大唐电信科技产业集团

INNOVATION AND PRACTICE OF TD-LTE FOR INTELLIGENT TRANSPORTATION SYSTEMS (ITS)

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Content

- Needs of ITS user
- Communication requirements of ITS services
- TD-LTE enhancement for ITS
- Application scenarios of enhanced TD-LTE
- Summary

Needs of ITS user

- **Safety**
  - Minimize the risk of accidents
  - Reduce the severity of the accident if it occurs
- **Efficiency**
  - Choose the optimized route to destination
  - Maximize the utilization of road resource
- **Comfort**
  - Obtain tourist information
  - Enjoy distributed games in the journey

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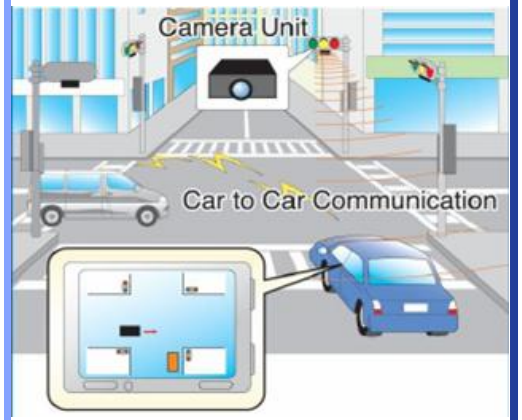
Applications of ITS

Safety

- Forward collision warning
- Roadwork warning
- Blind Merge warning
- Road condition warning

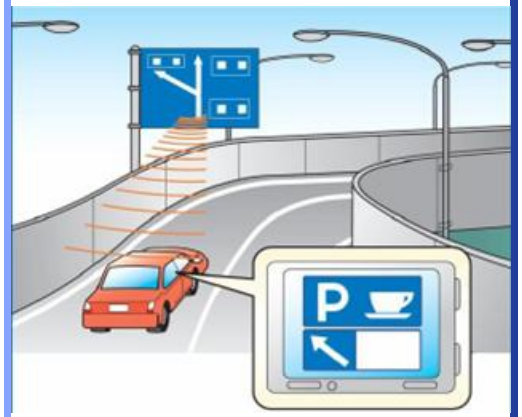


Efficiency

- Traffic information
- Limited access warning
- Enhanced route guidance
- Instant Messaging

Comfort

- Interest notification
- Media downloading
- Remote diagnosis
- Map downloads



Communication requirements of ITS services

Table 1 Communication requirements of ITS

	Latency	Range	Communication mode	Data rate
Safety	Very low(in tens of milliseconds)	short/medium	broadcast/unicast	low
Efficiency	Low/medium(in hundreds of milliseconds)	short/medium	broadcast/unicast	medium
Comfort	average(in seconds)	long	unicast/broadcast	high

TD-LTE

- **TD-LTE provides a strong communication platform for ITS**
  - High peak data rate: DL 100Mb/s, UL 50Mb/s
  - Low delay: CP 100ms, UP 5 ms
  - Variable Channel Bandwidth: 1.4MHz, 3.0MHz, 5MHz, 10MHz, 15MHz, 20MHz
  - Uplink/downlink flexibility
  - Lower cost per bit
  - Faster data access
  - Enhanced roaming capabilities
  - Wide range of deployment

TD-LTE enhancement for ITS

- **Network architecture enhancement**

- Objective: reduce the end-to-end delay
- Define: new transport channel (**ITS-B channel**) to broadcast downlink safety-related ITS message
- Introduce: new function component (**ITS mirror**) in eNB to receive the uplink heartbeat messages from vehicles and forward such messages back to nearby vehicles
- Introduce: new function component(**ITS analyzer**) in core network element, e.g. MME, which receives the input message from the “ITS mirror”, make relevant analysis, and forward relevant message to eNB if necessary.

TD-LTE enhancement for ITS

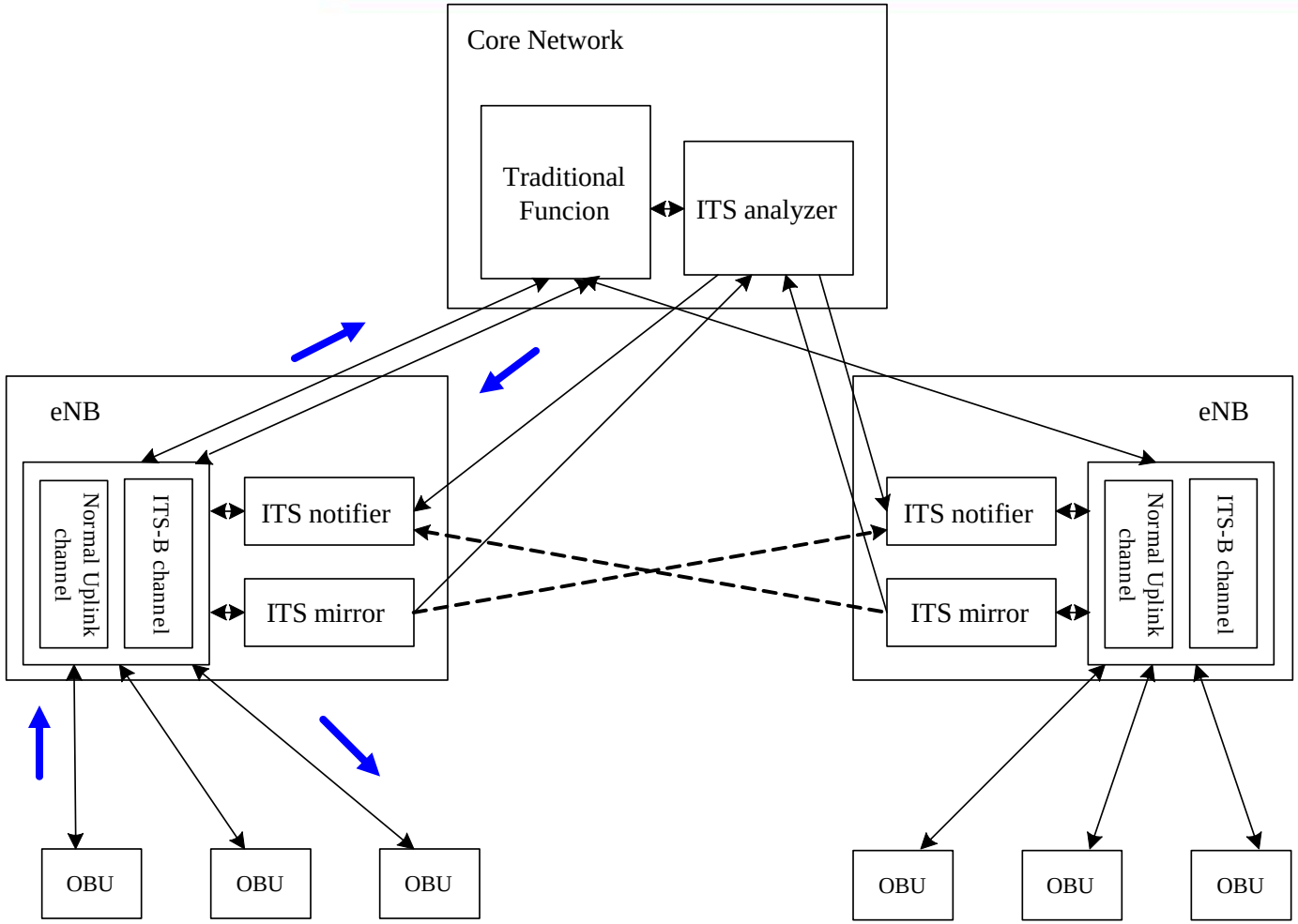


Figure 1 the TD-LTE systems with enhanced network architecture

TD-LTE enhancement for ITS

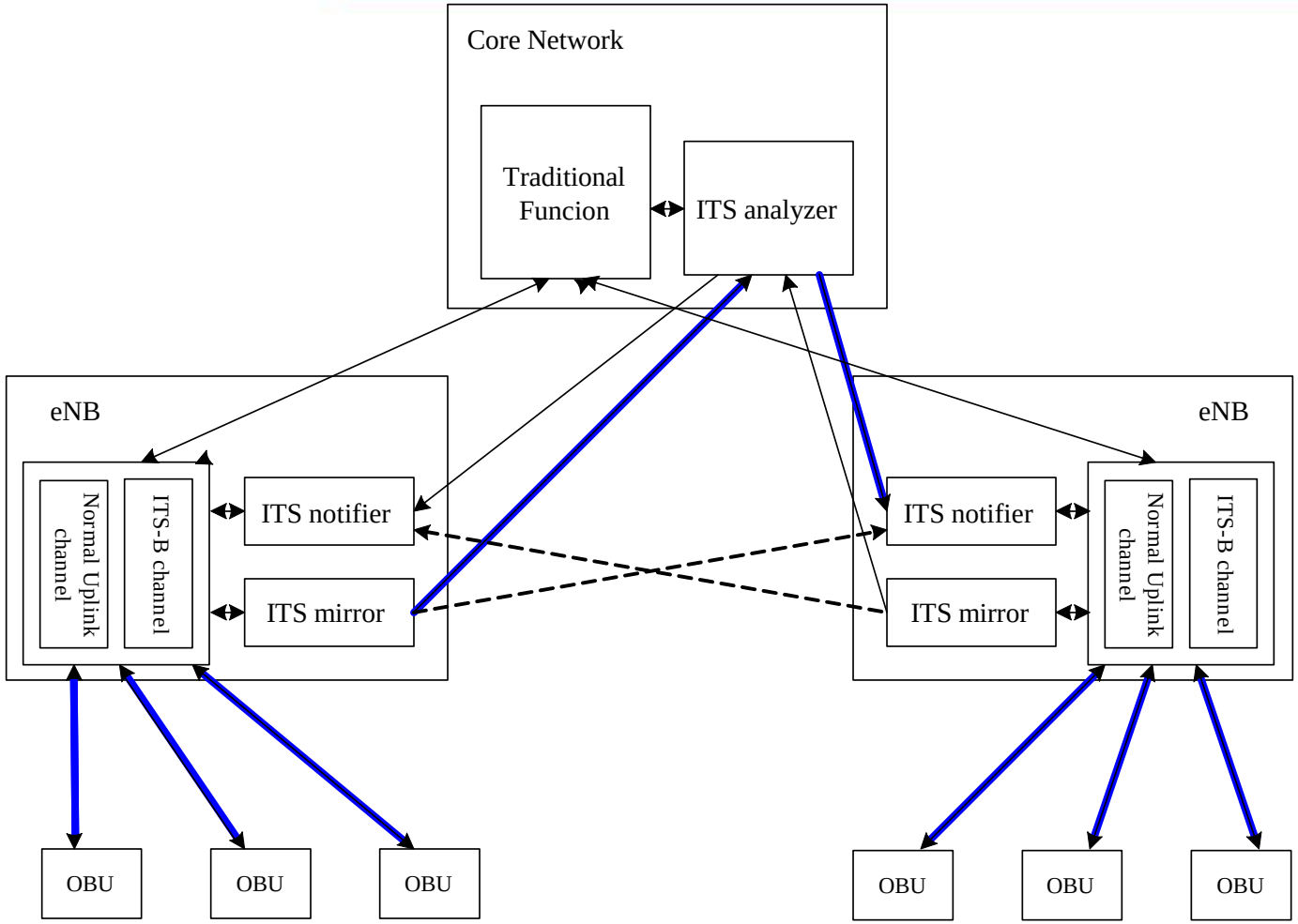


Figure 1 the TD-LTE systems with enhanced network architecture

TD-LTE enhancement for ITS

- **Access scheme enhancement(LTE-Hi)**

- Objective: achieve higher performance and lower cost indoor/hotspot deployment
- Dynamic TDD:
  - Adjust the proportion of the downlink and the uplink resources based on the services conditions
- Enhanced MIMO:
  - Adopt high-order MIMO, enhanced uplink MIMO, enhanced CSI feedback
- Optimized network access for IP services
  - Utilize local IP access method for both user plane and control plane to support high-speed data transmission

TD-LTE enhancement for ITS

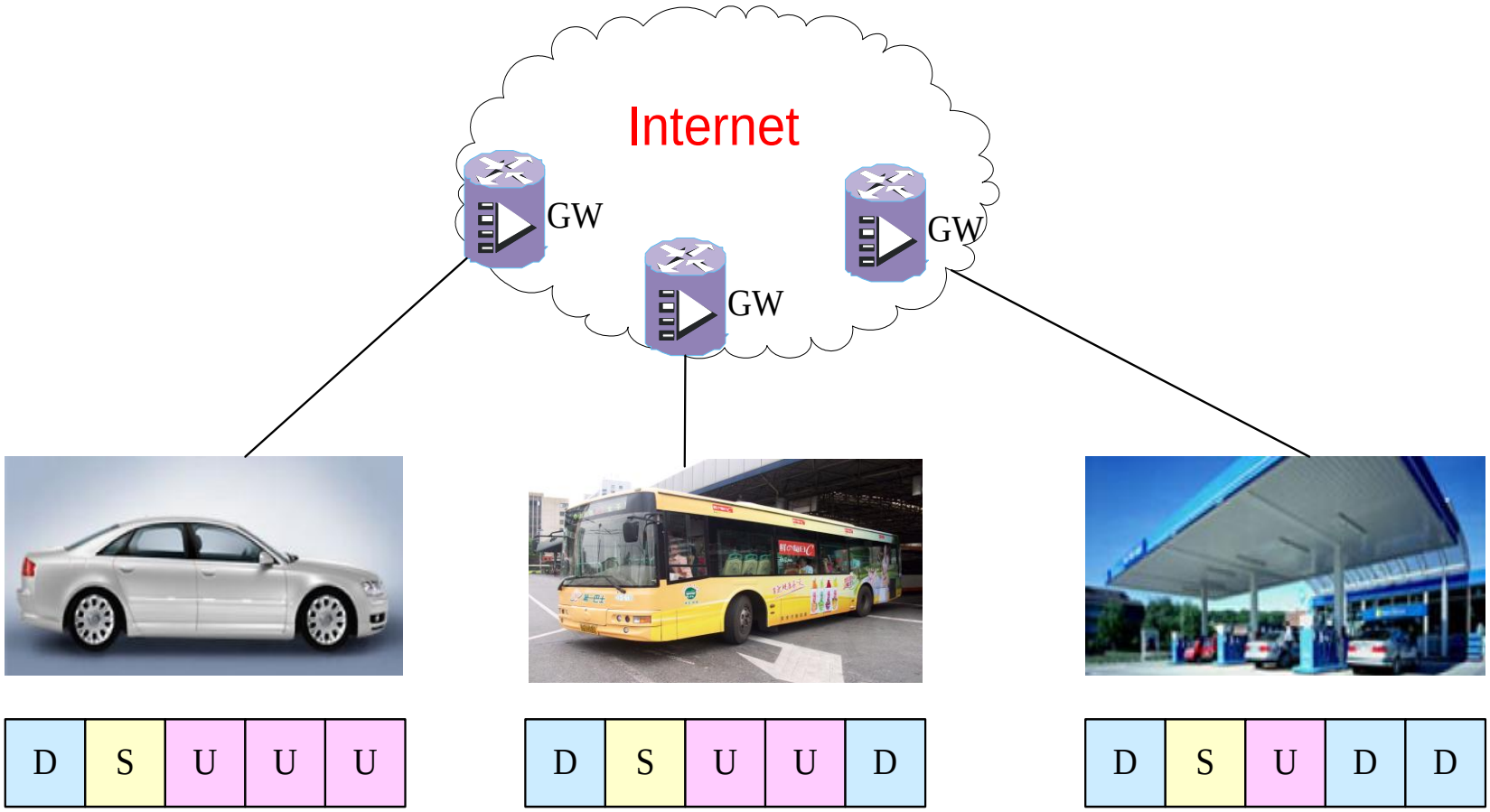


Figure 2 Dynamic TDD application in ITS

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Application scenarios of enhanced TD-LTE systems

- **Road hazard warning (RHW)**
  - Provide safety-critical warnings services with high movement speed and with low latency requirements
- **High speed data transmission in ITS hotspots**
  - Vehicle monitoring data and status information reporting
  - Notification or operation & management information issue

Road hazard warning (RHW)

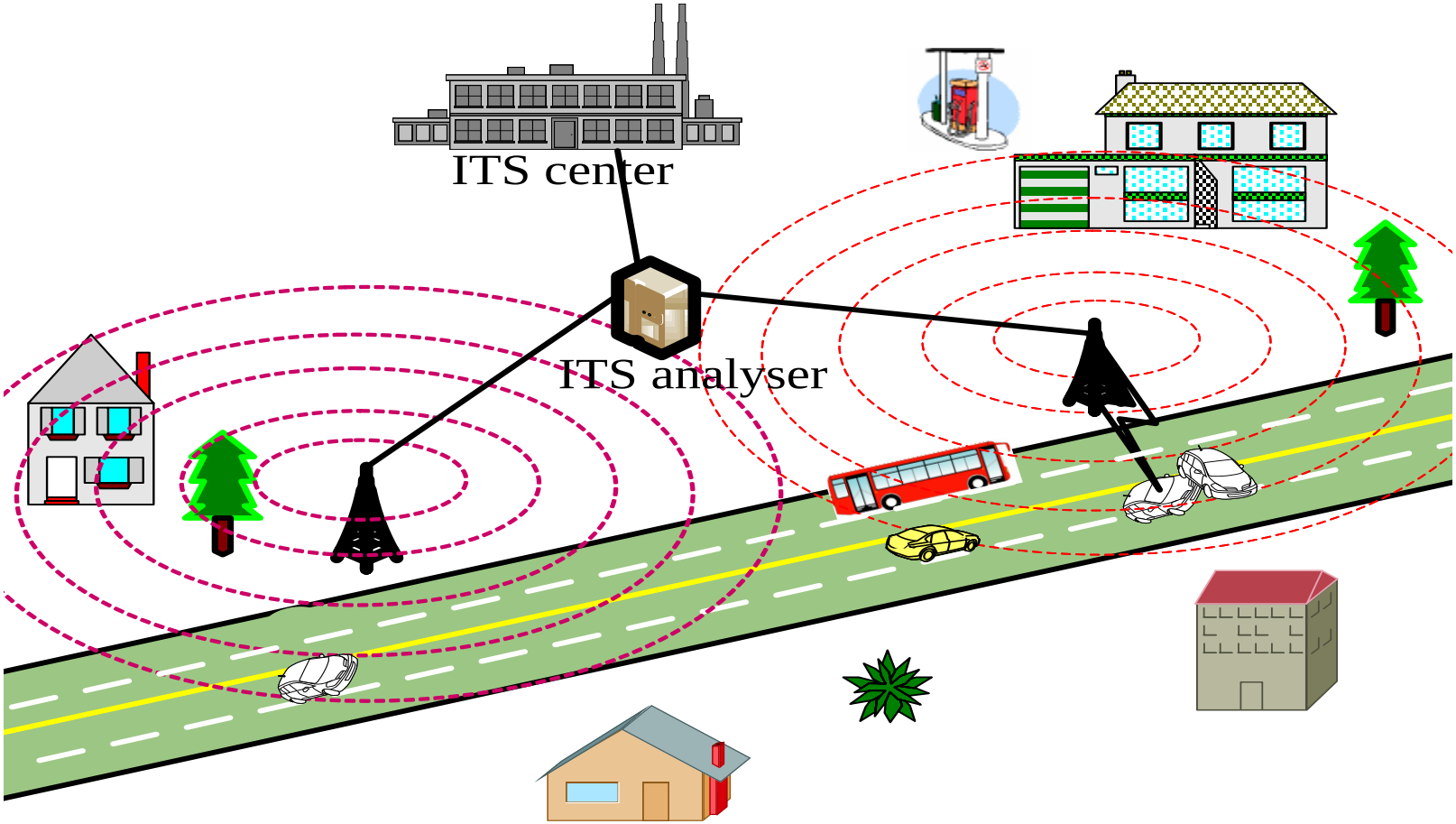

Figure 3 Example of road hazard warning

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High speed data transmission in public transport junction

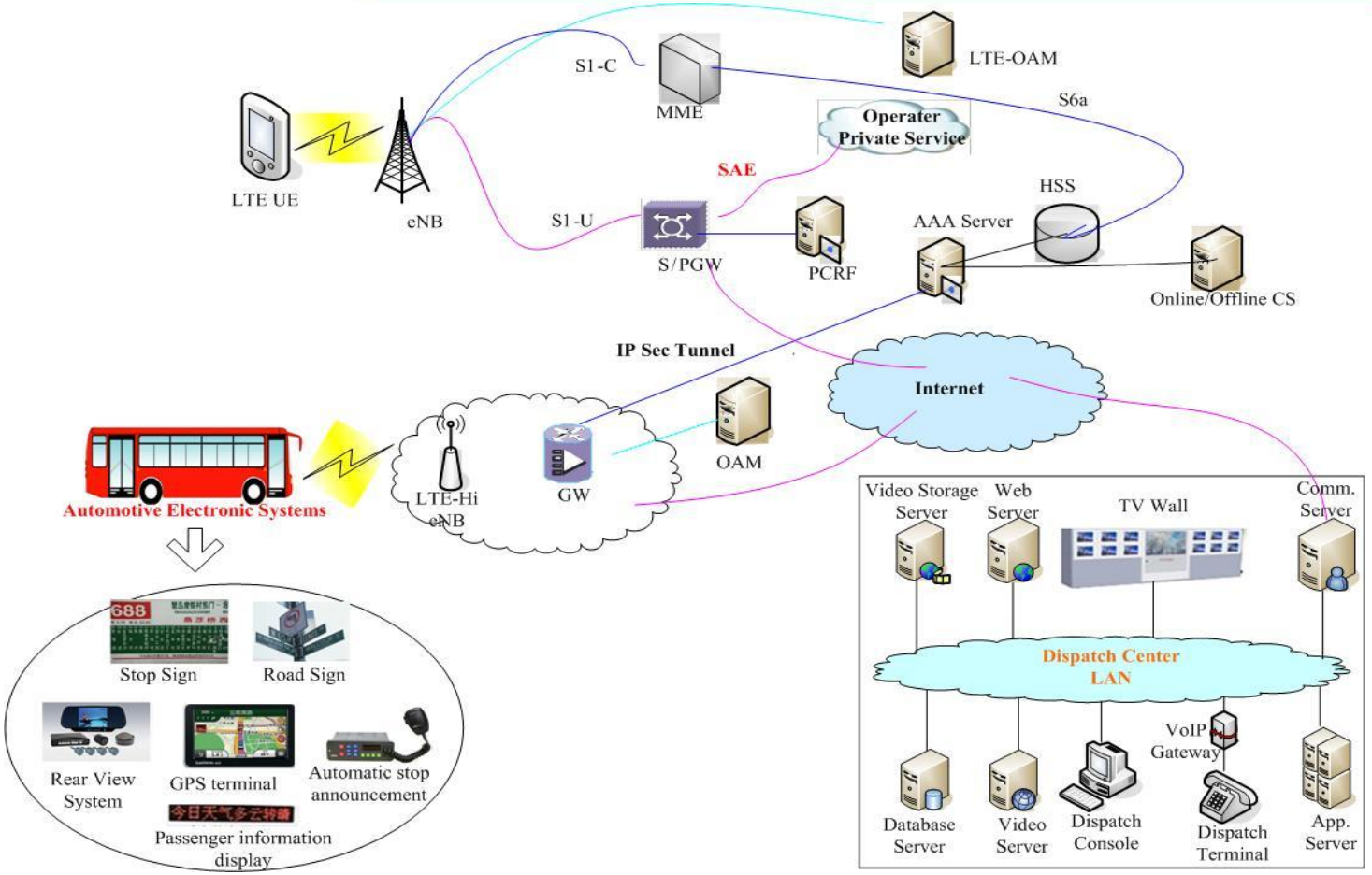

Figure 4 LTE-Hi systems to provide high speed data transmission in a public transport junction

Summary

- **ITS applications impose higher requirements on wireless communication systems**
- **TD-LTE provides an strong platform for ITS information transmission**
- **Enhanced TD-LTE systems can better support the safety-critical ITS application and high-speed IP-based ITS application**


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