Lesson 7

Internet Connected Car Applications and Services

Connected car

- Wikipedia: "A car that is equipped with Internet access, and usually also with a WLAN.

- The car sharing Internet access with other devices both on the inside and outside

- Car outfitted with special technologies that tap into the Internet or WLAN

- Provisioning of additional benefits to the driver"

Connected car

- McKinsey:

- "A vehicle optimising its own operation and maintenance as well as the convenience and comfort of passengers using on-board sensors and Internet connectivity"
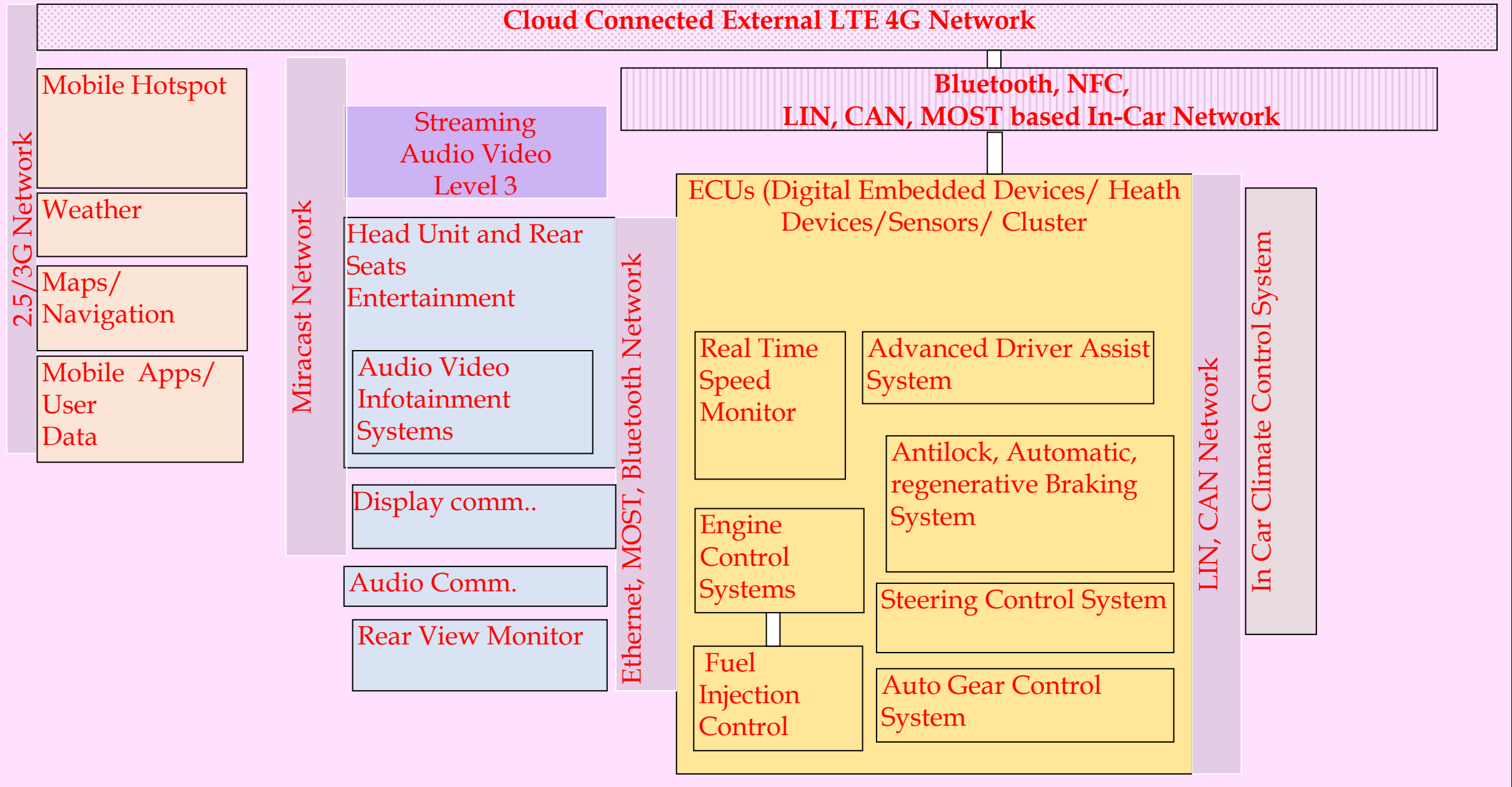
Cloud Connected External LTE 4G Network

Bluetooth, NFC, LIN, CAN, MOST based In-Car Network

2.5/3G Network

Mobile Hotspot

Weather

Maps/ Navigation

Mobile Apps/ User Data

Miracast Network

Streaming Audio Video Level 3

Head Unit and Rear Seats Entertainment

Audio Video Infotainment Systems

Display comm..

Audio Comm.

Rear View Monitor

Ethernet, MOST, Bluetooth Network

ECUs (Digital Embedded Devices/ Heath Devices/Sensors/ Cluster

Real Time Speed Monitor

Advanced Driver Assist System

Antilock, Automatic, regenerative Braking System

Engine Control Systems

Steering Control System

Fuel Injection Control

Auto Gear Control System

LIN, CAN Network

In Car Climate Control System

Fig. 12.5 Overview of a connected car

In-Car ECUs Cluster Network

- Connected car generates data using in-car Electronic Control Units (ECUs) cluster

- Digital embedded devices/product heath devices/sensors

In-Car ECUs Cluster Network

- Uses Bluetooth and NFC for inter-devices wireless communication, Controller Area Network (CAN) and Local Interconnect Network (LIN) for wire communication

- Multimedia devices use Media Oriented System Transport (MOST)

In-Car Cluster Systems and Controls

- Engine control, Speed control and brake system, antilock braking, automatic braking and regenerative

- Braking and Safety systems

- Seat and pedal controls

- Car environment controls: Car climate and light controllers control the air-conditioning, heater, ventilation, windows, light and temperature (ACHVWLT)

In-Car Cluster

- Automobile status monitoring: Automobile status monitoring, tyre pressure, real time, vehicle mileage, data loggers and driving assisting devices management, steerable head lights, windshield IR camera, windscreen heads up display, night vision assistance, and so on…..

In-Car Cluster System interfaces

- Soft programmable buttons
- Commands
- Voice activation,
- Advanced driver assistance system (ADAS)
- Wireless personal area connectivity in the automobile

Internet connected cars Application Examples

- Enable the services of Automotive Service Centre service

- Predictive maintenance using predictive analytics.

Internet connected cars Application Examples

- Route and Traffic Monitors

- Mobile API based car location

- Surrounding area maps

- Cached traffic reports for real time traffic monitoring

- Guided route programming and route planners

Internet connected cars Application Examples

- Infotainment Systems

- Miracast devices for streaming Internet radio and video

- Auto managed infotainment features

- Bluetooth connected music player, VCD/DVD

- Audio CD player

- LCD screen, touch panel screen, Displayed text-to-speech converters

Next generation in-car network Ethernet Connectivity

- Ethernet bus and Ethernet audio-video bridge

- Bridge between the connected number of subsystems and units

- For examples: Connectivity of other in-car networks with the head unit and rear seats, entertainment, driver information centre, advanced diver assistance system, and around view monitoring and gateways at ECUs.

Connected car Internet Connectivity

- 2.5G/3G/HSPA+/4G or Wi-Fi network
- Weather, maps, navigation
- Data feed of near real-time traffic conditions to the car
- Maps APIs
- Google maps

Connected car Internet Connectivity

- Location APIs

- A cloud platform transmits from nearby connected car in vicinity

- 4G LTE for streaming audio-video (Internet radio and mobile TV)

- Multimedia over the air

- Updates for its in-car infotainment system.

Internet connected car analytics

- Enables diagnostics

- Prognosis

- Car maintenance company services

- Comfort and convenience

Predictive Analytics Applications

- Automotive Components Predictive Automotive Maintenance Service (ACPAMS)

- Re-planning manufacturing process (RPMP)

ACPAMS

- A car maintenance service, Service centre applications
- Remote diagnostics
- Roadside assistance
- Car malfunction
- Car location based emergency services
- Reporting for the service-centre support

ACPAMS

- Remote care

- Connected car advanced analytics with in-depth views

- Car health monitoring

- Car health trend analysis

- Condition based maintenance triggers

ACPAMS

- Detecting dependencies amongst car health problems
- Depreciation analysis
- Driving behaviour analytics, analysis, detecting patterns of dependencies among vehicle health issues, location based geospatial analysis.

RPMP

- Re-planning, re-scheduling or innovating the production and manufacturing

- Design for Better customer experiences using the organised and analysed data

Gather Level 1 | **Enrich Level 2** | **Stream Level 3** | **Manage Level 4** | **Acquire Level 5** | **Organize and Analyse Level 6** | **IIoT/IoT Applications/ Services Level 6**

Connected Car

Connected Car

Connected Car

LTE Network

WiFi Network

IP Network

Internet Firewall

Comm. Mgmt

HTTP, TCP, UDP, LTE/3G/2G Mobile Comm and other Protocol Handlers

Message Router

Message Cache

Car and Devices Identity Mgmt & access Mgmt.

Car ECUs Devices and Diverse Sources Data

Messages caches

Message Routing

Database Firewall

Driver/Car User Server Data Mgmt.
Service Centre Server Data Mgmt.

Big Data Store

Database RDBMS

Message Routing

Event Processing

Prescriptive Analytics

Descriptive Analytics

Predictive Analytics

APIs for Developer

Apps for re-planning the marketing, sales, Services and offering better customer experiences

Manufacturing Unit Apps

Apps Service/Maintenance Centre /Service Calls/Diagnostics/ Predictive Analytics
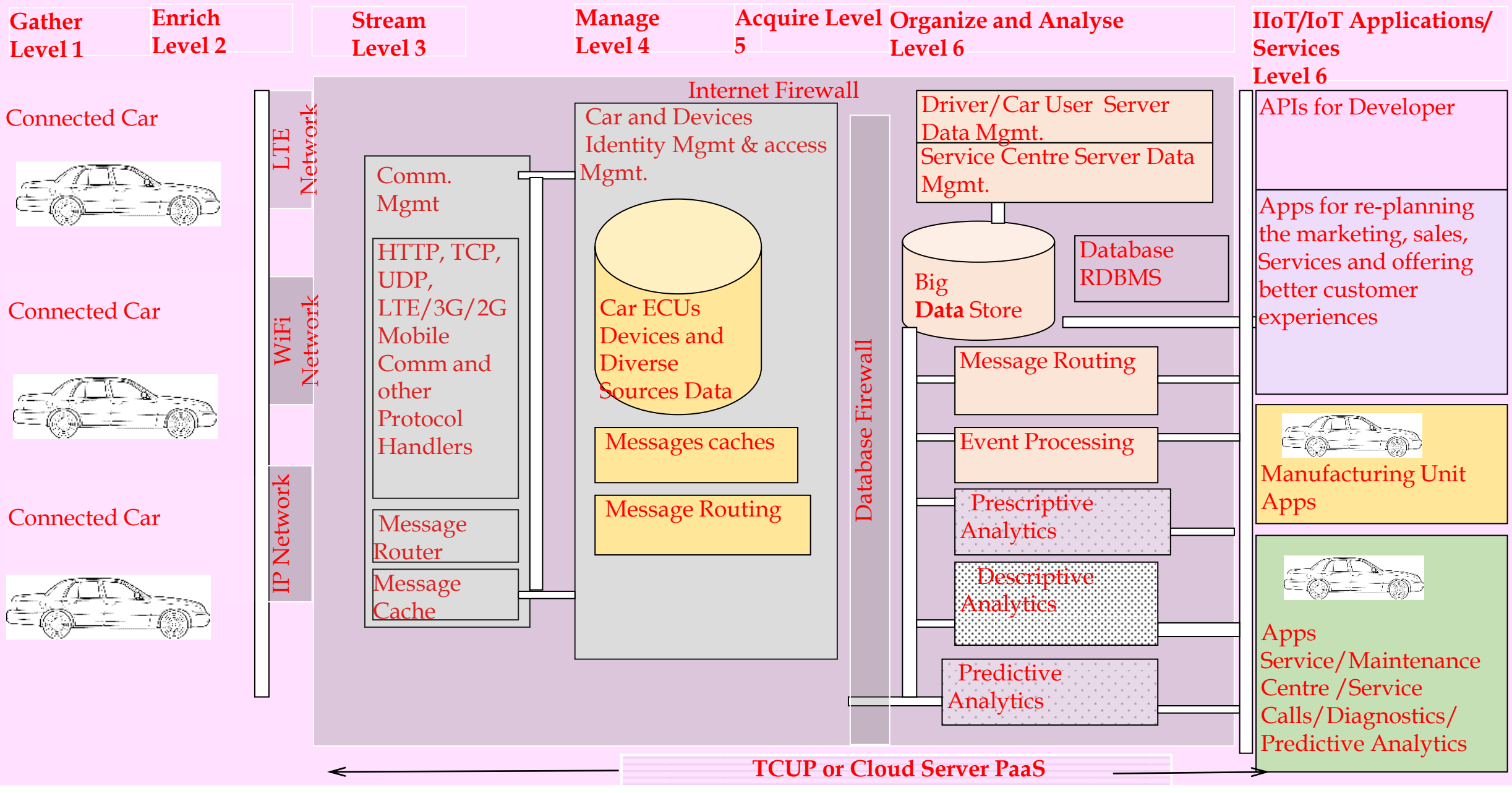
TCUP or Cloud Server PaaS

Fig. 12.6 Data flow diagram and architecture of Connected Car to TCUP Cloud Server for PaaS for Developers, Manufacturing Units and Maintenance Service units IoT applications/Apps/Services

Layer 1 (Gather): Oracle IoT Architecture Reference Model Design and Implementation

- The apps installing at the mobile and wearable devices embed hardware and software

- Gathering the car location, weather, traffic, navigation and car-health data.

- ECUs cluster gathering using the buses

- The embedded sensors and device hardware and software

- Gather the data and communicate that using the bus.

Layer 2 (Enrich and Stream): Oracle IoT Architecture Reference Model Design and Implementation

- Data collects using CAN, MOST, Ethernet and Miracast Wi-Fi devices and display board

- Software enriches the data, generating time series and location stamped data and adapts the data

- The central-computer smart gateway for ECUs cluster and provides cryptographic authentication, integrity and confidentiality functions for car cluster security.

Layer 3 (Manage): Oracle IoT Architecture Reference Model Design and Implementation

- TCUP or a cloud server PaaS consists of communication management functions for the accesses

- ECU cluster, infotainment and other systems management

- Data and messages routing and caching.

Layer 4 (Acquire and Organise): Design and Implementation

- The platform acquires the ACPAMS and RPMP data

- Events and data of devices and diverse sources

Layer 5 (Analyse + Intelligence): Design and Implementation

- Applications perform analytics and data visualisation and extract intelligence

Layer 6 (Enterprise Integration, Complex Applications Integration and SoA)

- Services and applications using ACPAMS, RPMP and services data

- Processes for the service, production and manufacture

- Re-planning

- Re-scheduling

- Innovating the production

- Better customer experiences

Design implementation layer 1 Hardware

- Design usages of Using mobile apps
- Embedded sensors and devices software.
- ECUs/embedded devices/sensors/car-components health devices
- Arduino AVR or ARM-based boards with the sensors
- Infotainment systems prototype Raspberry Pi 2 Model B+ or BB boards.

Design implements layers 1 and 2 Software

- Eclipse IoT stack based end-to-end IoT solutions with Java and OSGi Software

- Eclipse Kura development environment, gateway. Services, cloud connectivity, management of device, network configuration and applications

Design implementation Layers 3 and 4

- The project uses TCUP or other server platform
- Communication management
- Data Store
- Database

Design implementation Layers 5 and 6 Data Usages

- Service centre maintenance
- Re-planning Marketing and sales, service and product development functions
- Re-planning manufacturing processes
- Personalising and deepening customer experiences
- Developing additional value-added services

Summary

We learnt

- IoT applications and services enable car maintenance service, service centre applications

- Remote diagnostics

- Location car based emergency services

- Reporting for service centre support, remote care, fleet management, fuel and eco initiatives.

Summary

We learnt

- In-car network of ECUs

- Usage of Oracle reference model for ACPAMS, RPMP and other services.

- A central in-car computer enriches the generated data. In-car infotainment systems use Miracast devices for in-car network.

Summary

We learnt

- TCUP or other PaaS cloud enables the developer to develop new applications.

- The platform runs the applications for maintenance by Service Centre

- Re-planning

- Deepening customer experiences

- Developing additional value-added services.

End of Lesson 7 on
Internet Connected Car Applications and Services