Service-Oriented Architecture for Future Internet

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This talk describes the work by:

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- Prof. Kave Salamatian
- Dr. Yujun Zhang
- Dr. Yi Sun
- Dr. Hongtao Guan
- Dr. Yingke Xie
- Hongxia Zheng
- Xiaokun Zheng
- Jianhua Zhang
- Yonggong Wang
- and me
Contents

• A Clean-Slate design of future Internet architecture
  – Motivation
  – Basic Ideas
  – Platforms
  – Open Issues

Service-Oriented Future Internet Architecture (SOFIA), IEEE Infocom/Poster, Shanghai, China, April 2011
Future Internet Scenario

● Developing Trends
  – **Terminal**: from fixed to heterogeneous mobile ones (cell phone, PDA, sensor) with limited service capability
  – **Network**: from transmission to intelligent processing (cloud, OpenFlow)
Network as a Service Pool

- What user want is service
  - Get service from the Internet
  - Publish service in the Internet

Service = data + storage + computation + distribution
There is a consensus that

- the current TCP/IP architecture does not efficiently work for the future Internet, resulting in a series of problems such as:
  - Scalability problem
  - Mobility problem
  - Security problem
  - ...

Scalability Problem

- Traffic Scalability
  - Multimedia, cloud computing

- Routing system scalability
  - Multi-home, address fragment, traffic engineering

- Problem Essence
  - Network only acts as transfer channels, totally ignores what is transmitted
    - the same services are transmitted many times on a link
  - Dual roles of IP address make the address aggregation difficult

http://www.huawei.com/broadband/iptime_backbone_solution/era/100g_transport_era.do
Mobility Problem

• TCP/IP architecture: lose connection = lose everything
  – but mobile and battery-powered terminals cannot maintain constant connections

• Problem Essence
  – Complex terminal and simple network
  – Dual roles of IP address
Security Problem

• Security (3 levels)
  – Secure channel
  – Secure infrastructure
  – Secure service (not considered in existing approaches)

• Two alternative solutions
  – Solve it in architecture
  – Solve it in application layer (low efficiency)

• Problem Essence
  – The thin waist “IP” does not take security into account

SOFIA (Service-Oriented Future Internet Architecture)

TCP/IP Protocol Stack

SOFIA Protocol Stack

Narrow waist moves up

+ intelligence

Applications

Service Resource

Service ID

Locator: IP ethernet PPP...

Communication medias
SOFIA Network: an example

Service Migration

Service 1

Network 1

RegService: Service ID ➔ locator

Service 2

Network 2

UserService:

getService:

Service ID

User A

User B

Service 1

Service 2

context-aware

Service 1

Service 2

cache & computing

routing

forwarding

Context-aware Transfer

SOFIA

Network 1

Network 2

Service 1

Service 2

getService:

Service ID

Service 1

Basic Operations

• Service Registration
  – Register the mapping <service ID, locator>

• Service Request
  – Request the service with service ID

• Service Updating
  – Update the mapping <service ID, new locator>
SOFIA Router Model

Control plane

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<tbody>
<tr>
<td>ServiceID1</td>
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<td>LocalID1</td>
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<td>...</td>
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<td>NewLocatorID</td>
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</table>

Data plane

Packet Check

Lookup Engine

Output Queue

Local SIB: Local service to locator

Routing Info. Base: NetID to interface

Local RIB: Local locator to interface

BIB: Old locator to new locator

mapping

routing

update

MSCC: Memory Storage and Computation Capability

Counter
Solution to the Scalability Problem

• Add intelligence (storage and computation capacities) to network: service migration to implement service localization

• Context-aware routing and transfer (leverage the intelligence)

• Separation of identifier and locator
Solution to the Mobility Problem

• Separation of service identifier and locator

• Network can be a service resource
  – Store the data if it cannot deliver the data
  – Always-on connections are no longer required
Solution to the Security Problem

• 3 components in architecture
  – Sending box (virtualization/isolation/encapsulation)
  – Monitoring module
  – Authentication module

• Authentication and authorization at the service level
Router Prototype

• Based on PEARL
  – PEARL: A Programmable Virtual Router Platform
    [1]

Open Issues still working on

• Enabling techniques
  – Multi-attribute based service identifier
  – Routing and fast forwarding
  – Service isolation and migration
  – Implementation of security techniques

• Management of SOFIA network

• Theoretical models for network

• Testbed and evaluation
Thank you for your attention

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