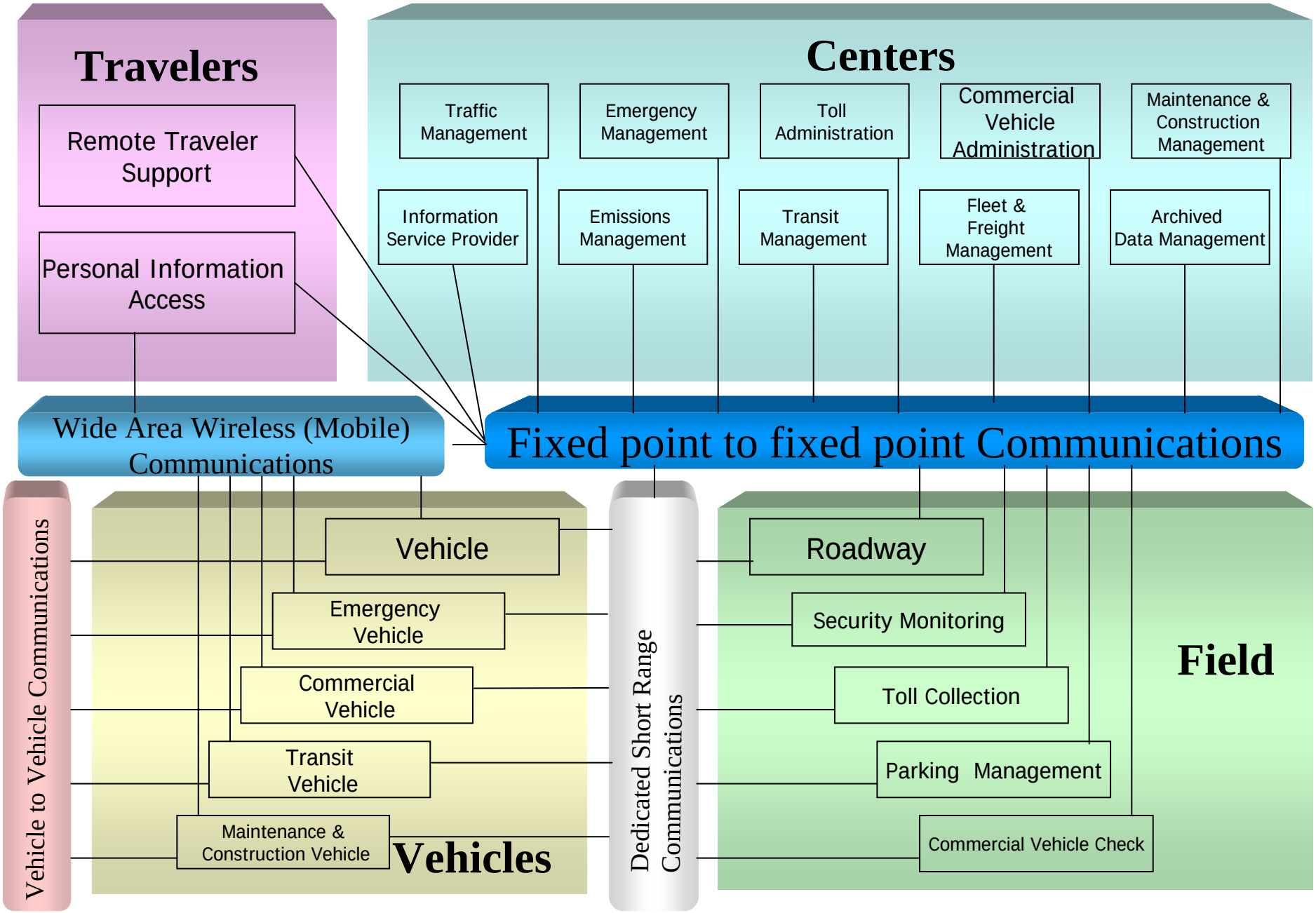
ITS America, 1996

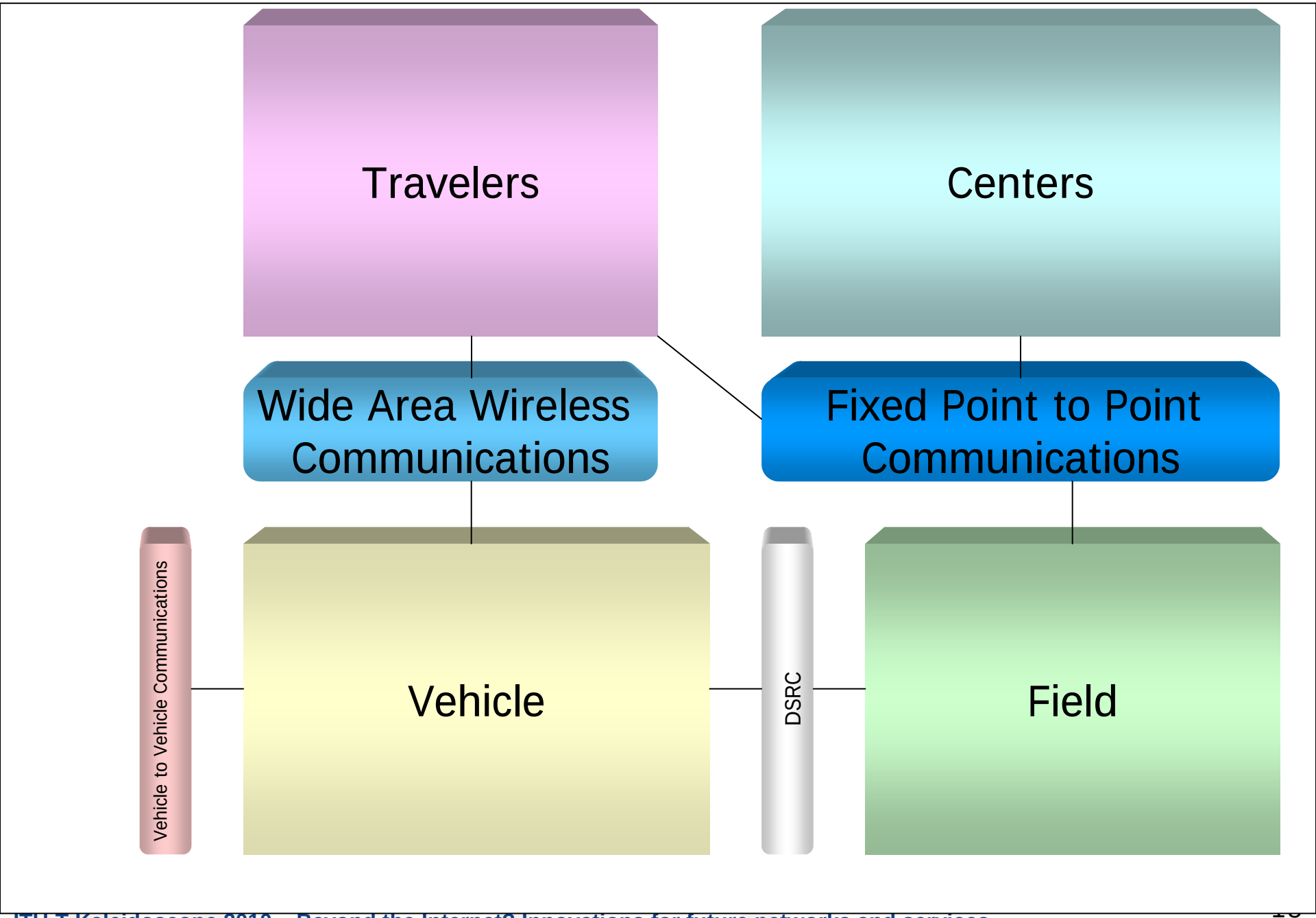
# Two classes of vehicle communication

- ITS( Intelligent Transport System)
  - Vehicle services using short range communication
    - probing,
    - fee collection,
    - intersection safety warning
- Tansport Telematics
  - Vehicle services using cell phone service
    - emergency management
    - stolen vehicle responses
    - remote vehicle support
    - personal route guidance

# ITS Architecture

(ITS America1996)




Travelers
Centers
Wide Area Wireless Communications
Fixed Point to Point Communications
Vehicle to Vehicle Communications
Vehicle
DSRC
Field

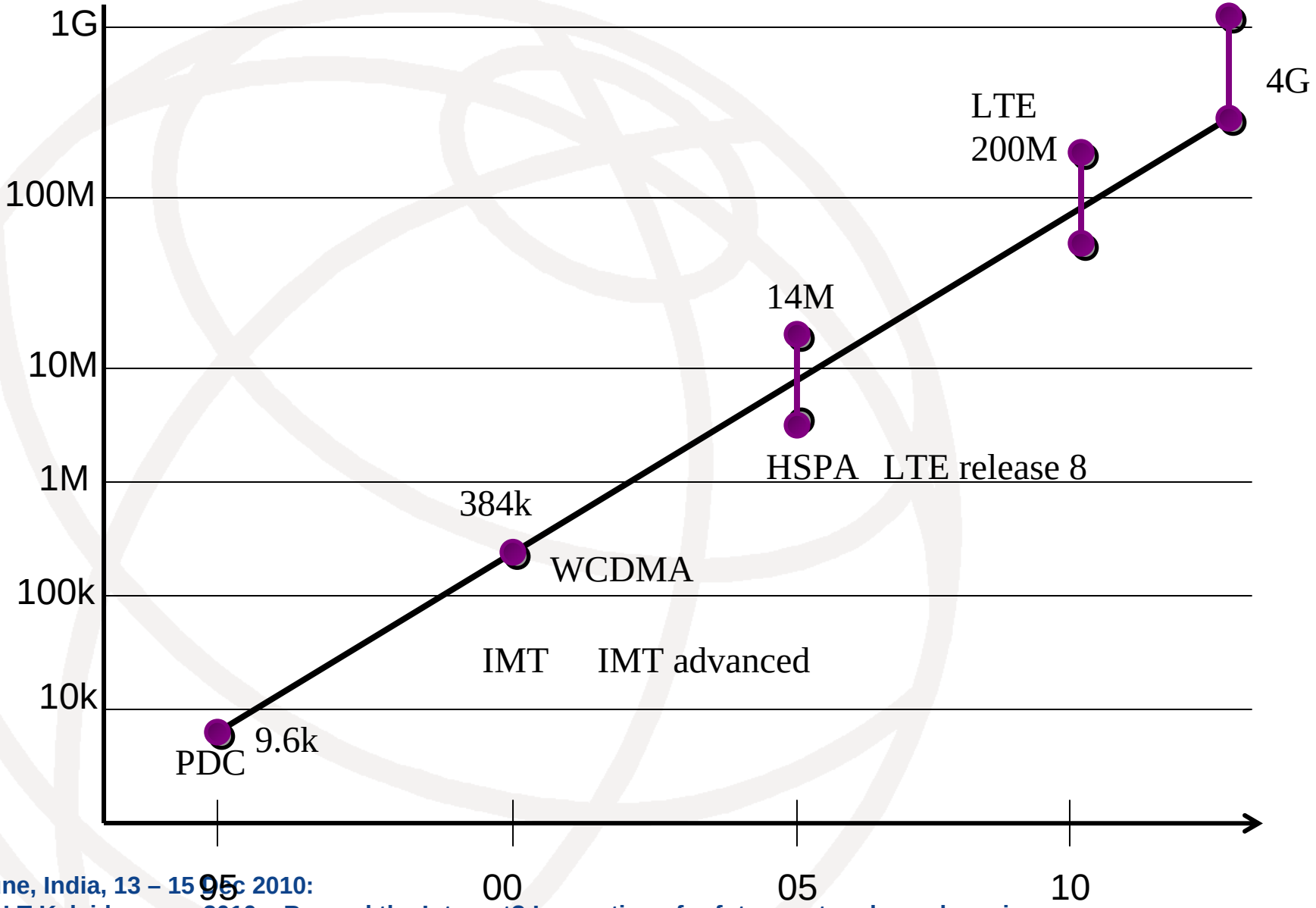
# Communication services for Vehicles

- When ITS study started in 1996, public wireless service was still premature.
- Dedicated short range communication system are proposed for ITS Communication.
- In latter half of 1990‘s, cell phone services became ubiquitous and quickly saturated in personal service market.
- Transport Telematics was expected to cultivate new market for Cell Phone Carriers.
- In 1990′s business model of cell phone for Machine to Machine communication was still premature and performance was also inadequate for some of ITS applications.

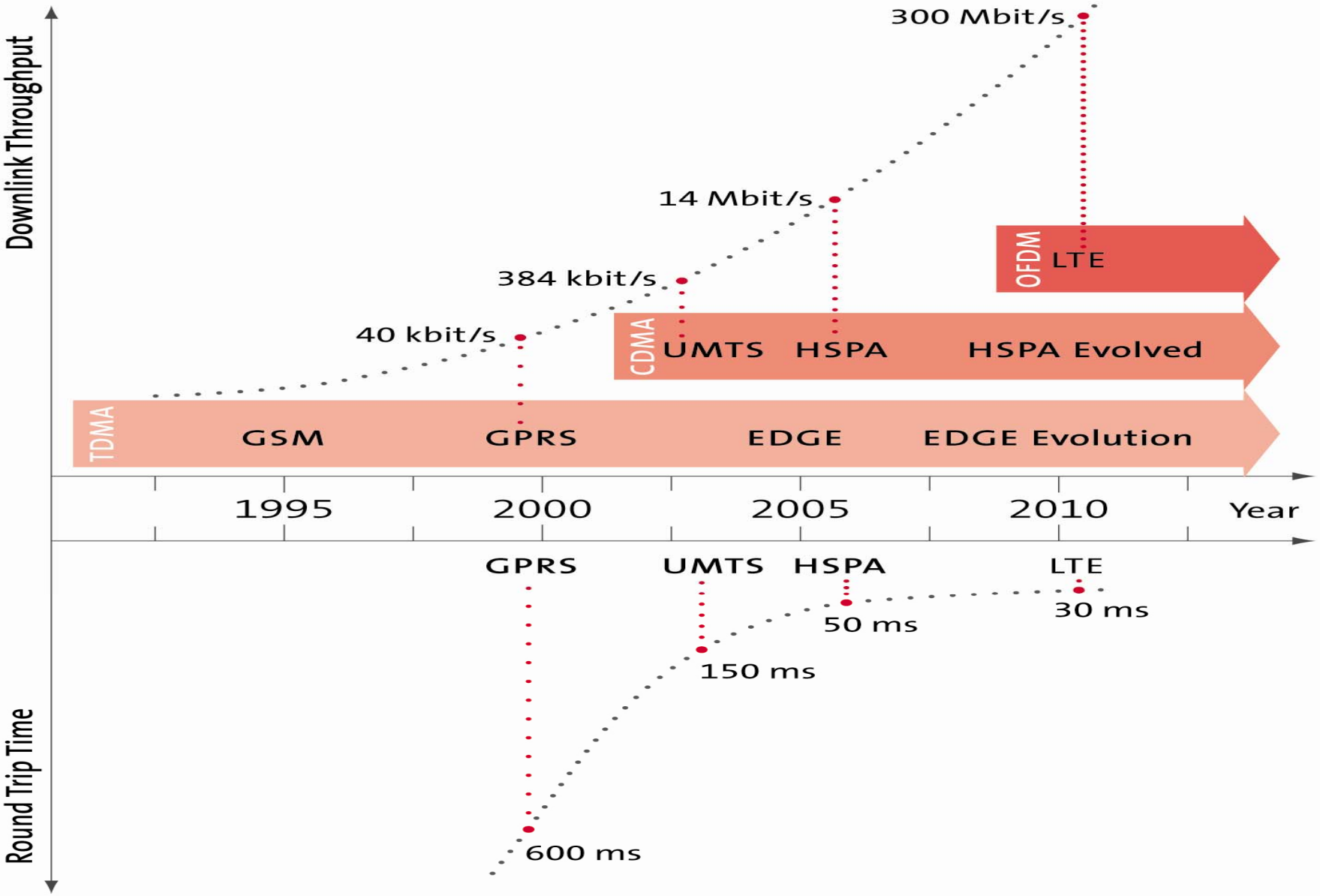
# Cell Phone for Vehicle Communication

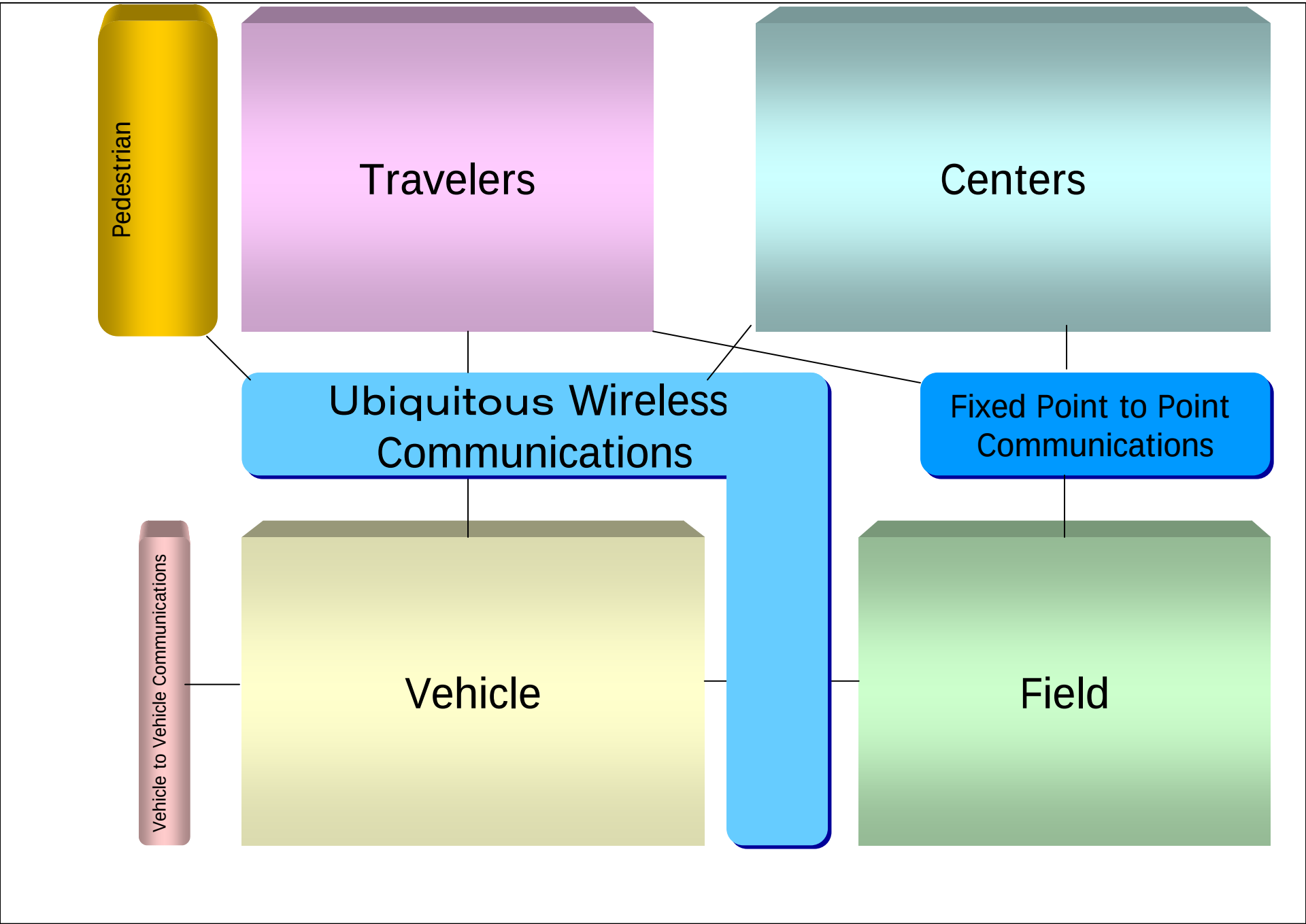
- Business model to charge for car telecom module as the second personal cell phone did not work in 90′s.
- In 2000′s transport telematics is a auto-manufacturer based MVNO service and efforts are paid to promote providing useful services for automobile users.
- Although performance of Cell Phone does not satisfy the requirement for ITS, appropriate design to satisfy requirement should be possible if new market is possible in future.
- In 2000′s performance of LTE and 4G cell phone is expected to have performance for many vehicle applications.

伝送速度

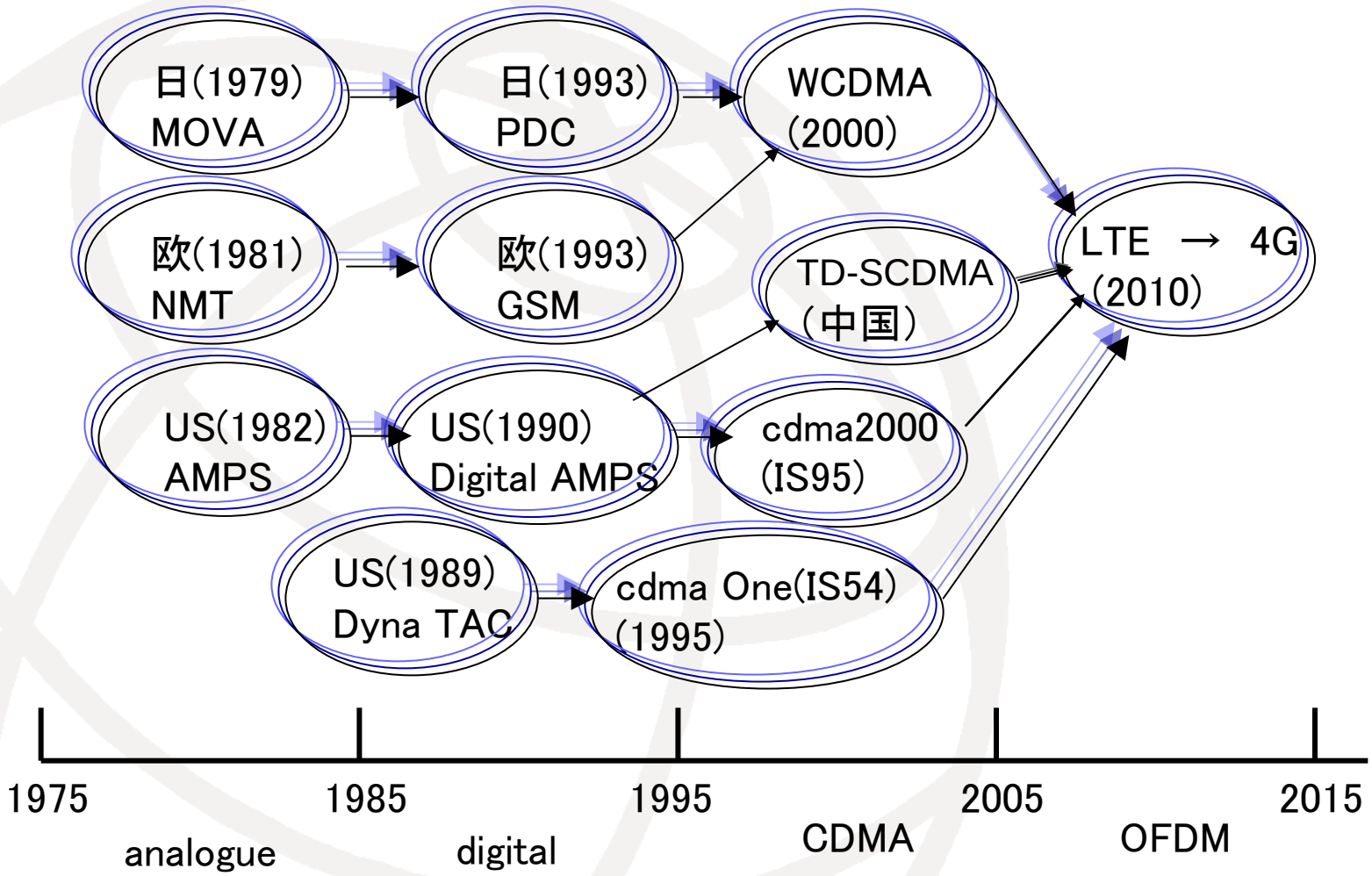

1G
100M
10M
1M
100k
10k
4G
LTE
200M
14M
HSPA
LTE release 8
384k
WCDMA
IMT
IMT advanced
9.6k
PDC
95
00
05
10

# Round trip time and speed of B3G

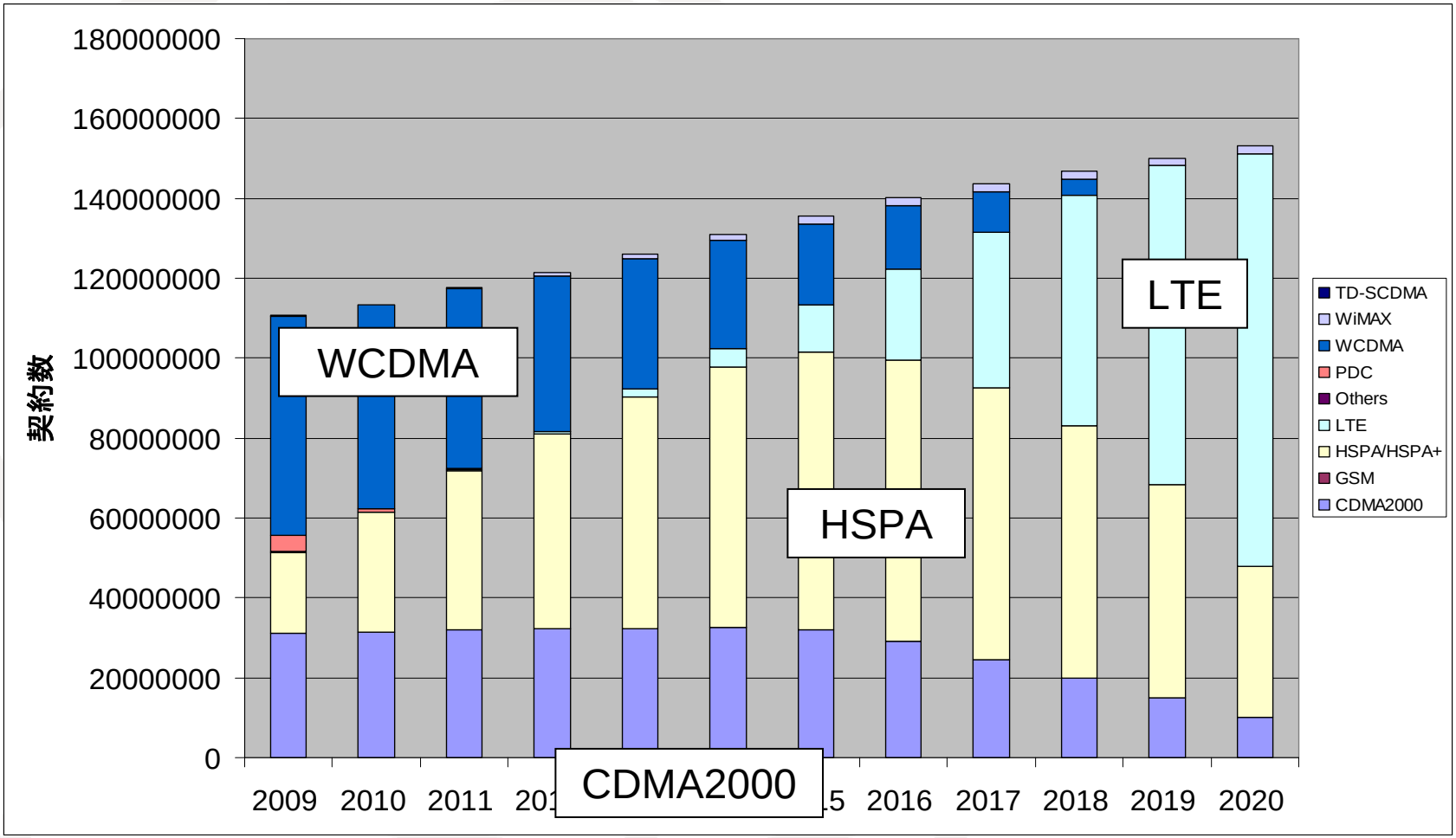



Pedestrian
Travelers
Centers
Ubiquitous Wireless Communications
Fixed Point to Point Communications
Vehicle to Vehicle Communications
Vehicle
Field

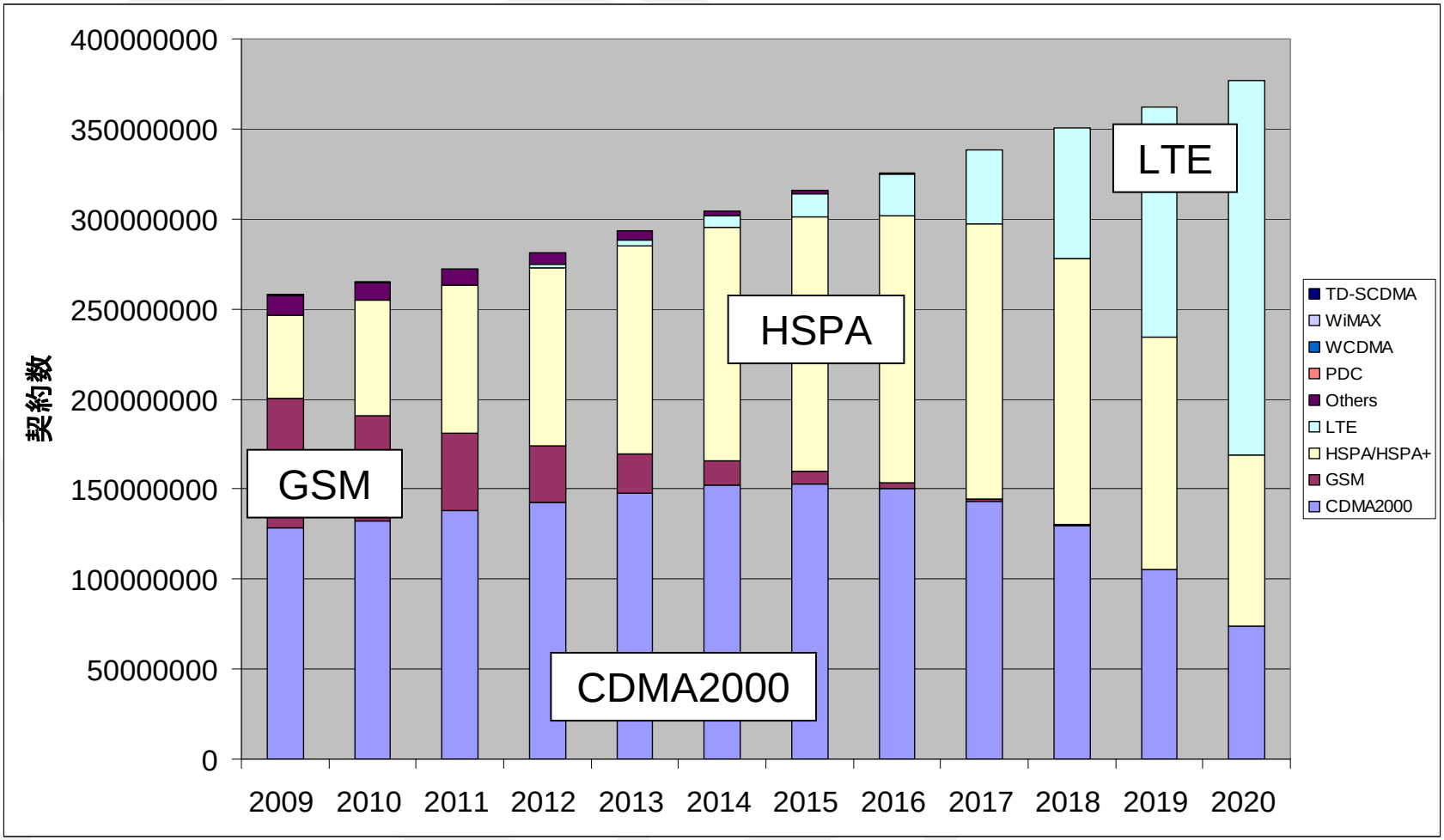
# Cell Phone standards can be unified after the history



# Prediction of LTE（Japan）



# Prediction of LTE （US）



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- Communication system for human use
- Broadband communication wireless and wireline
- Multimedia applications for human market
- Extension of range without repeater.
- Mobility management of human speed.
- Security to keep network
- Cost reduction by expansion of market
- Recent requests for low carbon systems

# Broad Range of Requirements for Machine to Machine Communication

Latency for Setup

0.1msec ~ 10msec ~ 1sec ~ 100sec

Distance of Communication

0.01m ~ 1m ~ 100m ~ 10km ~ 1000km

Data Speed

1b/s ~ 100b/s ~ 10kb/s ~ 1Mb/s ~ 100Mb/s

Coverage

point, surrounding, linear, plane(operator, national ,global)

Addressing

location, person, vehicle, machine, situation

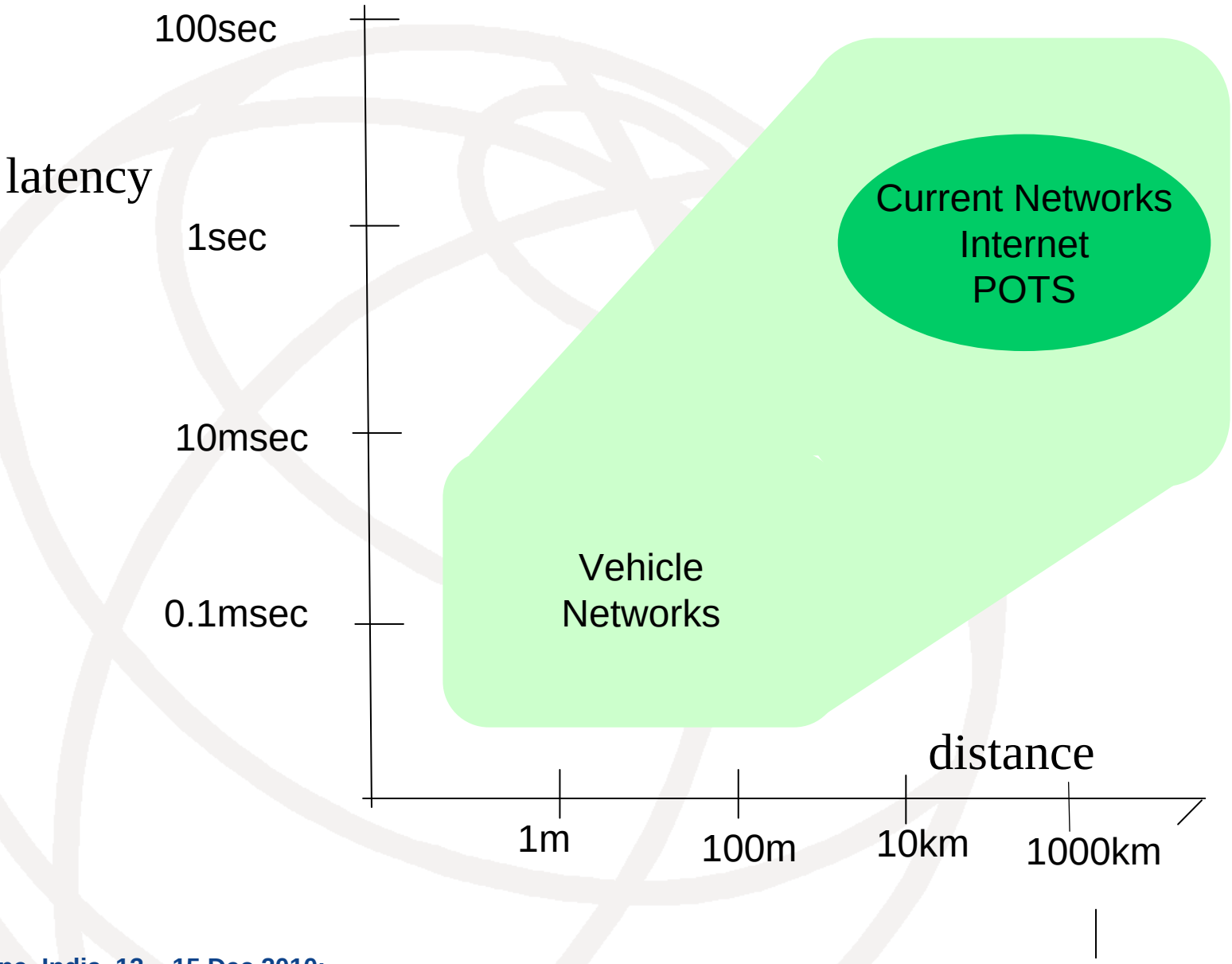
Error rate

$10^{-9}$, $10^{-7}$, $10^{-5}$, $10^{-3}$, $10^{-1}$

Technology life

5 years, 10 years, 20years, 100years

# An Example of Performance Requirement for Vehicle Service



## Communication performance requirement for intersection safety warning

| | |
|---|---|
| Latency for Setup | 10msec |
| Distance of Communication | 1m ~ 100m |
| Data Speed | 100b/s ~ 10kb/s |
| Coverage | surrounding |
| Addressing | location |
| Error rate | $10^{-5}$ ~ $10^{-3}$ |
| Life of technology | roadside 50 years<br>vehicle 20 years |

## Communication performance requirement for

# intersection collision avoidance

| | |
|---|---|
| Latency for Setup | 10msec |
| Distance of Communication | 1m ~ 100m |
| Data Speed | 100b/s ~ 10kb/s |
| Coverage | surrounding, linear |
| Addressing | location |
| Error rate | $10^{-9}$ ~ $10^{-5}$ |
| Life of technology | roadside 50 years |
| | vehicle 20 years |

## Communication performance requirement for
# mayday support

| | |
|---|---|
| Latency for Setup | 1sec ~ 100sec |
| Distance of Communication | 10km ~ 1000km |
| Data Speed | 10kb/s ~ 1Mb/s |
| Coverage | plane (global :cross border) |
| Addressing | vehicle, machine |
| Error rate | $10^{-5}$ ~ $10^{-3}$ |
| Life of technology | roadside 50 years |
| | vehicle 20 years |

- Business model of Cellular network to support small data traffic is needed.
- Keeping track many terminals having low traffic is needed.
- Possible number of vehicles to be served by cellular network is also be a problem.
- Major issue for DSRC is difficulty in investment just for vehicle, especially in low traffic density area.
- Common use of infrastructure for ITS and telematics will be a solution.
- To keep the cost low for safety application is to be studied including new protocol common with another M2M services.
- Study of common requirements for M2M communication is a challenge for new telecommunication market.