M2M Communications via XMPP

Near real time messaging in a federated world

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Outline

• Introduction
  – M2M: problem definition
  – Overlay networks

• XMPP
  – XMPP as overlay network
  – Virtual Identities
  – XMPP Standardization process
  – Software status, adopters
  – Web services over XMPP

• Mobile / Wireless support
  – Connection managers
  – Gateways

• Advanced Messaging Patterns
  – Pubsub

• Future research / standardization area
Machine to Machine: problem definition

• M2M often related to the “Internet of Things”
  – An attempt of definition: the networking of everyday life objects

• Need of abstractions over technology fragmentation
  – Growth of the Internet fostered by simple abstractions
    • END-to-END interoperability
    • Examples: IP (networking), DNS (naming, discovery), Sockets (API), HTTP (application level protocols), REST (programming paradigms)

• Allow innovation at the edges
  – Net neutrality is the real added value of the Internet
  – Bottom up approach
    • Make available the basic build blocks
    • Allow developers to concentrate on the application
Overlay Networks

- Logical networks abstracting the complexities of underlying physical networks
- M2M requirements
  - Message based end to end communication
  - Virtual identities hiding physical addresses
  - Message morphing
  - Message buffering
- Basic layer over which building...
  - Asynchronous messaging API
  - Advanced messaging (e.g. pubsub)
  - Discovery services
  - ...
eXtensible Messaging and Presence Protocol (XMPP)

- **Open Instant Messaging protocol**
  - End to end communication between any peer
    - Servers have public IP addresses and FQDN
    - Transport with end nodes can be of any type (IP, ZigBee, Bluetooth...)
  - XML based
    - Easily extensible with arbitrary payloads
    - Distributed network of “web services”
  - Federation
    - XMPP services are instantly connected at Internet scale

- **Ideal as overlay network for M2M**
  - Simple messaging API hiding underlying complexities
  - Support for very limited end nodes
XMPP Virtual Identities

- XMPP ids are named Jabber IDentifiers (JID)
  - user@server/resource
  - Domain owners can manage identities of their assets (“objects” or devices)
  - They can be mapped to any standard ID or address
  - Standard protocols can be used for learning JIDs
    - Eg: EPC code + ONS -> JID

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XMPP Standards Foundation

- **Lightweight** standardization body for XMPP
  - IETF Interfacing: XMPP Core Protocol RFCs
    - Transport and basic IM features
  - XMPP Enhancement Proposals (XEPs)
  - Trusted federation initiative

- **Relevant XEPs**
  - Web services transport: XML-RPC, SOAP, IO-Data
  - Service discovery (DISCO)
  - Publish/Subscribe and Personal Eventing (simplified pub/sub)
  - Binary Streams Over HTTP (BOSH)
  - Jingle: stream initiation and session handling
  - Stream compression and binary streams
  - Ad-hoc commands, dataforms: export of UI snippets to any end node

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Real World Applications

• Huge existing software base
  – Servers: open source and commercial scalable up to millions of nodes
  – Server components: write extensions in any language
  – Client libraries: available for any platform, (full support also in J2ME)
  – Clients: seamless desktop and web integration

• Adopters
  – IM: Google (GTalk, P2P in Android), Apple (iChat), AOL
  – M2M: TiVo, Isode, NOAA, Bioeclipse, BBC, Joost, ...
  – ISMB/Bluendo experience
    • RFID middleware
    • Sensor networks realtime backbone
    • Enterprise service bus
    • Connector for roaming devices / devices
Asynchronous Web Services

- Traditional “synchronous” web services
  - SOAP (XEP-072), XML-RPC (XEP-009) over XMPP
- Asynchronous web services
  - IO-Data (first draft under revision)
  - REST approach: users specify “actions” on “remote resources”
  - Asynchronous execution
    - data may be returned later within a session
    - The requester may login on other machines or change address

Diagram:
- Web service
- romeo@montague/office
- romeo@montague/mobile
- action: execute
- action: next
- status: complete

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Connection Managers

- Used for clients fully supporting the XMPP stack
- Improved scalability / security
  - Allow handling millions of concurrent low traffic connections
  - Isolation of core routers and services from direct traffic
- They adapt sessions for mobile connections over IP
  - Reliable transport using BOSH (HTTP streams)
  - Session suspend / resume
  - Binary encoding, content aware compression
  - Message pruning (traffic optimization)

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Gateways

- Network gateways
  - Connecting other messaging systems, e.g. SIP, IMPS, etc
  - Packet translation, identity mapping

- End nodes gateways
  - Mapping XMPP identities to sensor nodes
  - Keeping sessions alive and handling XMPP packets for end nodes
  - Communicating with end nodes using optimized ad hoc protocols
Advanced Event Distribution: Publish / Subscribe

- Messages sent to “topics” and delivered when subscribers become available
  - Loose coupling between event producers and consumers
  - Application level multicast, with hierarchical addressing
  - Easy reconfiguration of processing chains
  - High scalability
  - Simple APIs for client and service developers

- Example applications
  - Broadcasting configuration commands
  - Collecting events from sensors

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Federated Publish/Subscribe in XMPP

• XEP 60 – PubSub
  – Largest XEP, comprising detailed Pub/Sub use cases and implementation notes
  – Support in all servers as a dedicated component
  – Standalone implementations for pervasive application
  – No special support needed at client side (basic XMPP messaging allows using PubSub)

• Features
  – Sophisticated affiliation handling
    • Cross domain support
    • Access control for publishers and subscribers
  – Hierarchical topics (collection and leaf nodes)
  – Presence based delivery
Scaling PubSub

• **Horizontal scaling**
  – Any XMPP node can host a PubSub service
  – Any XMPP entity can subscribe to other domains pub/sub services
  – Discovery problem: e.g. given a RFID tag, how to identify related topics in foreign domains?

• **Vertical scaling**
  – Grant delivery times in nodes with high numbers of subscribers
  – Prioritize out queues using shadow topics chained with high priority topics

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Further research / standardization areas

- **API**
  - Simple cross platform client messaging API

- **Gateway functionalities**
  - Mapping WSN identities to XMPP identities
  - Bridging of structured messages between other IM networks

- **Discovery mechanism integration**
  - Built-in XMPP disco only allows discovery features of known nodes
  - Discovery of nodes by features, location, other properties

- **Pubsub taxonomies**
  - Discovery of relevant topics (events) for a given items
  - Classification of event hierarchies

- **Local Link Messaging**
  - Direct communication with local objects, without passing through home servers
Questions?

Thanks for your attention

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Mobile XMPP related blog
http://blog.bluendo.com/ff

More info about XMPP
XMPP Standards Foundation
http://www.xmpp.org