A Service-Oriented Framework for Networked Appliances to Achieve Appliance Interoperability and Evolution in Home Network System

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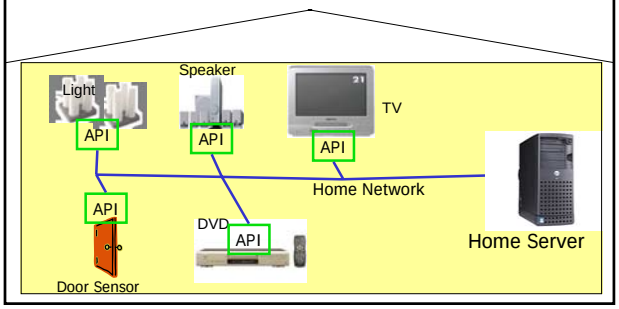
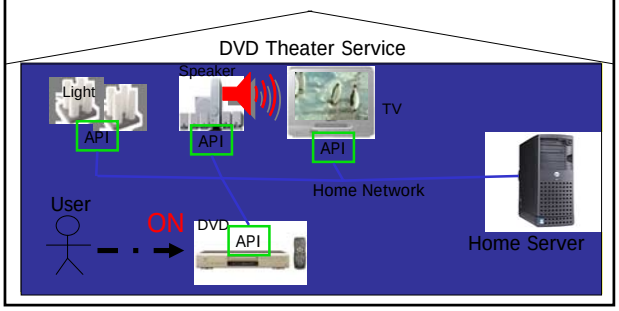
Home Network System(HNS)

- HNS controls home networked appliances with API and high-performance processor



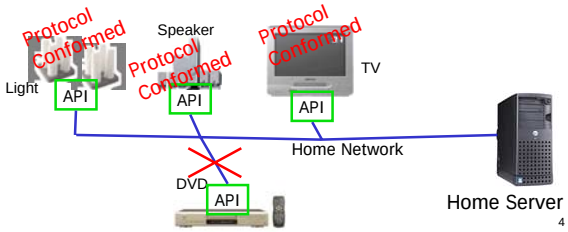
HNS Integrated Services

- In HNS integrated services, multiple appliances are orchestrated



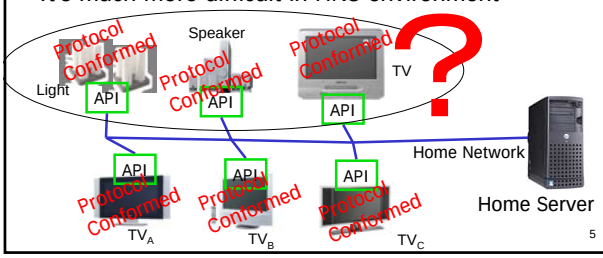
Protocol Conformance and Appliance Interoperability

- Each appliance must conform to the standardized HNS protocol
  - ECHONET, DLNA (NMPR) etc…
- Checking protocol conformance is easy



Protocol Conformance and Appliance Interoperability

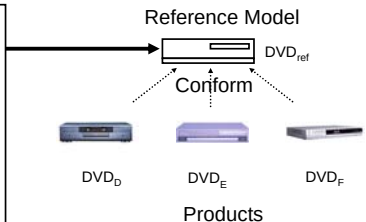
- Combined behavior of multiple appliances should be tested
  - Dependency between appliances, procedure to call features
- It's much more difficult in HNS environment



Conventional Approach for appliance interoperability [1][2]

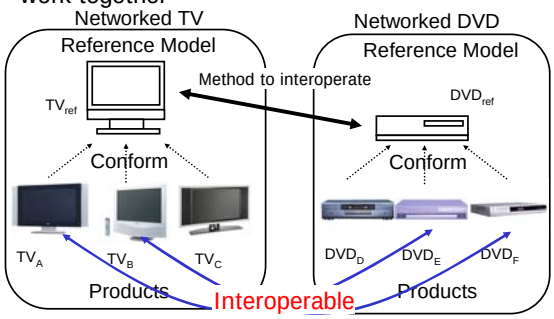
- Prepare strict reference models for multiple-vendor-appliances

```
CM:GetProtocolInfo()
CM:GetCurrentConnectionIDs()
CM:GetCurrentConnectionInfo()
AVT:GetDeviceCapabilities()
AVT:GetMediaInfo()
AVT:GetPositionInfo()
AVT:GetTransportInfo()
AVT:GetTransportSettings()
AVT:Next()
AVT:Pause()
AVT:Play()
AVT:Previous()
```



Conventional Approach for appliance interoperability [1][2]

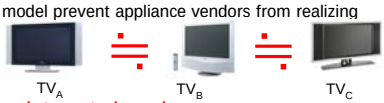
- With adopting the models, multiple appliances can work together



3 Problems on HNS evolution

- E1:problem in reference model
  - Strict model Lacks flexibility in changing the reference model

- E2:problem in vendor-specific-appliance
  - The strict reference model prevent appliance vendors from realizing specific features



- E3:problem in various integrated services
  - To conform interoperability, conventional approach limits the variety of integrated services
  - Only integrated services defined beforehand are executed.

Objective and Approach

Objective

- Propose Service Oriented Framework for HNS integrated services

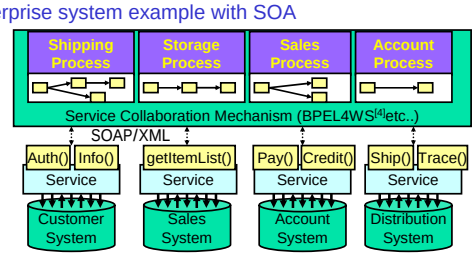
Approach

- To apply SOA (Service Oriented Architecture[6]) to HNS
  - HNS eliminate the rigorous reference model
  - Each appliance provides its features in a form of self-contained services
  - HNS integrated services are realized by changeable combination of these services

Service Oriented Architecture[4]

- All integrated processes consists of services
- Every service is self-contained, and connected loosely
  - Self-contained service, loose-coupling

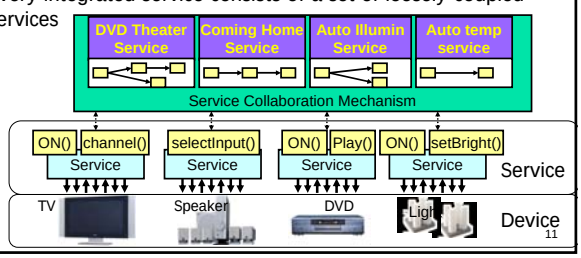
Enterprise system example with SOA



→ **Realize light-weight system with a set of self-contained services**

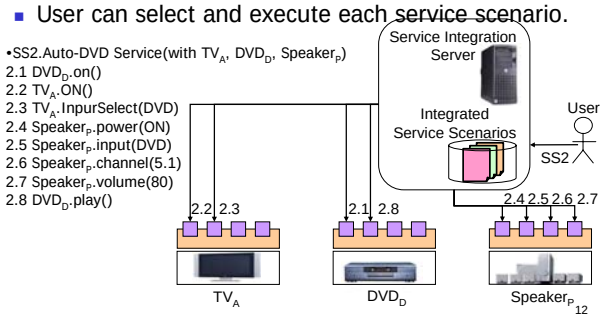
Service Oriented Framework for HNS

- The service layer aggregates the features of the appliance as a set of services, and exports the services with a standardized procedure
- Every service is self-contained
- Every integrated service consists of a set of loosely-coupled services



HNS Integrated Services with Proposed Framework

- A set of appliance service methods is given.
- User can select and execute each service scenario.

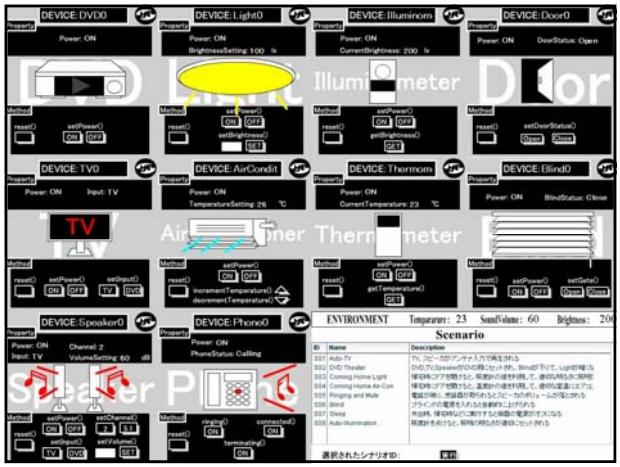


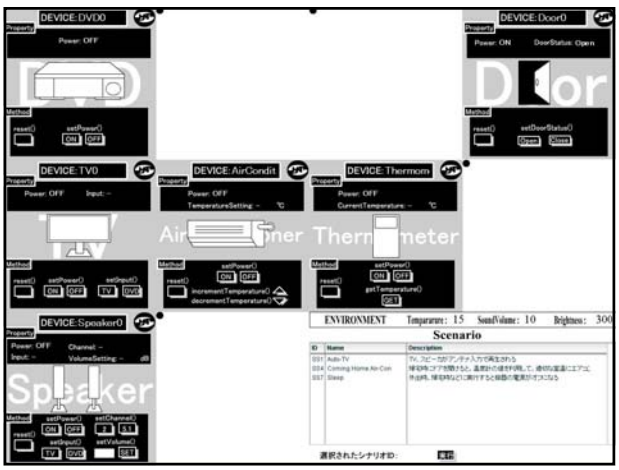
Inplementation

Environment

- Macromedia Flash MX 2004 professional
- Apache Axis 1.1
- Jakarta Tomcat 4.1
- Java2 SDK SE 1.4.1_02

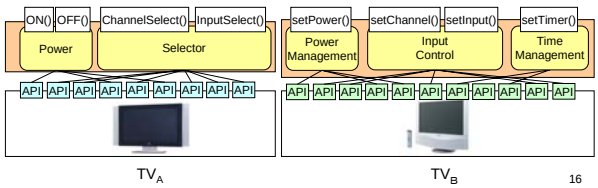
- We made HNS prototype with Flash interface and Java Web services.
  - Each service scenario can be modified by updating XML definition file.
  - Each device is implemented virtually with java component.





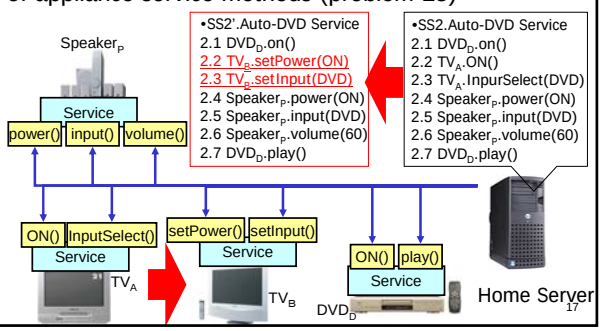
Evaluation
: Problem on Reference Model(E1) and Appliance(E2)

- Every appliance with self-contained services doesn't need strict reference model (Problem E1)
- Each appliance vendor can implement various appliance method freely (Problem E2)



Evaluation
:Problem on HNS integrated services(E3)

- Each HNS integrated service is executed as combination of appliance service methods (problem E3)



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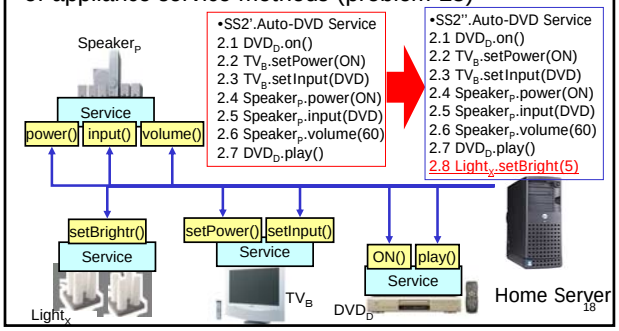

Conclusion

- We proposed Service-Oriented Framework for networked appliances in HNS
- We evaluate our framework qualitatively on reference models, vendor-specific-appliances, HNS integrated services.

Future Research

- Support users to make “good” scenarios.
  - Dependency within appliance.
  - Feature interactions
- Define sophisticated service scenarios
  - Loop, if else, etc..

- Thank you