Vehicular Communication Gateway

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Outline

- **NGN Home Networking**
- **OSGi Architecture**
- **DLNA Architecture**
- **UPnP**
- **SIP in NGN OSGi**
- **SIP-UPnP Bridging**
- **IMS+Digital Home Networking**
NGN Home Networking
NGN Home Networking

- **IMS-based NGN**
  - Split service plane and transport plane
  - Horizontal service convergence
  - Fixed-Mobile Convergence

- **Residential Gateway**
  - Local network <-> External Network
  - Remote control, Monitor home alliance, etc
  - OSGi (Open Services Gateway initiative)
  - DLNA (Digital Living Network Alliance)
NGN Home Networking

- Scenario – Commands

```plaintext
Command – ON

Success/Failure Response
```

Mobile Host → IMS → Home Domain
NGN Home Networking

- Scenario – Status Query

Query – room temp. sensor

Status Response( room temp. 90F)

Home Domain

IMS
NGN Home Networking

- Scenario – Asynchronous Events

Subscribe event - Door Ring

Notification (Door Ring)

Mobile Host

Home Domain

IMS
NGN Home Networking

- Scenario – Media Streaming

Mobile Host

Media Streaming

IMS

Create Session

200 OK

Home Domain
OSGi

- **From 1993 ~**
  - IBM, Nokia, Panasonic, Sony, etc
  - Release 4, Version 4.1, Apr. 2007

- **Three types of components**
  - Framework
    - Run on JVM (Java Virtual Machine)
    - Service Registry
    - Administrate bundle life-cycle
  - Bundle
    - Publish/Find services
    - Import/Export packages
  - Service
OSGi

- Architecture Overview
OSGi

- Architecture Overview
  - 1 framework ↔ many bundles
  - 1 bundle ↔ many services

Telecom Service Integration for ITS

IMS Services
OSGi

- **Control Model**
  - Start framework
    - download bundles/ check updated bundles from data center of service provider
  - Resolve all installed bundles
  - Start bundles for service provisioning
OSGi

- Bundle Life Cycle
OSGi

Services/Packages Sharing Model

- Service sharing → service registry
- Package sharing → import/export packages in the manifest file
DLNA

- The components of DLNA
  - Digital Media Server, DMS
  - Digital Media controller, DMC
  - Mobile DMC, M-DMC
  - Digital Media Player, DMP
  - Digital Media Renderer, DMR (DMU (uploader), DMD (downloader))
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DLNA Application (GUI)

- DMP/DMC API
- DMS API
- DMR API

DLNA Engine
- DMS, M-DMS, DMP, M-DMR, DMR, DMC, M-DMC, M-DMD, M-DMU, +UPn+, +UPn+, +PPR1+, +PPR2+, DMP'

Player Engine
- Trick Play, Slide Show, etc.

XML Parser
- UPnP SSDP, GENA, SOAP
- HTTP (Client, Server)
- RTP/RTCP (Client, Server)
- DRM (Client, Server)

Peer (Target Adaptation Module)
- Window System
- Codecs
  - H/W Codecs
  - S/W Codecs
- File System
- TCP/IP, UDP
- Drivers

H/W

The section requires customization
DLNA Core
User Developing Modules
Option
Use of open source (Expo)
API (Application Program Interface)

1) +PR1+, +PR2+, DMP are to be supported
2) Possible to be supplied by OKI ACCESS Technologies Co., Ltd.
3) Can be supplied...
4) Can be supplied...
DLNA
DLNA
DLNA
UPnP

- Universal Plug and Play
- Three types of components
  - Control Point (CP)
  - Device
  - Service
UPnP

- Protocol Stack

Diagram showing the protocol stack with layers including:
- UPnP Vendor Defined
- UPnP Forum Working Committee Defined
- UPnP Device Architecture Defined
- HTTPMU (Discovery)
- HTTPU (Discovery)
- SOAP (Control)
- HTTP (Description)
- HTTP (Event)
- SSDP
- GENA
- UDP
- TCP
- IP
UPnP

- **HTTPU/HTTPMU**
  - The extension of HTTP
  - Over UDP (Unicast and Multicast)

- **SSDP**
  - Simple Service Discovery Protocol
  - via HTTPMU
    - Advertising: GENA event method “Notify”
    - Searching: HTTP extension method “M-Search”
  - via HTTPU
    - for response

- **GENA**
  - Generic Event Notification Architecture
  - Subscribe/Notify
UPnP

- **SOAP**
  - Simple Object Access Protocol
  - Lightweight, XML-based protocol for exchange of information in a decentralized, distributed environment
  - Usage:
    - HTTP method: “POST” + Content-Type header: “text/xml”
UPnP

Phases of Operation

- Addressing
  - DHCP or Auto IP

- Discovery
  - When a device joins the network, it advertises its participation (multicast)
  - A control point may search for particular devices or services
  - They all use SSDP to forward message

- Description
  - This phase makes the control point know the information of devices
  - CP can query service description of the devices which it would like
UPnP

- **Operation**
  - Control/Action
    - In this phase, the control point uses SOAP to forward a message for controlling the device.
  - Event
    - CP utilizes GENA Subscribe for observation of the status of the devices.
    - The device utilizes GENA Notify to inform CP of the event of changed status.
  - Presentation
    - A device should provide an HTML-based administrative interface that allows a user to directly control the device and view the device status.

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SIP in NGN OSGi

Why to choose SIP for NGN Home Networking?

- Transport Independence
  - SIP is an application layer protocol and is independent of the underlying transport protocol
- Scalability
  - works well in both LAN, WAN, 3G, etc
- Extensibility
  - allows new method / message types, new types / forms of addresses, and any kind of MIME body type
- Security
  - Authentication, Encryption (HTTP Authentication, S/MIME)
    [RFC 3261]
- Mobility
  - Registration
- Compatible with IP Multimedia Subsystem
  - IMS takes SIP as its signaling protocol
## SIP in NGN OSGi

- SIP vs. Other solutions

<table>
<thead>
<tr>
<th></th>
<th>SIP</th>
<th>HTTP</th>
<th>SMTP</th>
<th>SNMP</th>
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<tr>
<td>Event</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Mobility</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Scalability</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
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<tr>
<td>Media session</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
</tr>
</tbody>
</table>
SIP in NGN OSGi

Corporate Intranet

IMS

Mobile network

Any data network!

SIP Proxy

SIP UA

Protection

In Home

Outside World

Telecom Service Integration for ITS

IMS Services
SIP-UPnP Bridging

- **Goal**
  - SIP UA in external network can control UPnP home alliance
    - Switch on/off, etc
  - SIP UA in external network can monitor status of all home alliances
    - Home security, emergency notification, etc
SIP-UPnP Bridging

- System Modules

Telecom Service Integration for ITS

IMS Services
SIP-UPnP Bridging

- **SIP User Agent**
  - Capable of remote control to home alliances

- **Control Point**
  - Search/Subscribe/Control the UPnP devices
  - Inter-process communication with control point bundle

- **Control Point Bundle**
  - Register/Publish the supported UPnP functionalities to OSGi service registry
  - Notify SIP-UPnP Bridging bundle of changing status of the UPnP devices
SIP-UPnP Bridging

- **OSGi Service Registry**
  - Provide the capability of service searching for all OSGi bundles

- **SIP Library Bundle**
  - Export the related packages of SIP stack

- **XML Parser Bundle**
  - Translate SIP signaling from the format of text/xml to Document Object Model (DOM) tree
  - Translate UPnP response/event to DOM tree
SIP-UPnP Bridging

- SIP-UPnP Bridging Bundle
  - Register with SIP registrar
  - SIP MESSAGE method for Control/Action
  - SIP SUBSCRIBE/NOTIFY methods for events
  - Register/Publish event callback services to OSGi service registry
  - Request CP bundle to invoke actions
  - Informed about changing status of UPnP devices by CP bundle
  - Mutex for synchronization
  - Maintain device DOM tree
    - A data structure for maintaining status of all active devices and recording what actions were executed, etc
SIP-UPnP Bridging

Case of registration

- **Step 1.** register with SIP registrar
- **Step 2.** register the related services to OSGi service registry
SIP-UPnP Bridging

- Case of subscription
SIP-UPnP Bridging

- **Case of subscription**
  - **Step 1.** SIP UA sends a SIP SUBSCRIBE request
  - **Step 2.** SIP-UPnP bridging bundle queries OSGi service registry for getting the references of XML parser bundle and CP bundle
  - **Step 3.** SIP-UPnP bridging bundle requests XML parser bundle to translate text/xml to DOM
  - **Step 4.** SIP-UPnP bridging bundle requests CP bundle for event subscription
  - **Step 5.** CP bundle IPC with CP
  - **Step 6.** CP subscribes to UPnP light status via GENA protocol
SIP-UPnP Bridging

Case of action invocation

- In step 1, SIP UA sends a SIP MESSAGE request
- Steps 2-5 are similar to case of subscription
- In step 6, CP invokes service via SOAP protocol
SIP-UPnP Bridging

- Case of notification
SIP-UPnP Bridging

- Case of notification
  - **Step 1.** UPnP light notifies CP of some device status changed
  - **Step 2.** CP IPC with CP bundle to inform of changed device status
  - **Step 3.** CP bundle queries OSGi service registry for getting the reference of SIP-UPnP bridging bundle
  - **Step 4.** CP bundle inform SIP-UPnP bridging bundle of changed status in the format of XML
  - **Step 5.** SIP-UPnP bridging bundle queries OSGi service registry for getting the reference of XML parser bundle
  - **Step 6.** SIP-UPnP bridging bundle requests XML parser bundle to translate xml to DOM, and then updates root DOM tree.
  - **Step 7.** SIP-UPnP bridging bundle sends a SIP NOTIFY message to SIP UA
Scenario Analysis

- Scenario 1 – User Context Triggered Service
  - Alice is walking on her way home, if the distance between Alice and her home is less than a threshold which can trigger some services. For example: the air conditioner can automatically turn on before Alice is back to home.
  - Requirements:
    - IMS Context Server
    - Residential Gateway
    - Home Devices (must support UPnP)
Scenario Analysis

- **Scenario 2 – Home Device Triggered Service**
  
  - Maria turns on washing machine every morning and goes to supermarket to buy some stuff. She hopes herself could be notified when the washing machine turned off by anybody, and Maria can use her mobile device to control the home devices anywhere.

  - **Requirements:**
    - IMS Context Server
    - Residential Gateway
    - Home Devices (must support UPnP)
Scenario Analysis

- **Scenario 3 – Resource Switching in A Call**
  - Bob and Alice can switch the resource (messages, voice or video) in a call
  - Requirements:
    - End devices
    - Session Manager
    - Presence Manager
Scenario Analysis

Scenario 4 – Streaming Video from Home Storage to Mobile Device

- Bob is away on official business, but he wants to browse the multimedia content which is stored at home media storage via his mobile device

- Requirements:
  - DLNA Media Agent
  - DLNA Proxy
  - Management Server
  - Residential Gateway (run DLNA Media Proxy Server)
  - Home Devices
Interworking Architecture

Application Server
(Home Service Provider)

IMS

Internet

3G / WLAN

Residential Gateway

Telecom Service Integration for ITS

IMS Services
Scenarios for IMS+Home

- Scenario 1 – User Context Triggered Service Flow

- Home Device
- Residential Gateway
- Context Server
- UA

Service Triggered → SIP Notify → SIP Publish
Scenarios for IMS+Home

- Scenario 2 – Home Device Triggered Service Flow

Diagram:
- Home Device
- Residential Gateway
- Context Server
- UA

Sequence:
1. Home Device subscribes to the Residential Gateway.
2. Residential Gateway notifies the Context Server.
3. Context Server checks the criteria.
Scenarios for IMS+Home

Scenario 3 – Signaling Flow for Resource Switching

1. Trigger
2. Resource Switching Request
3. Resource Switching Request
4. Resource Switching Reply
5. Fix Session Composition
6. Lookup IP Address
7. Reply IP Address
8. Session Composition Notification
9. Application Control
10. Application Control Notification
11. New Data Stream
Scenarios for IMS+Home

- **Scenario 4 – Streaming Video from Home Storage to Mobile Device**
  - Address and access control information management
  - Acquiring for the DLNA device discovery and service information
  - Retrieving the media content in home
  - Media content streaming
Scenarios for IMS+Home

Step 1 – Address and access control information management

- DLNA Media Proxy Server running at the home server device initially registers its IP address and the user authentication and authorization to use the service.

- Whenever the information is changed, the DLNA Media Proxy will promptly update the new information to the DLNA Proxy Management Server using the SIP Register Method.

- Thereafter, DLNA Media Agent acquires the real IP address of the DLNA Media Proxy Server from DLNA Proxy Management Server using the SIP URI of the DLNA Media Proxy Server.
Scenarios for IMS+Home

- **Step 2** – Acquiring for the DLNA device discovery and service information
Scenarios for IMS+Home

- Step 3 – Retrieving the media content in home

Diagram showing the process of retrieving media content in the home environment.
Scenarios for IMS+Home

- Step 4 – Media content streaming
Any Question?