VIRTUALIZATION OF RESIDENTIAL GATEWAYS

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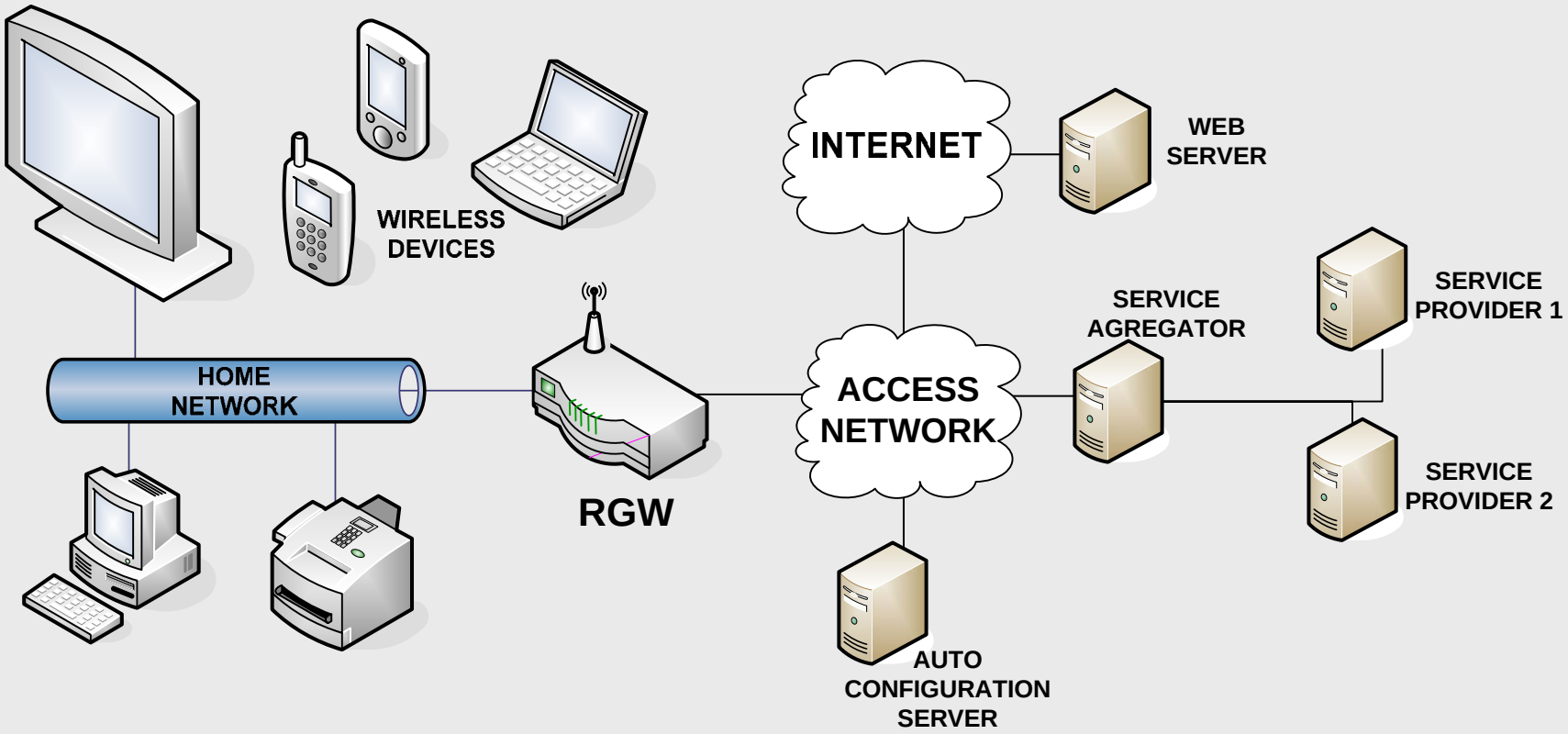
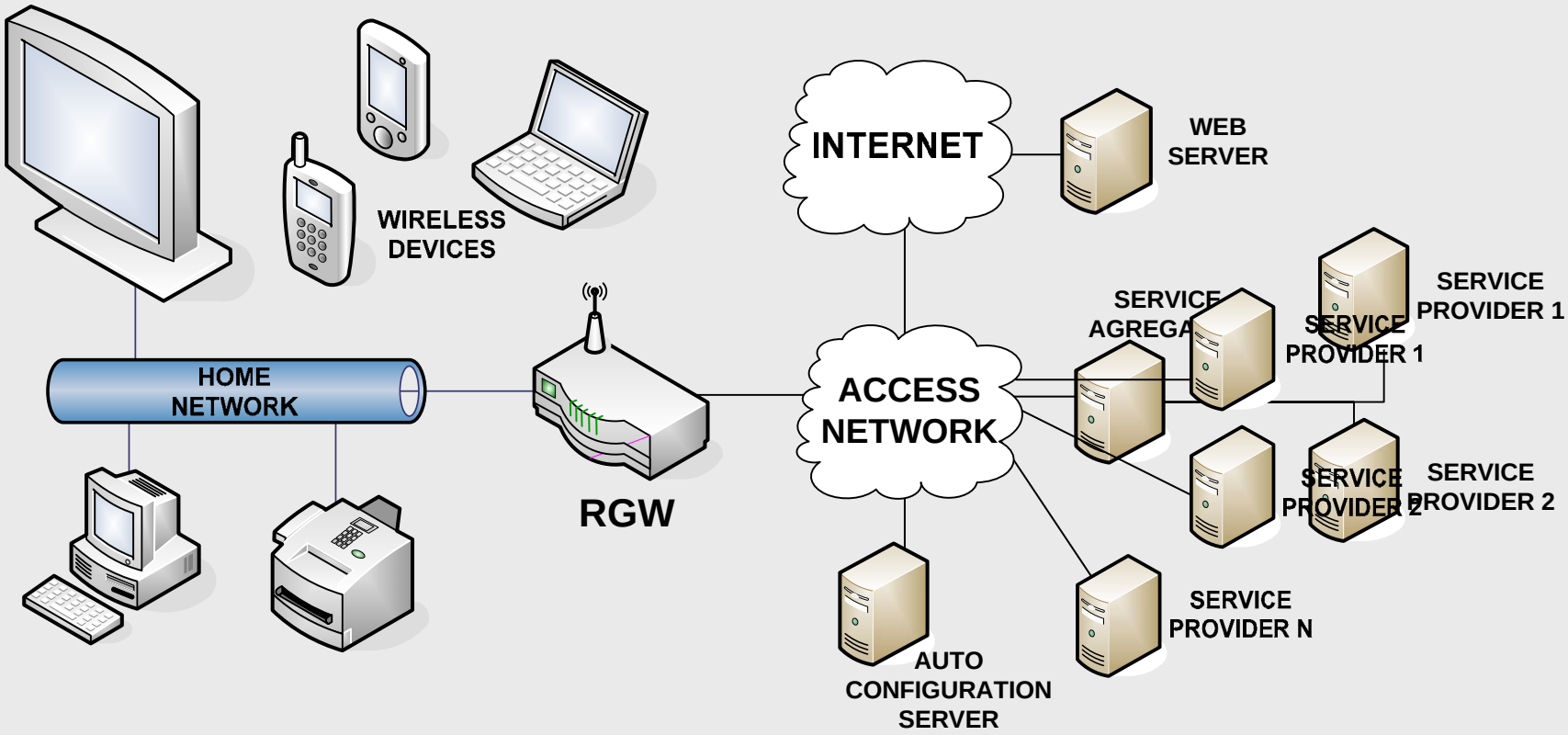
Current Scenario



Future Scenario



Objectives

1. Provide one low cost device
2. Management of multiple services
3. Remote management from multiple service providers
4. Differentiation of users
5. Confidentiality
6. Independency
7. Liability

Residential Gateway

- "A Residential Gateway is one or more devices that connects one or more access networks to one or more home networks and delivers services to the home environment"‡
- Main features:
  - Provide a remote management service to
    - residential gateway (RGW)
    - home networks
    - devices connected the residential gateway
  - Allow device or application to connect with a certain QoS
  - Recognize and combine device capabilities to offer customers a better "integrated home environment"

‡ D. Waring, "Residential Gateway Architecture and Network Operations," International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) document: JTC 1/SC 25/WG 1 N 848, May 1999.

Current Approaches

- Mono-Provider management
  - Based on JMX: Only the operator manage the RGW
  - Based on RBAC (Role-Based Access Control): problem is tackled as a policy-based access
- Multi-Provider management
  - Based on Virtual platforms to provide isolation
  - Limited to two kinds of managers
    - the operator: controls the service platform
    - service providers: manages the virtual platforms
  - Virtual platforms based on JMX bundles
- Different business model and architecture

Current Projects

- European projects and open forums
  - Multi Service Access Everywhere (MUSE, IST-026442)
  - Multimedia Networking (MEDIANET, IST-026025)
  - Platforms for Networking Service Delivery (PLANETS, MEDEA+ project A-121)
  - Home Gateway Initiative (HGI)

OSGi

- Java-based open, common architecture for network delivery of managed services
- Services are added through software components (*bundles*)
- Only one root administrator
- Not pre-define remote management standard

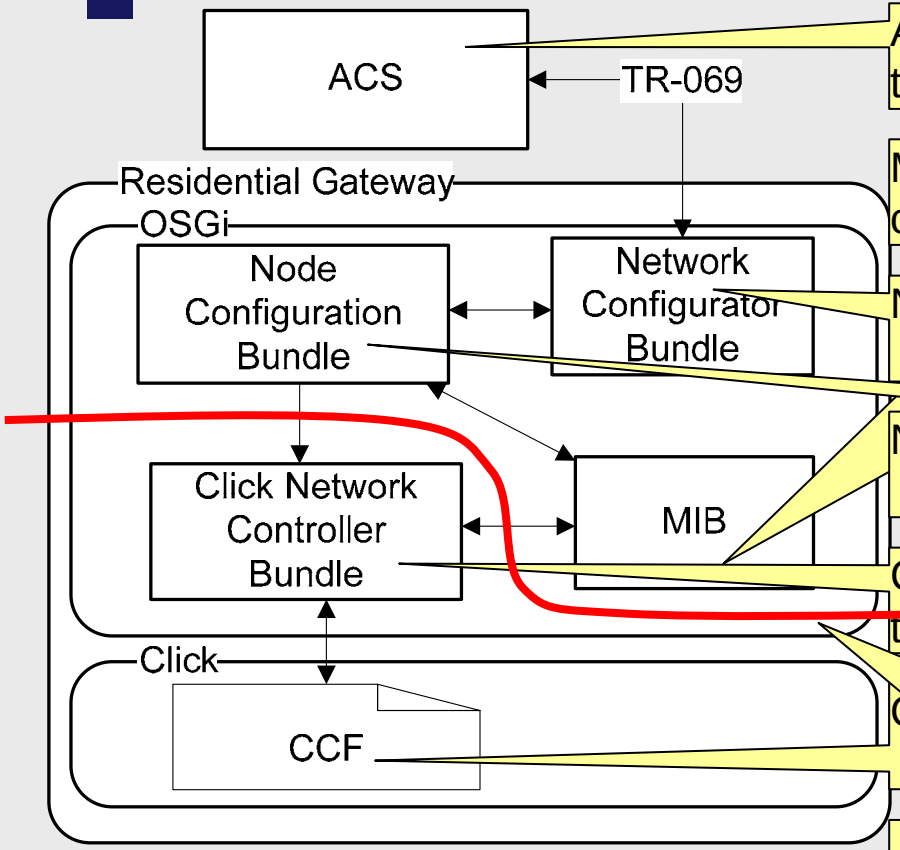
Virtualization (I)

- Every machine is composed of different abstractions and interfaces
- A virtual machine is the combination of a real machine and a virtualization software
- A virtual machine executes software that can be a process or a complete system
- Features
  - A way of relaxing constraints
  - Increase flexibility
  - Development of an isomorphism
  - Not an abstraction
  - Isolation between different instances

Virtualization (II)

- Virtualization Process
  1. Mapping of virtual resources to the real resources in the underlying machine
  2. The use of real machine instructions and system calls to carry out the actions specified by the virtual machine
- Types
  - Process Virtual Machines (Multi-programming, Emulators, Optimizers, High Level Languages Virtual Machines)
  - System Virtual Machines (Virtual Machines Monitors, Hosted Virtual Machines, Whole System Virtual Machines, Co-design Virtual Machines)

Mono-Provider Model



ACS: stores configuration data of the services in the access providers side

MIB: based on the TR-098 protocol stores the configuration of the RGW

NeCB: a TR-069 client to communicate with ACS

NoCB: Used by NeCB to store data in a MIB

CNCB: configures the router translation data from the MIB

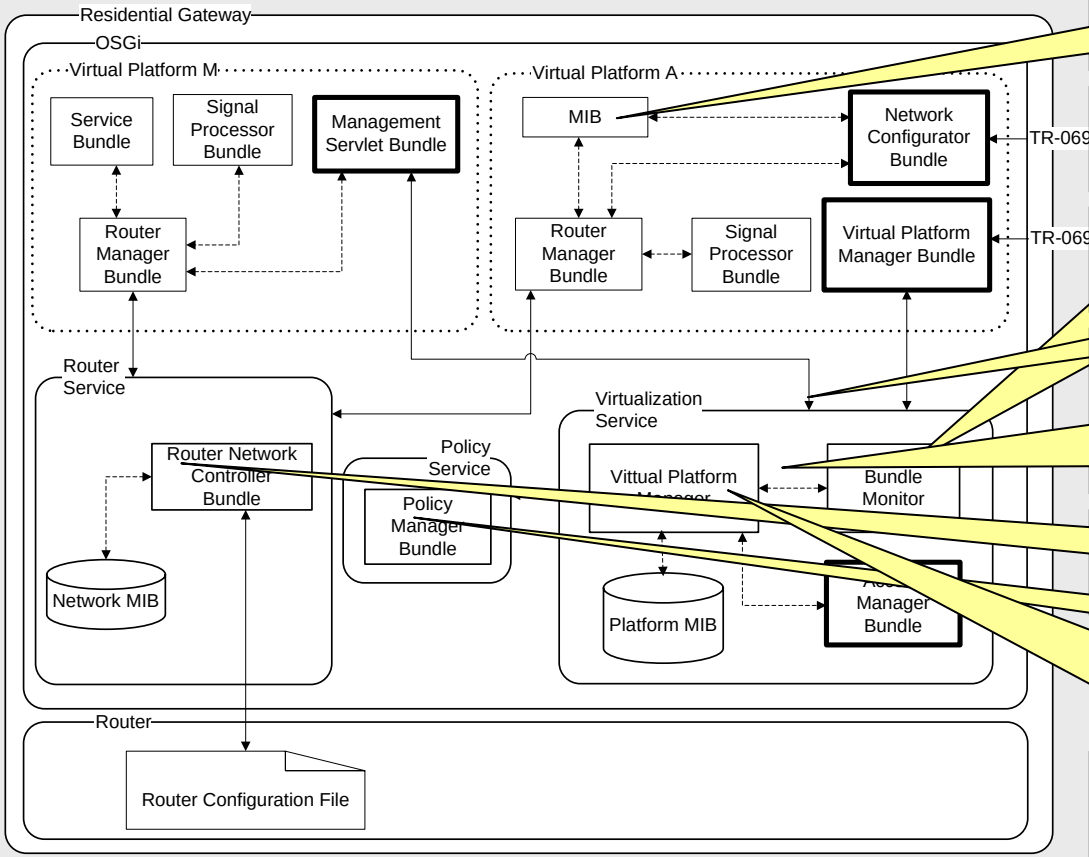
C… onfiguration file of the router software Click!

First abstraction:
generic management / router specific management

Evolution to Multi-Provider

- Basic architecture for the automatic management by one manager
- Multiple managers
  - Each provider manages its own services
  - No other provider manages/knows those services
- Virtualization provides isolation between managers
  - Each provider in one virtual platform
  - Each provider works as it is the only provider of the RGW
- Virtual Platforms
  - Only one manager
  - The set of bundles from a service provider

Multi-Provider Model



Virtual Bundle: a bundle in a virtual platform

System Bundle: a bundle out of virtual platform

Global Service: a service define by a bundle that can be use by all bundles

Local Service: a service define by a bundle that can be use by bundles in the same situation

Router Service: configures the router

licy Service: defines access for users

Virtualization Service: virtualization software

Multi-Provider Roles

- RGW vendor
  - Predefined bundles and services for configuration of router and updating predefined bundles
- Access provider
  - Defines access policies
  - Configures QoS policies
- Service provider
  - Installs services
  - Manages services
- Final user
  - Installs its own services and bundles

Results

- Prototype implemented on an embedded PC
  - Router software Click
  - OSGi implementation Oscar 1.5
  - Ubuntu 6.06 Linux
- Two different configuration systems:
  - Automatic configuration based on the TR-069 protocol
  - Manual configuration using a servlet in a bundle
- Virtualization Service implemented
  - Mechanism for a first access of the service provider
  - Creation of new virtual platforms
  - Management of global and local services
- Router Service developed
  - Configuration of the behaviour of the router

Conclusions

- Virtualized model for the management of a RGW in a multi-provider scenario
- A new virtual architecture developed based on the study of classical virtual machines
- Most objectives have been achieved due to the use of OSGi and virtualization
  - ✓ Provide only one device
  - ✓ Management of multiple services
  - ✓ Remote management of multiple service providers
  - ✓ Confidentiality
  - ✓ Independency
- We used open source software

Future Work

- Differentiation of end users: Professional and domestic over the same RGW
- Define a mechanism for controlling and managing the policies
- Notification of concurrent use of resources
- Liability: controlling resources, like the use of CPU in Java, in order to detect and manage possible abuses in a virtual platform
- Connection to more than one access network