Vehicular Networks and Telematics Applications: Next ICT industry for the knowledge-based economy

By

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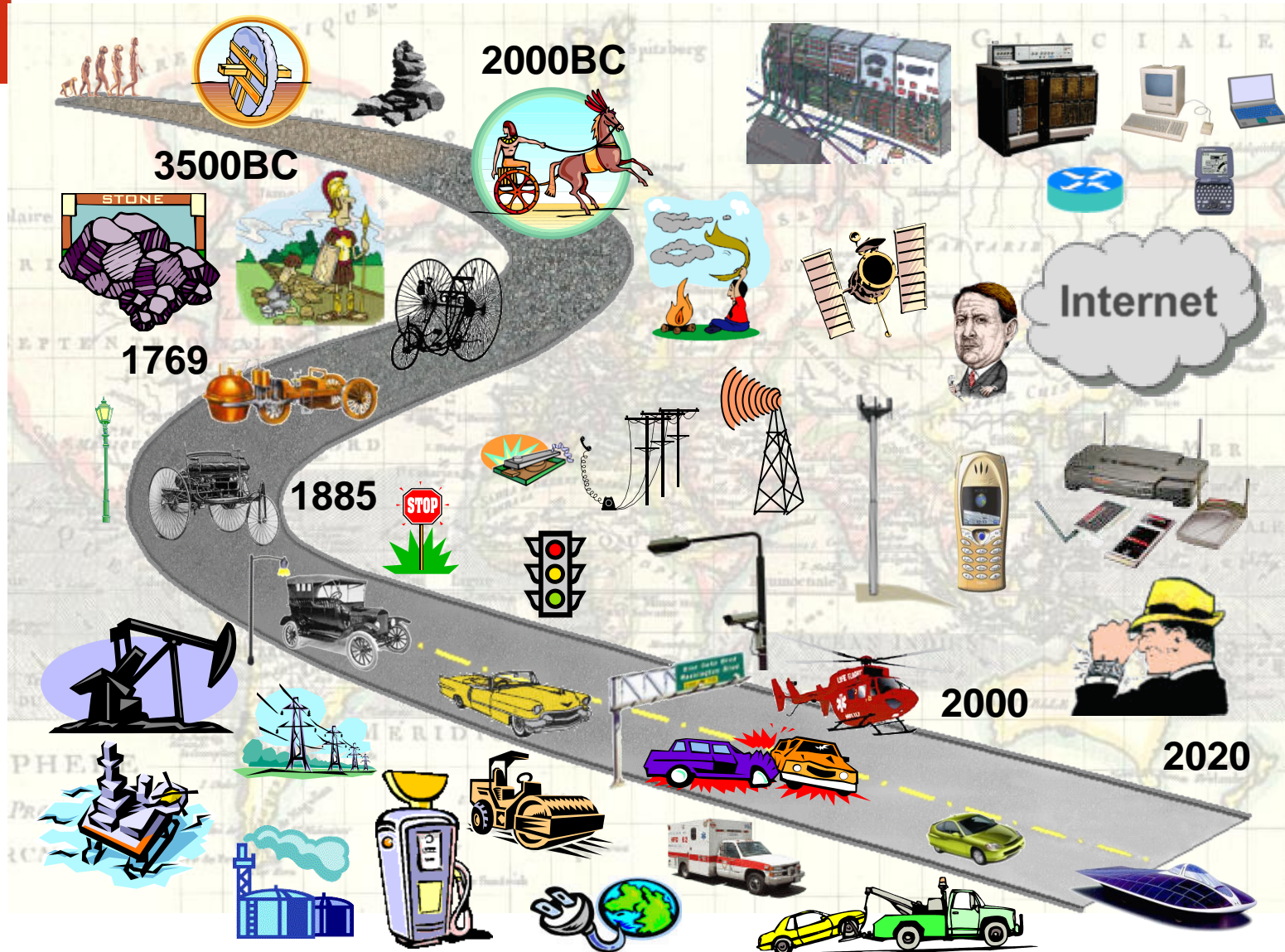
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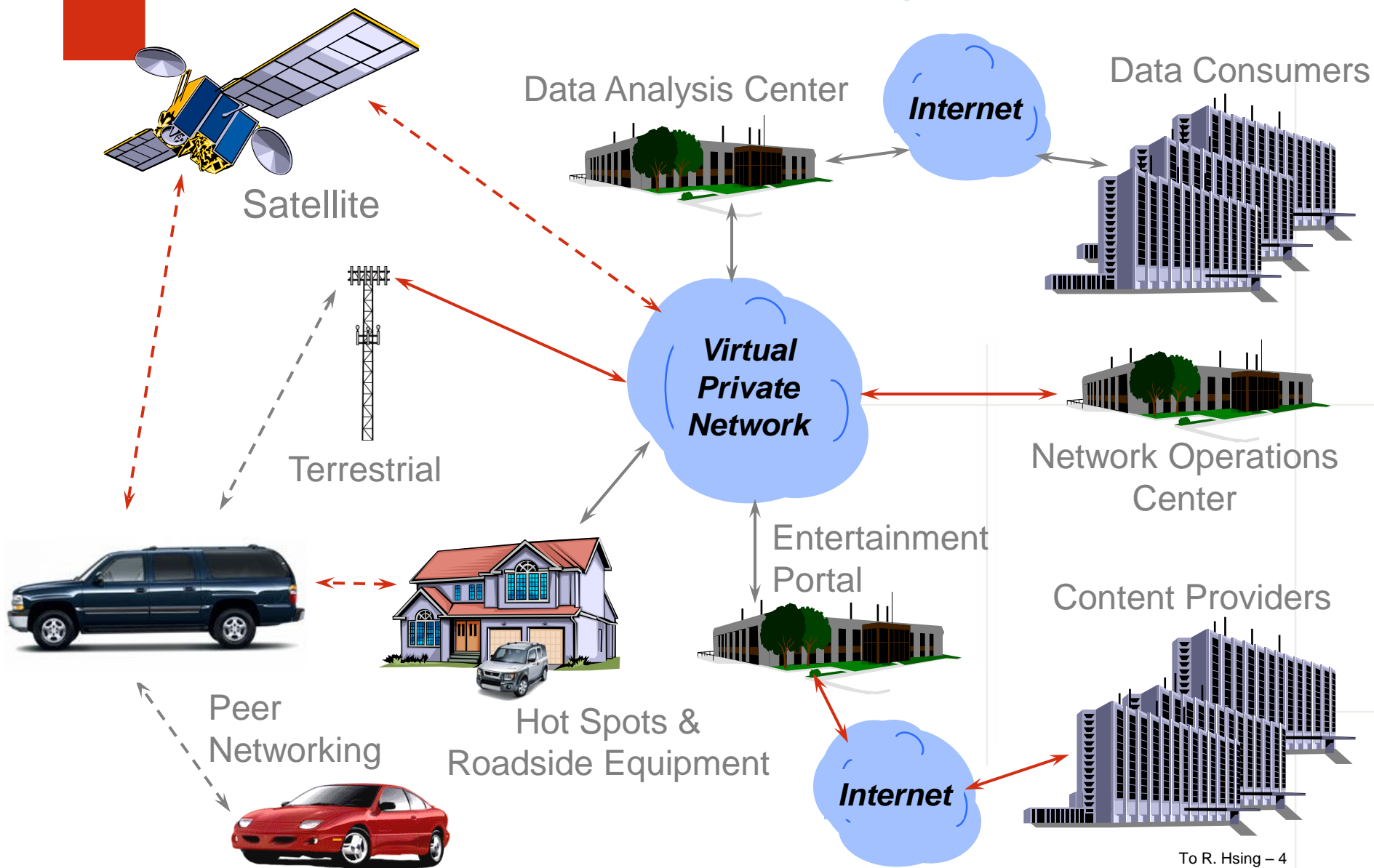**E-mail: pszczech@telcordia.com**

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- Vehicular Networks & Telematics Applications
- Standards
- Opportunities, Challenges and Applications in Telematics
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The Connected Vehicle Paradigm

Data Analysis Center

Internet

Data Consumers

Satellite

Virtual Private Network

Network Operations Center

Terrestrial

Entertainment Portal

Content Providers

Peer Networking

Hot Spots & Roadside Equipment

Internet

ELEMENTIVE

What We really Need:

1. **Knowledge-based Economy with High-Profit Margin Business**
2. **A Rich Portfolio of Intellectual Capital (IC)**
3. **Global Marketing/Sales, Alliance, and Distribution Channels**

Proposed Solution:

Vehiclular Networks and Telematics Applications

Challenges and Opportunities:

Technologies
Standards
Government Policy
Business Model

Why ? How?

Connected-Vehicle Model is Rapidly Morphing

Car & Electronic Component Life Cycles diverging

- Automobiles   - Median life is 9.2 yrs
                     - Design cycle is 3.5 yrs
- Components   - Median life 2.0 yrs
                     - Development cycle 0.5 yrs

Closed electronic components & software under assault
 - Open architectures (Android, iPhone 3G, Intel's MID)
 - Carried-in devices (PNDs, cell phones, PDAs, mp3 players)

After-market devices for cars proliferate
 - Mushrooming growth
 - Advanced capabilities
 - Have crossed "impulse" purchase thresholds

Major Concerns and Key Objectives

- Safety

- Traffic Congestion & Environment (i.e. Energy)

- Mobility Applications

- Privacy-Preserving Secured Communication

Through
WiFi, GPRS, Edge, EVDO, Wireless 3G, WiMax, LTE, UMB, and IMS/Mobile Ad Hoc Networks
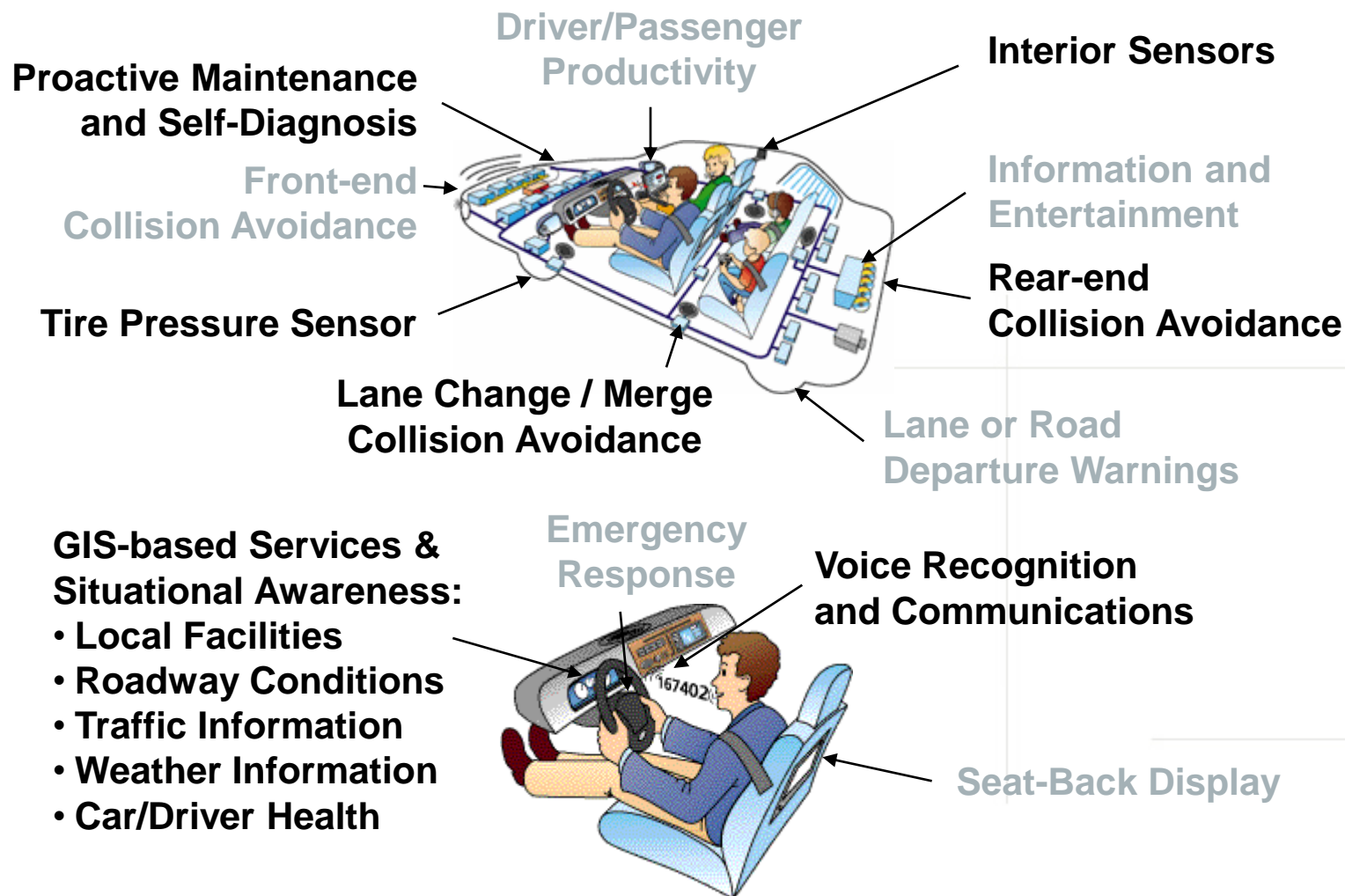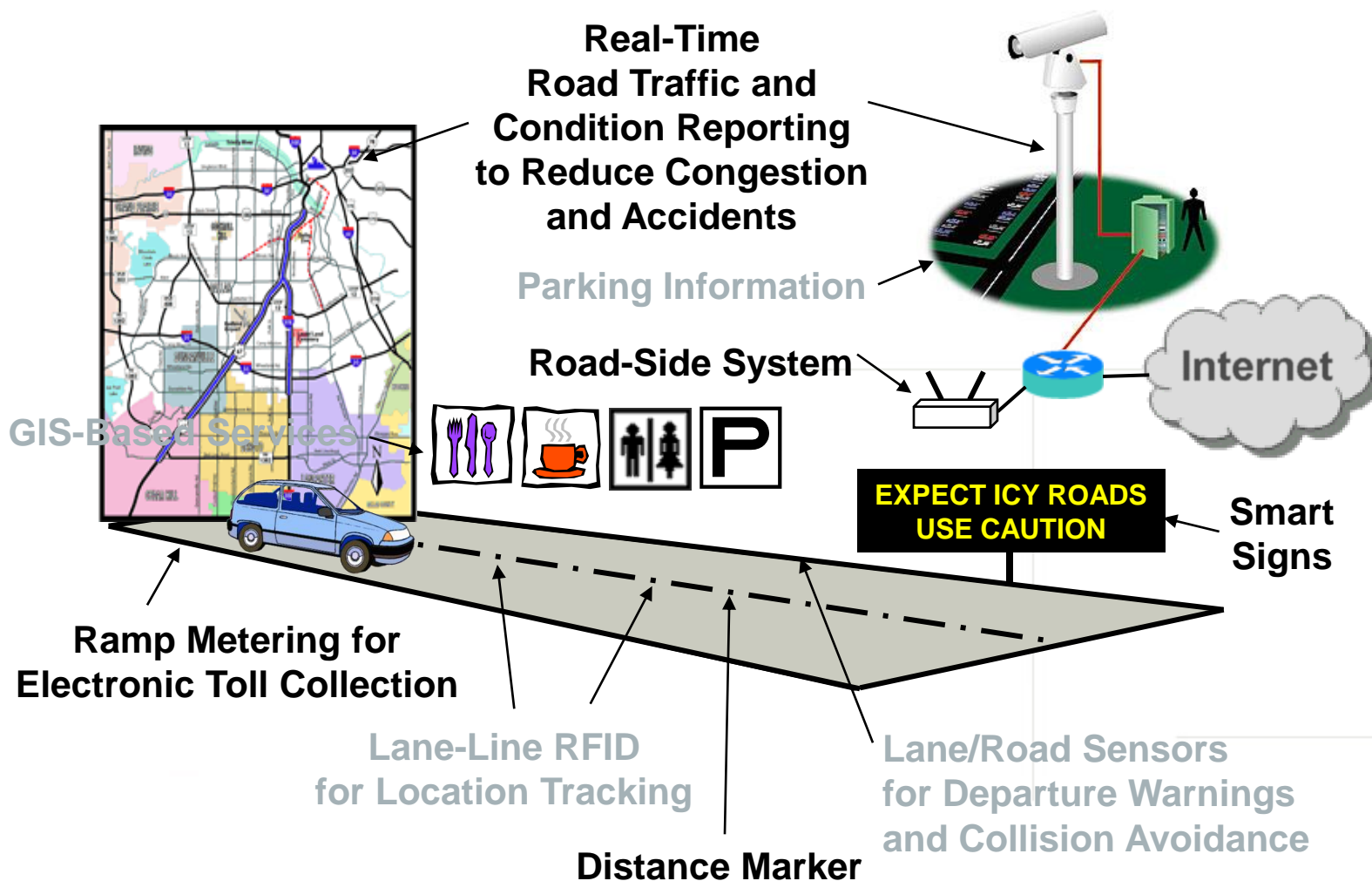## This is all about

.NET	**.CAR**	**.ROAD**
人	車	路

.CAR
A Ubiquitous Communications Node

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Driver/Passenger Productivity

Interior Sensors

Proactive Maintenance and Self-Diagnosis

Front-end Collision Avoidance

Information and Entertainment

Tire Pressure Sensor

Rear-end Collision Avoidance

Lane Change / Merge Collision Avoidance

Lane or Road Departure Warnings

GIS-based Services & Situational Awareness:
- **Local Facilities**
- **Roadway Conditions**
- **Traffic Information**
- **Weather Information**
- **Car/Driver Health**

Emergency Response

Voice Recognition and Communications

Seat-Back Display

.ROAD
Ubiquitous Awareness for Transportation

Real-Time Road Traffic and Condition Reporting to Reduce Congestion and Accidents

Parking Information

Road-Side System

GIS-Based Services

Internet

EXPECT ICY ROADS USE CAUTION

Smart Signs

Ramp Metering for Electronic Toll Collection

Lane-Line RFID for Location Tracking

Lane/Road Sensors for Departure Warnings and Collision Avoidance

Distance Marker

.NET Essential Infrastructure is Well Under Way

- 3G / 4G poised to deliver unprecedented:
  - Coverage
  - Bandwidth
  - Latency
  - Reliability

- Future wireless technologies to deliver explosive range & depth of services
 - Personalization
  - Immediacy
  - Anticipation

Wireless communications and Mobile Ad Hoc Networking are Enablers for

Dramatically Improved

- **Safety**
- **Security**
- **Efficiency**
- **Convenience**
- **Information**
- **Entertainment**

Based on

- **Software and Applications**
- **Protocols**
- **Intelligence and Autonomy**
- **Computing**
- **Ad Hoc Networking**
- **Storage**
- **Communications Technologies and Interfaces**
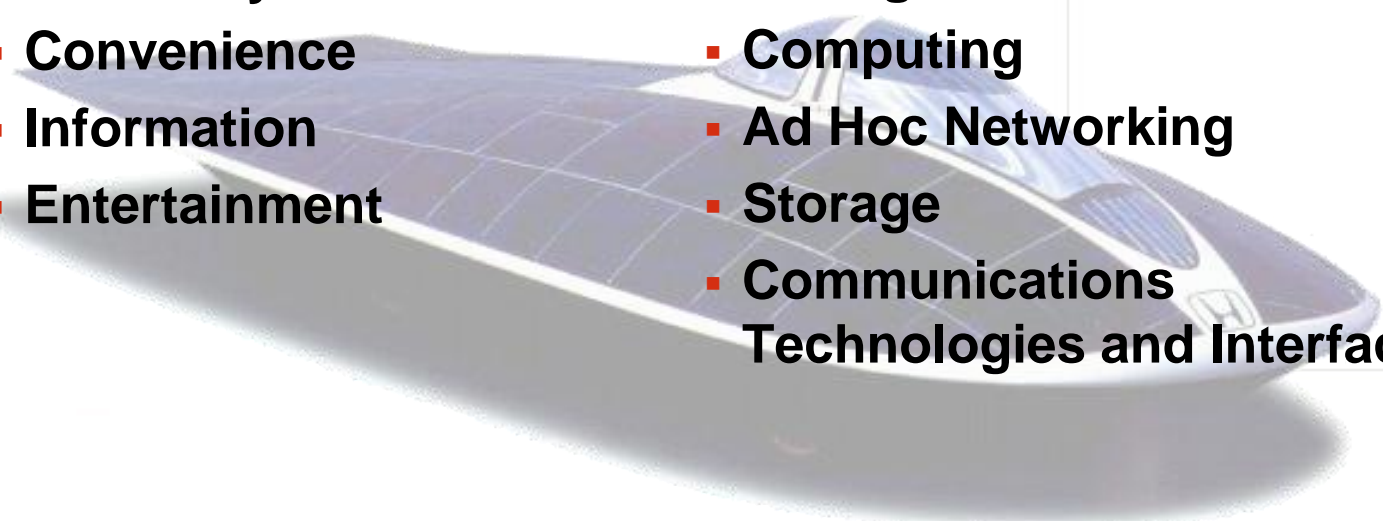
USDOT Connected Vehicle Research Focus Areas

- Connected Vehicle Technology
- Connected Vehicle Applications
  - Safety Applications
    - Vehicle to Vehicle Communications for Safety
    - Vehicle to Infrastructure Communications for Safety
  - Mobility Applications
    - Real-Time Data Capture and Management
    - Dynamic Mobility Applications (DMA)
  - Environmental Applications
    - Applications for the Environment: Real-Time Information Synthesis (AERIS)
    - Road Weather Applications for Connected Vehicles
- Connected Vehicle Technology Policy and Institutional Issues
- Use of DSRC for V2V Safety Applications
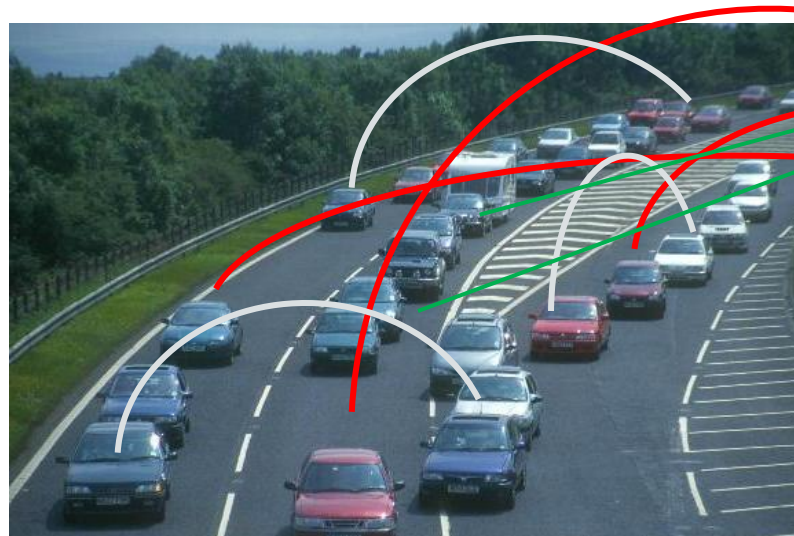
Vehicular Networks & Telematics App.
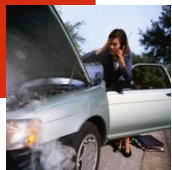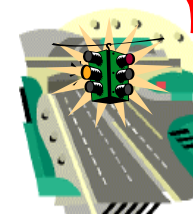
Safety/Auto Services

Navigation & Mobility

Infotainment & E-commerce

Telematics Enabled Vehicles

V2I Communication
V2V Communication
GPS

Connected Vehicle Services

- Safety/Auto services
  - Driver Safety and Security
  - Vehicle Maintenance
- Navigation & Mobility
  - Traffic, ETA, POI, Localized Searches
  - Tolls and Parking
- Infotainment & E-Commerce
  - Digital Content
  - Social Networking

Enabling Trends

- Smartphone Platforms
  - App Store Business Model
  - Tethering for OBU
- OBU and Passenger Entertainment Systems
  - Embedded wireless and sensors
  - Smartphone integration with improved HMI
- Infrastructure
  - Vehicle Infrastructure Integration (Future)
  - Cloud based delivery
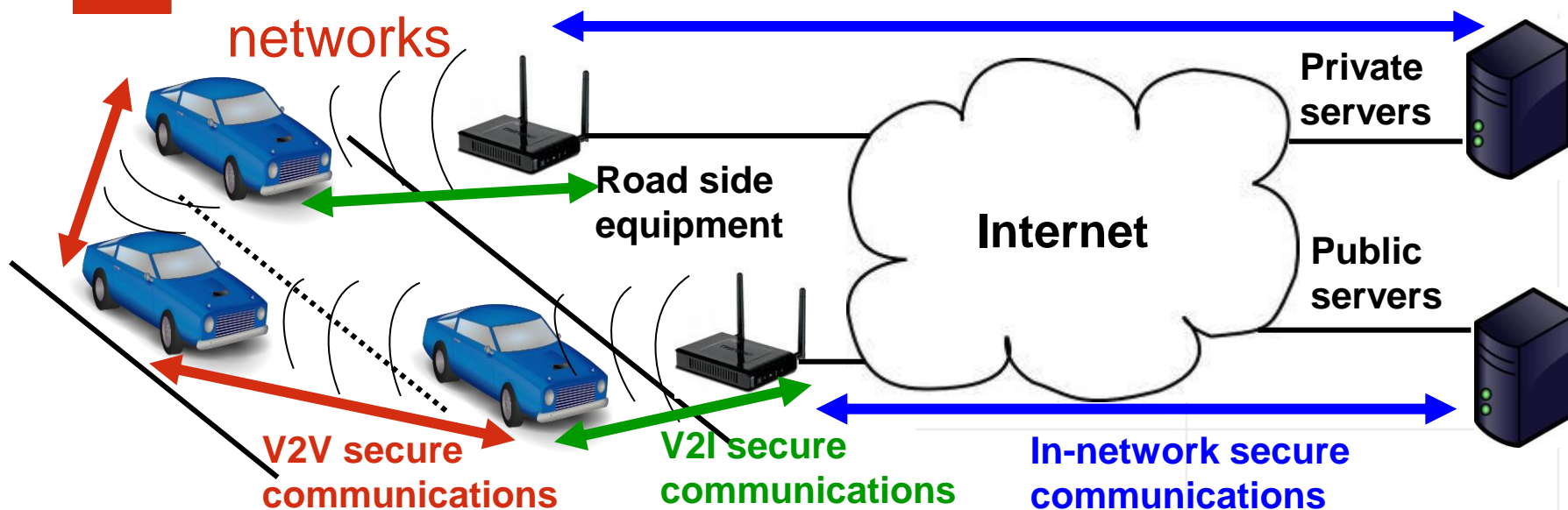
Example Vehicle Applications

- Cooperative collision avoidance
- Lane-change assistance
- Road condition warning
- Intersection collision warning
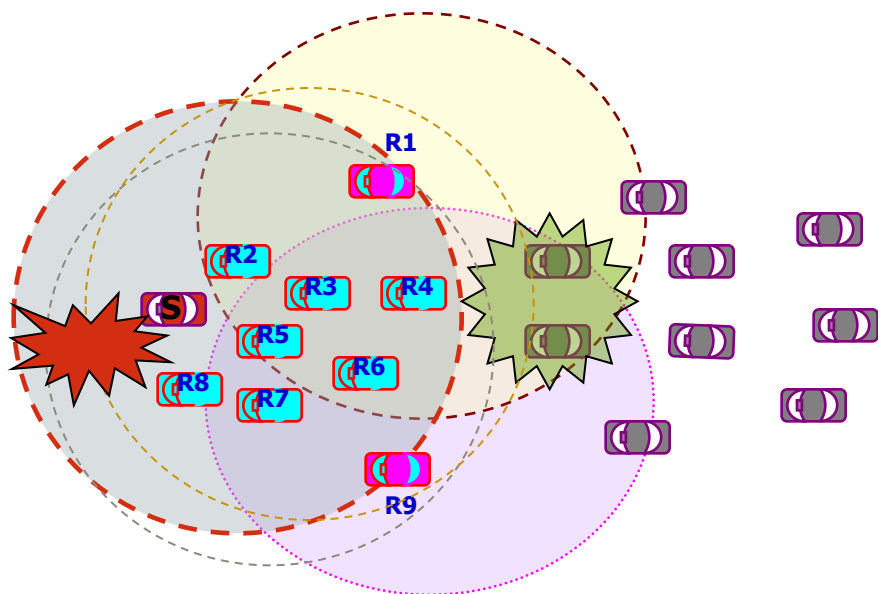
- Need reliable reception of messages
- Need quick dissemination of information
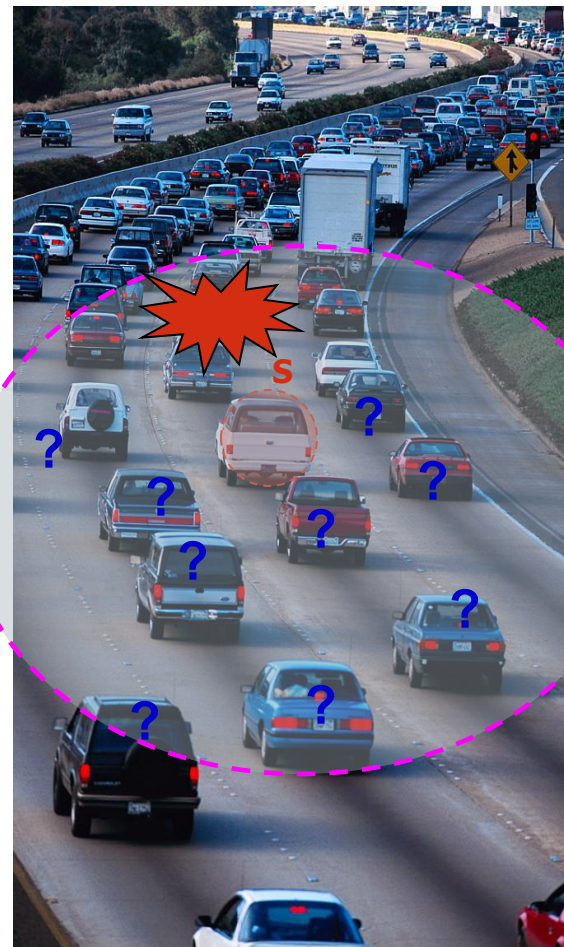
End-to-end secure communications in vehicular networks

- **Security requirements in vehicular networks**
  - Authentication and data security
  - Privacy (Identity, location, type of service)
  - Secure broadcasts
  - Scalability & real-time response
  - Availability & malicious behaviour detection

Security challenges & solutions

- How can we secure vehicular communications while preserving users privacy?
  - Adaptive privacy-preserving vehicle authentication, authentication using symmetric random key-sets
  - New PKI and certificate schemes (combinatorial certificate schemes, IBE)
  - Authenticated and encrypted broadcasts
- Real-time response, limited bandwidth & scalability requirements?
  - New application layer security protocols for vehicular networks (e.g. VDTLS)
- Malicious behaviour detection?
  - Non-interactive detection schemes

Why ITS Telematics Standards Are Important

- Deliver standards for transportation connectivity
- Enable an interoperable ITS by cooperating with a broad stakeholder community to ensure:
    - Standards development is a participatory process
    - Resulting standards are
        - Acceptable
        - Relevant to marketplace
        - Meeting public/consumer needs

US ITS Standards Development Organizations (SDOs)

SDO	Full Name
AASHTO	American Association of State Highway and Transportation Officials
ANSI	American National Standards Institute
APTA	American Public Transportation Association
ASTM	American Society for Testing and Materials
ATIS	Alliance for Telecommunications Industry Solutions
IEEE	Institute of Electrical and Electronics Engineers
ITE	Institute of Transportation Engineers
NEMA	National Electrical Manufacturers Association
SAE	Society of Automotive Engineers
TIA	Telecommunications Industry Association

Cellular Wireless Technologies Evolution

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| 1G | 2G | 2.5G | 3G | 3.5G |

EDGE

LTE (E-UTRAN)

NMT

TACS

GSM

GPRS

HSPA

W-CDMA (UMTS)

HSDPA

HSUPA

TD-SCDMA (China)

3GPP

D-AMPS (IS54/136)

AMPS

CDMA (IS-95)

1xRTT

1xEV-D0 Rev 0/A/B
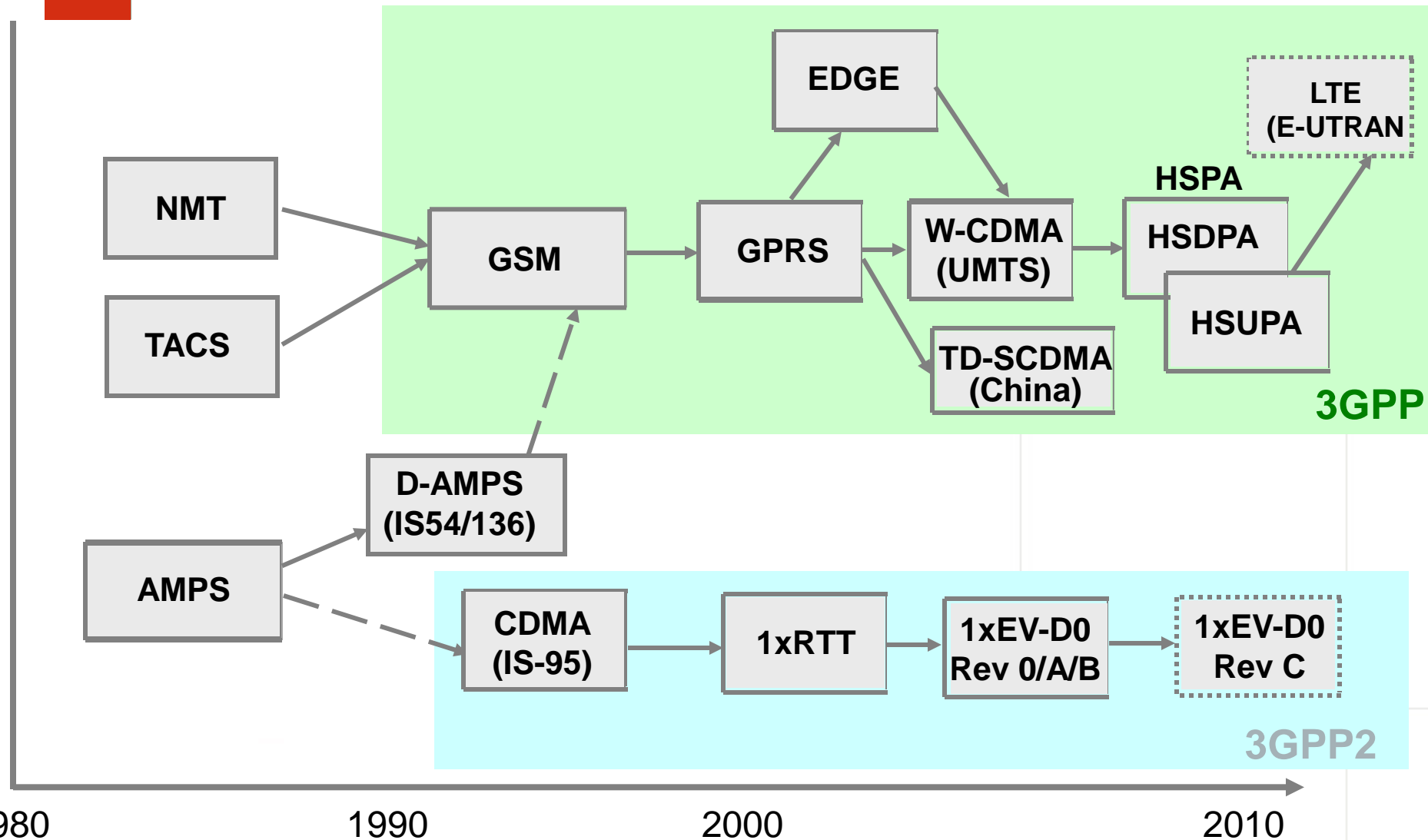
1xEV-D0 Rev C

3GPP2

1980   1990   2000   2010

Conclusion (1): Major Challenges:

- Technologies

- Standards

- Government Policy

- Business Models

Conclusion (2): Potential Research Topics in Telematics

- Develop the secured broadcast algorithms to support safety applications

- Detect the serious malicious behaviors and malicious vehicles?

- Design a privacy-preserving Public Key Infrastructure (PKI) for V2V networks.

- Design high-speed Protocol process for V2V applications

.NET

.CAR

.ROAD

Connectivity & Services

Communications Node & In-Car Network

Critical Data & Situational Awareness

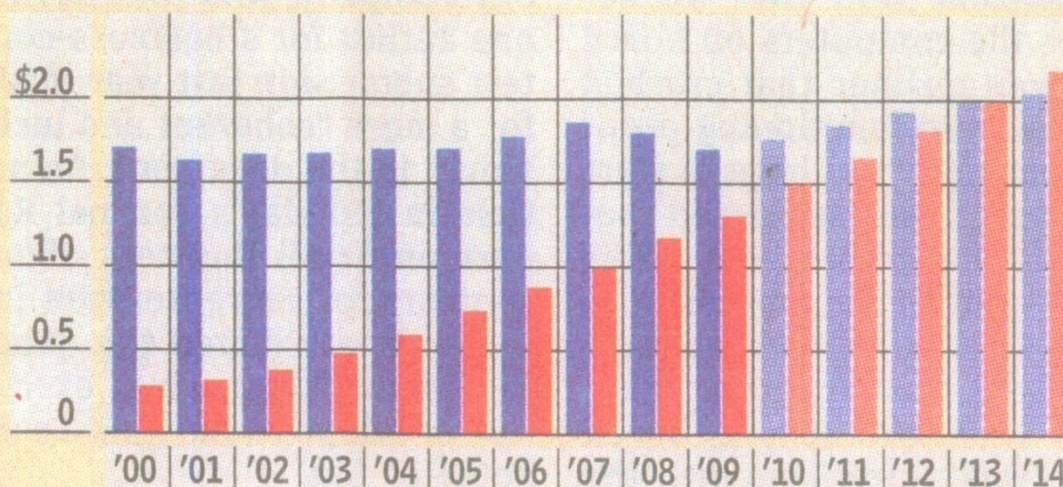*Ubiquitous Telematics Services*

Size of the manufacturing sector, in trillions of 2005 U.S. dollars, for: ■ U.S. ■ China

5/22/2010

Source: IHS Global Insight   Note: Figures starting in 2010 are forecasts

■ **China is poised to overtake the U.S. as the world's largest manufacturer.** The U.S. manufacturing sector, which shrank last year as factories slashed output during the recession, is growing again. But China's manufacturing sector–measured in value-added terms, which tallies the value created at each step of extended production processes–should eclipse that of the U.S. in 2013.

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