UPnP in Integrated Home- and Building Networks

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- CEESAR & iHomeLab at Lucerne University of Applied Sciences & Arts
- Background
- UPnP
- CARUSO
- Issues and Solutions
Center of Excellence for Embedded Systems Applied Research at Lucerne University of Applied Sciences & Arts

Meta topic:
Building seen as system

Main research areas:

- iHomeLab – research platform for the intelligent home
- Building & Home Automation
- Middleware / Commissioning
- Intelligent User Interfaces
- WSN / ZigBee
- IP fieldbus systems
- Localisation / Ambient awareness
- Low Power Low Cost Embedded Systems

Applied research with focus on industrial applicability
strong cooperations with industry partners
We are launching the iHomeLab, the platform for ... 
- Education & Research 
- Technology transfer 
- newest Applications & Trends 
- Events and Presentations
**Situation:** A Building comprises independent Networks for automation, IT, telecommunication, security & safety, multimedia, domestic appliances

**Vision:** An IP based integrated network for seamless interoperation of the different domain networks

**Requirement:** management overhead operational costs shall be low

**Solution:** UPnP (research project CARUSO)

**Issues:**
- Multicast message distribution in large networks
- Security
- User profiles
- User interfaces
- Complex use-case based services
**UPnP**: widely accepted, powerful approach

- currently for SOHO internet gateways and multimedia devices
- UPnP covers IP addressing, device and service discovery, description, control, eventing and presentation.
- standardised device classes: "Device Control Protocols" (DCPs).
CARUSO I

CARUSO: Our integration approach
- Operates with UPnP devices and CPs based on UPnP
- Allows on-the-fly integration of control-points, allows for example users to control the network via mobile devices (PDA)
• Logically independent Networks for device infrastructure and for CPs
• Servers are connected via backbone
• Device Network is accessed by the servers only
• Fallback to standard UPnP possible
Multicast
- UPnP multicast produces considerable network traffic
- CARUSO server structure forms smaller network segments which reduces multicast traffic
- Restricted search command (no “search all“)

Security
- Device network is not public accessible
- Mobile CP's may connect to the servers only
- Server runs security services
- It may act as security console for devices implementing UPnPs device security
User Profiles

- server holds access control information
- predefined access levels for all actions of all known UPnP DCPs ("Device Control Protocols", Profiles, Classes)
- A user may for example access all Light switch controllable devices, and rejects access to all HVAC devices
- Global policy for all non-DCP devices
- Position-based access
- Server receives authenticated SOAP actions from the CP network. The users access level and the one of the action are compared, and on OK the action is forwarded to the device.
User Interfaces:
- Already rudimentary foreseen by UPnP

Proposed Enhancement:
- User-specific task based system view
- XAML, part of Microsoft WPF (Windows Presentation Foundation)
- An UI bundle on a CARUSO server generates the XAML description, using the devices UPnP description. XAML event handlers point to UPnP actions.
Services
- UPnP -> device centric
- User -> use case centric

Example "watch a DVD" or "prepare room for a presentation meeting".
- Service contains light, blinds, beamer and media player

A service involves several Devices
- New UPnP device: "Services Server"
- High-level service runs as OSGi bundles on the server node, which has the ability to control the involved devices.
- Future: Device Profile for Web Services (DPWS), UPnP 2.0 may merge web-services and UPnP