M2M MULTIMEDIA DELIVERY AND CONTROL USING MOBILE WEB SERVICES

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Outline of Talk

1. The M2M Ecosystem in a Nutshell
2. Mobile Web Servers for M2M Terminals
   - Synchronous and Asynchronous Servers
   - Multimedia Extensions for mobile Web Services
3. M2M Multimedia Delivery and Control Topologies
   - RTP/UDP Delivery Strategy
   - RTSP/TCP Control Strategy
4. Conclusion

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The M2M Ecosystem in a Nutshell

Today’s Internet and the WWW

- High-tech Web Servers.
- Hosts Web Service and Resources.
- Transparent Access to the Clients.
- Neutral towards diverse clients.

Internet of Things = M2M

M2M Terminal

CONSUMER + PROVIDER

M2M Mobile Web Services

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Internet of Things = M2M

M2M Terminal

CONSUMER + PROVIDER

Web Server

Transparency Access

Web Services

- Specialized functions
- Internal process
- Access interface

- Private Data
- Multimedia
- Websites RESOURCES

M2M Mobile Web Services

Publish/Search/Outsource

Web Service Broker/Cloud Computing

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Mobile Web Servers for M2M Terminals

General Concept – Synchronous Interaction – Asynchronous Interaction – Server Processes – Multimedia Extensions

Synchronous Server
- hosts synchronous mobile Web Services
- short-lived execution model
- request-response interaction strategy
- client in blocked state
- service management not possible

Asynchronous Server
- hosts asynchronous mobile Web Services
- long-lived execution model
- multiple interaction strategies*
- client in unblocked state
- service management is possible

Asynchronous Server offers three Server Endpoints

Synchronous Server and Asynchronous Server
One layer of a bigger platform, called the Mobile Server Platform

* request-response | solicit-response | one way | notification
Mobile Web Servers for M2M Terminals

General Concept – Synchronous Interaction – Asynchronous Interaction – Server Processes – Multimedia Extensions

Services are exposed directly through the Mobile Web Server layer

Asynchronous Server offers three Server Endpoints

Synchronous Server and Asynchronous Server

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Mobile Web Servers for M2M Terminals

General Concept – Synchronous Interaction – **Asynchronous Interaction** – Server Processes – Multimedia Extensions

**Serving M2M Terminal**

- M2M Software Application Layer
- Mobile Web Server Layer
- Multi-Interfaced Mobile Web Services
- SOAP
- REST

**Consuming M2M Terminal**

- M2M Software Application Layer
- Mobile Web Server Layer
- Multi-Interfaced Mobile Web Services
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The interaction between Server Endpoints ➔ 2 major server processes

- Services are exposed indirectly through the Server Endpoints
- Asynchronous Server offers three Server Endpoints
- Synchronous Server and Asynchronous Server

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Mobile Web Servers for M2M Terminals

General Concept – Synchronous Interaction – Asynchronous Interaction – Server Processes – Multimedia Extensions

Mandatory process to consume asynchronous mobile Web Services

Involved Server Endpoints

Service Creation Process

Service Management Process

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Mobile Web Servers for M2M Terminals

General Concept – Synchronous Interaction – Asynchronous Interaction – Server Processes – Multimedia Extensions

Only possible subsequent to the Service Creation Process

STATES OF AN ASYNCHRONOUS MOBILE WEB SERVICE

- open.running
- open.notrunning
- open.notrunning.suspended
- closed.abnormalCompleted.terminated
- closed.abnormalCompleted
- closed.completed
- closed.abnormalCompleted.aborted

Service Instance

Request with Observer EPR

Response with Instance EPR

Service Observer

Notification Listener

GetProperties
Unsubscribe
Subscribe
SetProperties
ChangeState

Events and State Notifications (solicit-response / notification)

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Mobile Web Servers for M2M Terminals

Integration of RTSP and RTP

Extended RTSP States in Asynchronous Server

Delivery Resource → Asynchronous Services
Control Resource → Synchronous and Asynchronous Services

Multimedia Delivery Strategy → RTP/UDP

Multimedia Control Strategy → RTSP/TCP

The RTSP SETUP, PLAY, PAUSE and TEARDOWN are exposed as states of asynchronous services

The RTSP OPTIONS and DESCRIBE methods are exposed as synchronous mobile Web Services
Quick Recap

Consuming M2M Terminal

Serving M2M Terminal

Internet or Proprietary Network

Network Constraints!

Interaction between M2M Terminals

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Quick Recap

Consuming M2M Terminal

Serving M2M Terminal

Internet or Proprietary Network

Result ➔ Inaccessible M2M services ➔ No M2M multimedia applications

Direct IP access is not always possible ➔ operator restrictions, security, authenticity ...

Network Address Translations (NAT) and firewalls

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Quick Recap

Consuming M2M Terminal

Serving M2M Terminal

New M2M Multimedia Delivery and Control Topologies for mobile Web Services

Result → Inaccessible M2M services → No M2M multimedia applications

Direct IP access is not always possible → operator restrictions, security, authenticity ...

Network Address Translations (NAT) and firewalls

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M2M Multimedia Delivery and Control Topologies

Direct Delivery and Direct Control

CONTROL CHANNEL

NAT/FIREWALL

INTERNET

keep-alive

DELIVERY CHANNEL

Requires a public IP for the serving M2M terminal!

1. RTSP OPTION/DESCRIBE → TCP hole punching → Synchronous service execution
2. RTSP SETUP → TCP hole punching → Service Creation Process → Ready
3. UDP Datagram → UDP hole punching → Delivered to → sends Keep-alive
   The multimedia delivery channel established!
4. RTSP PLAY → TCP hole punching → Service Management → Ready → Playing
5. starts the RTP/UDP multimedia delivery → Bypasses the UDP hole → Received!
6. RTSP PAUSE → TCP hole punching → Service Management → Playing → Ready / Keep-alive
7. RTSP TEARDOWN → TCP hole punching → Service Management → Playing/Ready → Init

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M2M Multimedia Delivery and Control Topologies

Direct Delivery and Relayed Control

1. Server establishes a permanent TCP tunnel with the IAG → TCP hole punching
2. The client sends RTSP SETUP to the IAG → IAG relays it to server → SCP response
3. Client/server sends UDP packets to IAG → IAG introduces client/server → UDP keep-alives
4. Client sends RTSP PLAY to IAG → IAG relays it to server → Service Management Process
5. Server directly delivers media over the RTP/UDP channel through asynchronous service
6. Client may send RTSP PAUSE, TEARDOWN via IAG → Service Management Process

Requires Full-Cone NAT at the client!

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M2M Multimedia Delivery and Control Topologies

Relayed Delivery and Relayed Control

1. Server establishes a permanent TCP tunnel with the IAG → TCP hole punching
2. The client sends RTSP SETUP to the IAG → IAG relays it to server → SCP response
3. Only client sends UDP to IAG → IAG is not introducer gateway → sends keep-alive to client
4. Client sends RTSP PLAY to IAG → IAG relays it to server → Service Management Process
5. Server indirectly delivers media over the RTP/UDP channel that is relayed by the IAG
6. Client may send RTSP PAUSE, TEARDOWN via IAG → Service Management Process

Works with every network where TCP/UDP are enabled!

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Conclusion

- Mobile Web Servers for M2M terminals
  - Asynchronous and Synchronous servers
  - Asynchronous Server endpoints and processes

- Multimedia extensions for M2M mobile Web Services
  - Delivery with RTP/UDP and asynchronous services
  - Control with RTSP/TCP synchronous/asynchronous services
    - OPTIONS and DESCRIBE as synchronous services
    - SETUP, PLAY, PAUSE, TEARDOWN as asynchronous service states

- The delivery and control topologies provide solution for NAT issues in M2M
  - Direct Delivery and Direct Control
  - Direct Delivery and Relayed Control
  - Relayed Delivery and Relayed Control

- Integration with the IP Multimedia Subsystem is ongoing
End of Talk

Thank you for your attention!

M2M Software Application Layer

Mobile Web Server Layer

Multi-Interfaced Mobile Web Services

Questions?

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