FIRST@PC: Service-oriented Testbed for Future Internet

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Conceptual Service Model for FI

- Integrated dynamic service composition
Evolution of application services and methodologies

• Methodological

Pre-published / Fixed form of Services are inefficient to meet the diverse user’s requirements or context!!
(Low-flexibility, Low-scalability, Low-adaptability, Low-reusability...)

Types of services: \( D \) (demand) \( \gg \) \( S \) (supply)
Quality of services: Best effort

Composite Service

Dedicated resource

Communication Infrastructure (e.g., Internet)

Communication Infrastructure (e.g., Internet)

<legacy service>

Happy

Unhappy

Relative Happy

Absolutely Happy

Types of services: \( D \) (demand) \( \approx \) \( S \) (supply)
Quality of services: Best effort or Statistically guaranteed

Composite Service

Service overlay network (SON)

Shared resource

Distributed computing resources

<SON-based service>

Types of services: \( D \) (demand) = \( S \) (supply)
Quality of services: Absolutely guaranteed

Composite Service

Virtualized resource element

Programmable communication & computing Infrastructure

<Ideal service scenario>
A Tentative Model for Dynamic Media-Oriented Service Composition

Intelligent & Immersive media-oriented services

- Highly massive (UHDV, 3D video, ...)
- Highly interactive (Haptic, ...)

Composite services

Repository for service components, templates & data

- Services
- Data
- Templates

Service Mediator

- Service transaction
- QoS management

Discover & select candidate set of services & template

Execute & monitor composite service

Service Request

Service Instances

Resource Broker

- Resource aggregation
- Resource monitoring

Discover & select candidate set of comp. & net. resources

Allocate & monitor comp. & net. resource

Resource Provisioned Service Overlay Network

Virtualized computing & networking resources

Meta-data flows

Control flows

Programmable Clusters, Nodes, (e.g., PEC, PCN, PWN, ...) ...

Programmable Substrates

Repository for virtualized computing & networking resources

- Computing resources
- Storage
- Networking resources

Discover & select candidate set of comp. & net. resources

Allocation (Tspec)

Creation, deletion, alteration of instances (e.g., slices)

Abstraction

Negotiation (Rspec)
Future Internet TB Research Positioning

Contents & Services

- Personal Media
  - Tagging
  - RSS
  - Blogs
  - Social networking
  - Personal broadcasting

- Digital Contents
  - DMB/DTV
  - Digital cinema
  - VoIP
  - E-book
  - On-line game

- Ubiquitous Computing Services
  - Telematics/Localization service
  - Intelligent robots
  - u-Home service
  - Health care service

Components

- Wireless Networking
  - WiBro
  - HSDPA
  - W-CDMA

- Programmable Networking
  - OpenFlow
  - NetFPGA

Computing & Networking Components

- ITSoC
- Microprocessor
- Embedded SW

Virtualized Computing/Networking Testbed

Service-Oriented Internet Testbed

- SaaS (Software as a Service)
- SaaS over Virtualized Network Infra
- iPhone Apps Framework
- Google App Engine
- Microsoft .NET

- Dynamic service composition based
- Future Internet Service Framework

Architecture

- Experiment Workflow & Services WG
- Control Framework WG
- Substrate WG
- PlanetLab/VINI/Orbit
- Manageable Network Testbed
- IBM Blue Cloud
- GRID computing
- Utility Computing

Infrastructure

Virtualization

ITSoC

UTile Computing

OpenFlow

NetFPGA
SOA vs. Testbed
(for service-oriented testbed construction)

- Service-oriented Computing Environments
  - Focused on dynamically composing user applications with functional association of services
  - Do not consider effective usage of computing/networking resources

- Virtualized Computing/Networking Testbed
  - Construct distributed computing testbed which supports programmable networking and computing resource virtualization
  - Focus on running various network experiments on the testbed
Towards Service-Oriented Virtualized Computing & Networking Testbed

Virtualized networking testbed supporting from experiment control to application design

Construct an extended testbed supporting complicated service composition and stable operation as well as computing/networking resource virtualization thorough extended tools for service control and management

- Convenient usage of virtualized resources
  - Provide service developers with a way to utilize virtualized computing/networking resources in providing services

- Dynamic service composition by applications
  - Dynamically compose services depending on the functional relationship among services and handle events of testbed

- Service and resource adaptation combined with monitoring
  - Monitor resource utilization and adapt services accordingly
  - Dynamically adapt virtualized resources according to the request of a service
Project Overview

• Goal (1st Phase: 2009-2011, 2nd Phase: 2012-2013)
  – As a part of joint project with ETRI FI Testbed Project (leader: Dr. Jinho Hahm)
  – PC-based prototype construction of virtualized and service-oriented testbed for dynamic service composition
    • PC-based virtualized computing/networking platform design using NetFPGA/OpenFlow
    • Service operation and control over dynamic virtualized slices
  – Possibly aligned with GENI PL Cluster …

• Members (around 30 persons)
  – GIST: Dr. JongWon Kim
  – KAIST: Dr. Sue Moon
  – CNU: Dr. Daeyoung Kim, Dr. Jaeyong Lee, Dr. Byungchul Kim
  – POSTECH: Dr. Hwangjun Song
  – KHU: Dr. Sungwon Lee
Project Roadmap

• 1\textsuperscript{st} year) Setup development environment and develop initial platform prototype
  – Design and prototype initial form of PC-based platform for dynamic service control
• 2\textsuperscript{nd} year) Develop Platform Spiral 1 Model
  – Implementation and experiment of initial PC-based platform for dynamic service control
• 3\textsuperscript{rd} year) Develop Platform Spiral 2 Model
  – Complement function and performance of component architecture
• 4\textsuperscript{th} year) Develop advanced platform prototype
  – Advanced design, implement, and experiment of PC-based platform
• 5\textsuperscript{th} year) Develop Platform Spiral 3 Model
  – Update advanced function and performance of PC-based platform for dynamic service control
Design PC-based platform prototype architecture using NetFPGA/OpenFlow (2009-2011)

- PC-based node architecture which selectively uses hardware-accelerated networking (NetFPGA)

- Programmable networking satisfying independency and compatibility with existing infrastructure (OpenFlow)

- Support virtualization with PlanetLab at the center and nodes federation

- Share computing capability of nodes

- Propose software architecture for dynamically interconnect and control PC-based virtualized nodes
- Implement software stack for unified management and control of distributed services utilizing available resources of nodes in creating a slice
Scenario-based Approach

Ubiquitous and smart collaboration environment
Thank you!

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