

Service-Oriented Architecture for Future Internet

Zhenyu Li

Ph.D., Assistant Professor



Institute of Computing Technology

Chinese Academy of Sciences

<http://fi.ict.ac.cn>

This talk describes the work by:

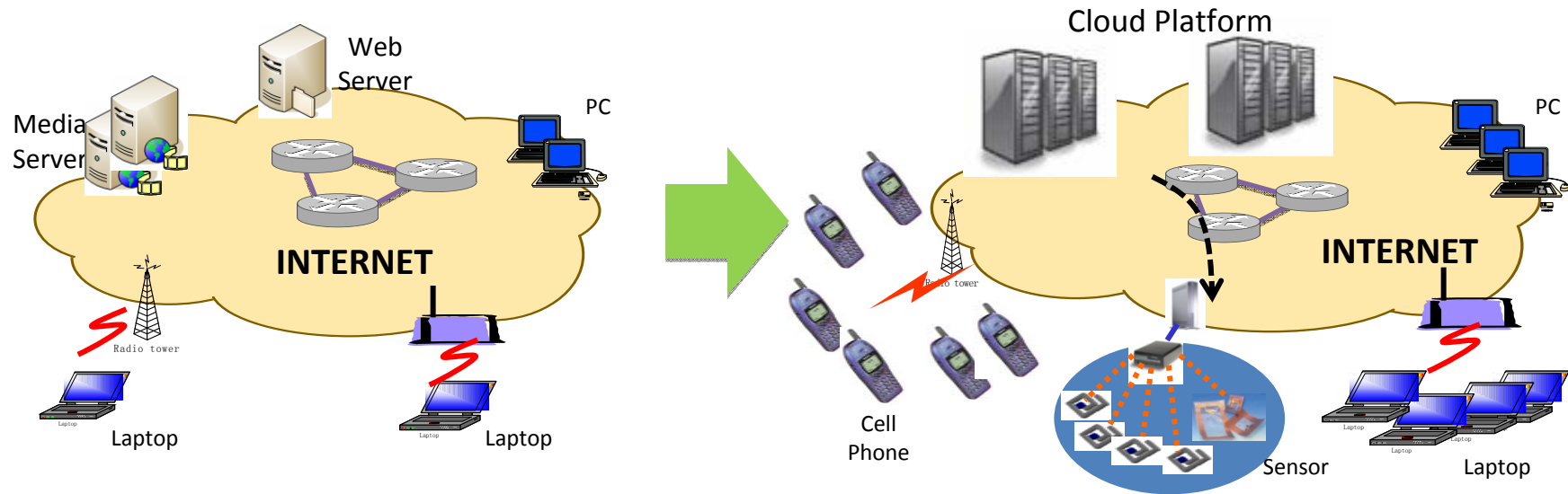
- Prof. Gaogang Xie
- Prof. Kave Salamatian
- Dr. Yujun Zhang
- Dr. Yi Sun
- Dr. Hongtao Guan
- Dr. Yingke Xie
- Hongxia Zheng
- Xiaokun Zheng
- Jianhua Zhang
- Yonggong Wang
- and me

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

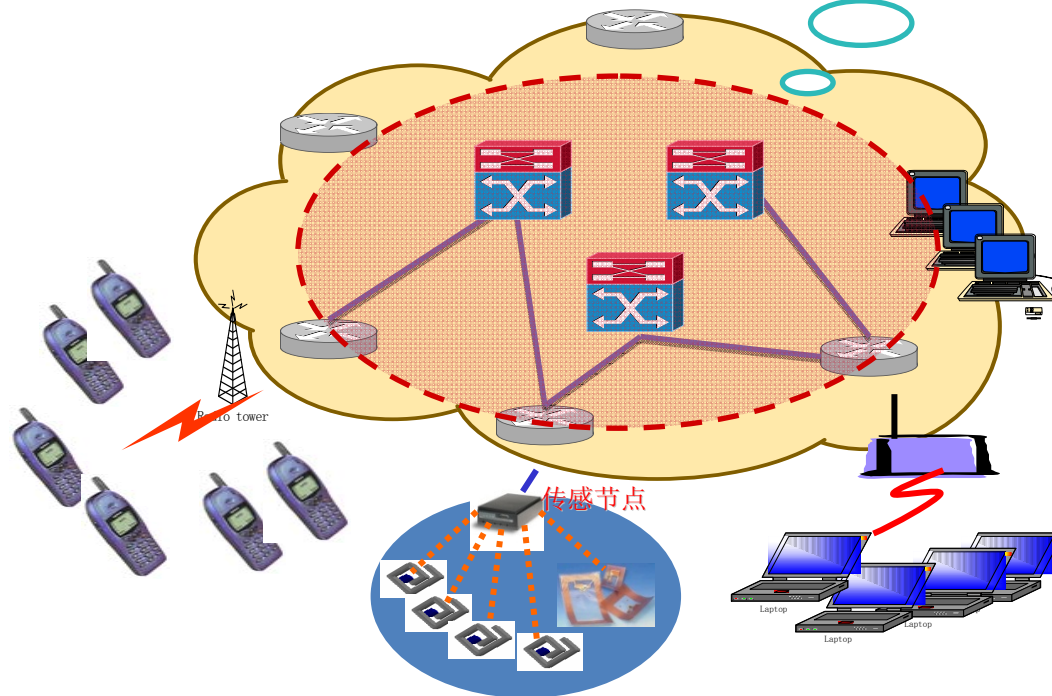
- **Terminal:** from fixed to heterogeneous mobile ones (cell phone, PDA, sensor) with limited service capability
- **Network:** from transmission to intelligent processing (cloud, OpenFlow)

Network as a Service Pool

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

Network is viewed as a
Service Pool

Service = data + storage +
computation + distribution

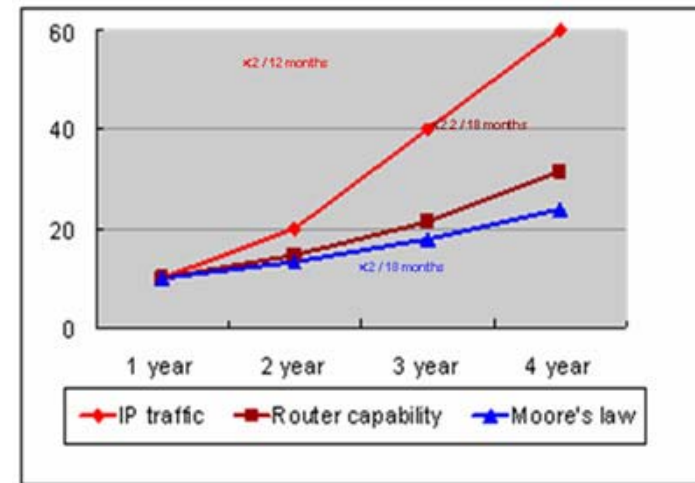


There is a consensus that

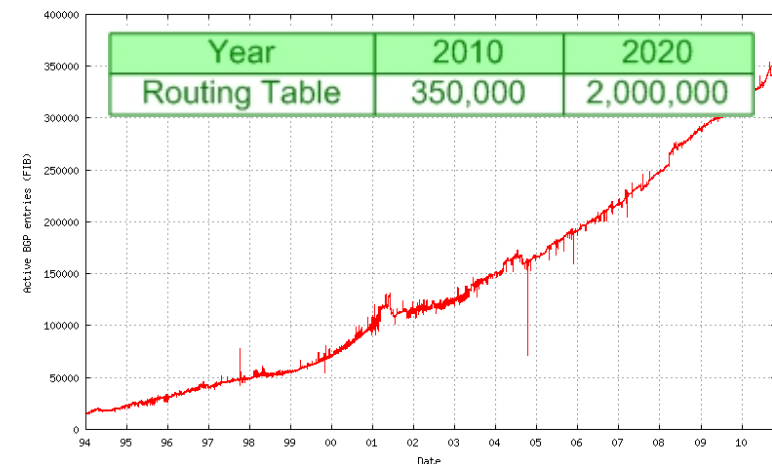
- the current TCP/IP architecture does not efficiently work for the future Internet, resulting in a series of problems such as:
 - Scalability problem
 - Mobility problem
 - Security problem
 - ...

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



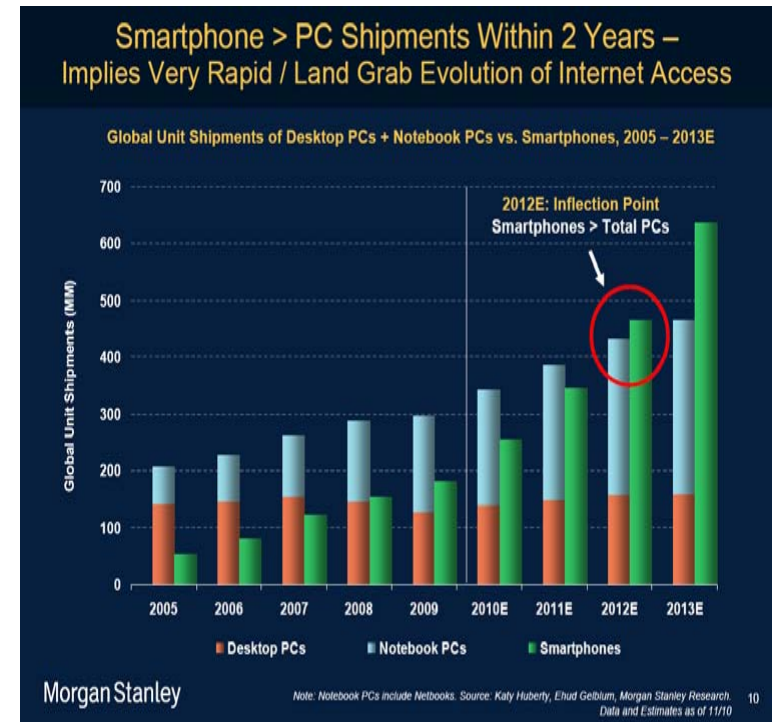
http://www.huawei.com/broadband/iptime_backbone_solution/ra/100g_transport_era.do



BGP data obtained from AS6447 1994-present
Report last updated at Wed Oct 27 00:00:00 2010 (UTC+1000).

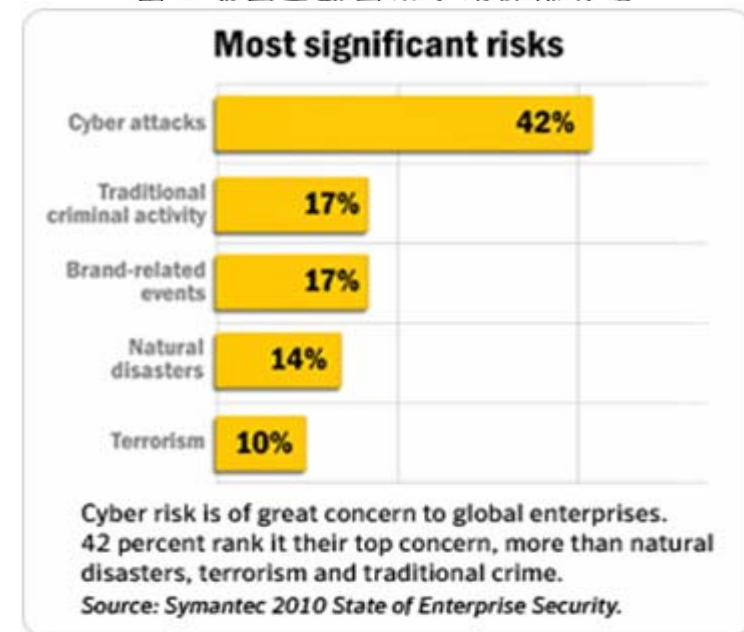
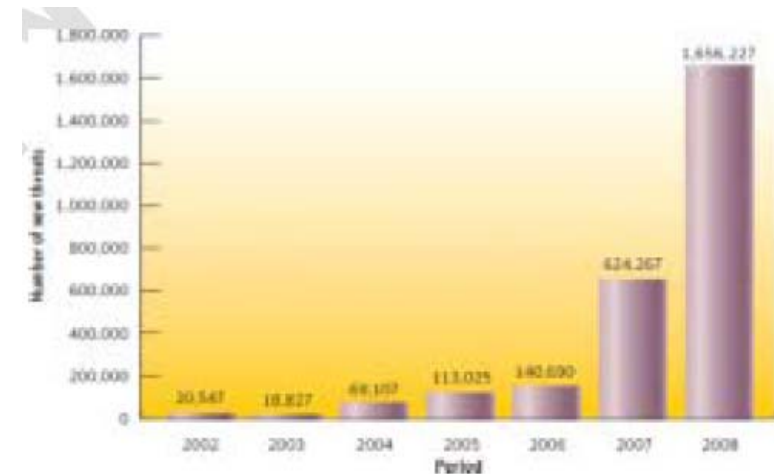
Mobility Problem

- 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

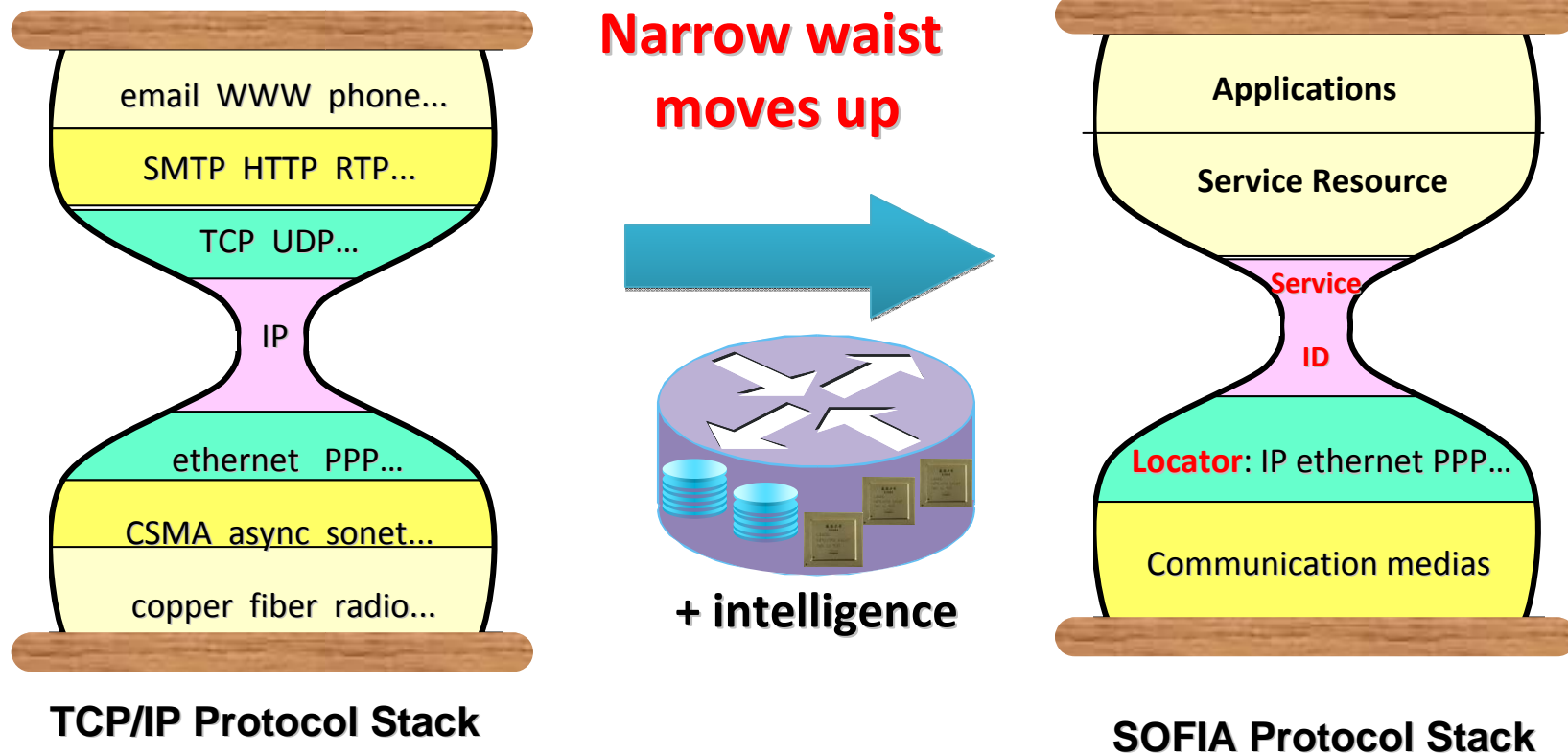


Security Problem

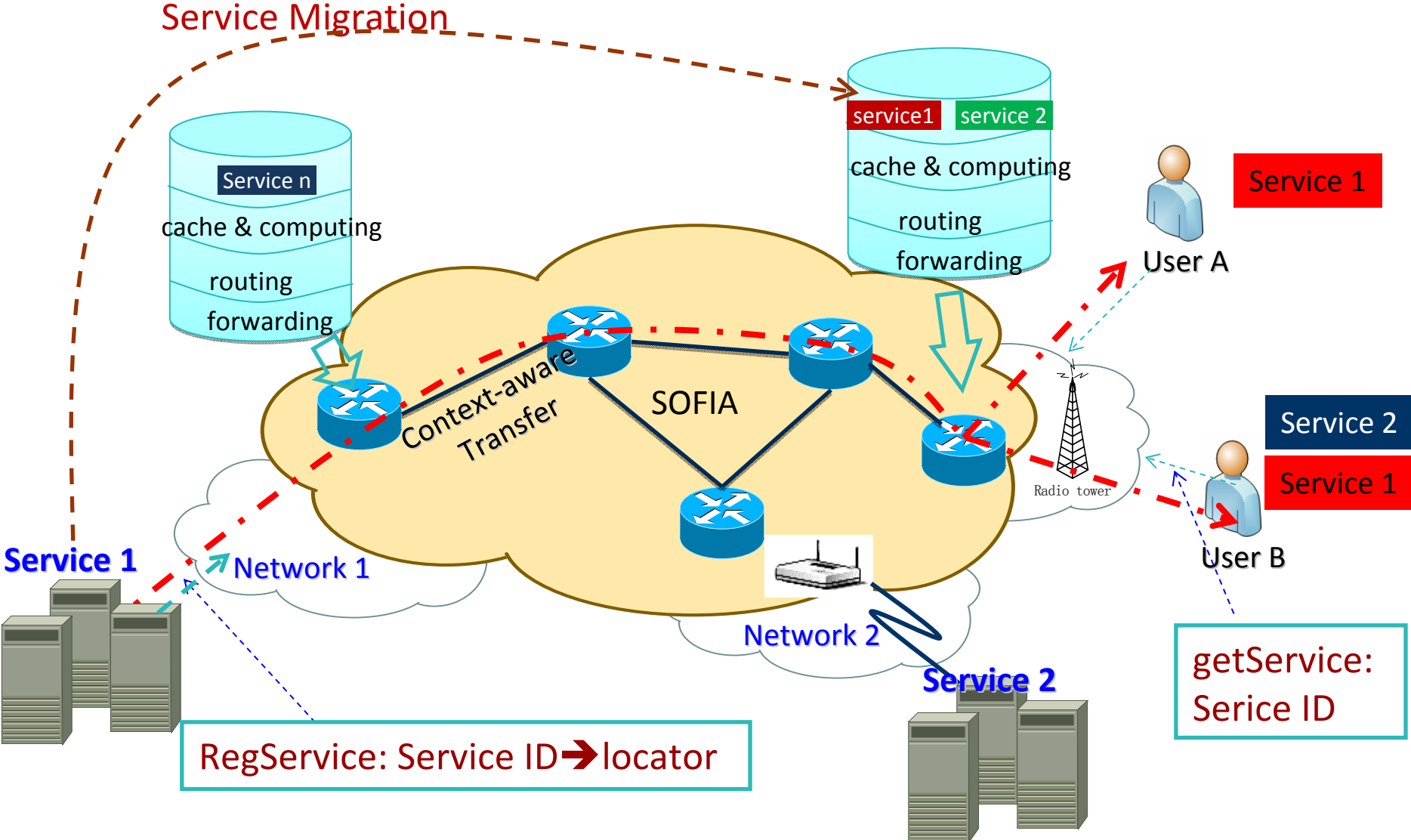
- Security (3 levels)
 - Secure channel
 - Secure infrastructure
 - Secure service (not considered in existing approaches)
- Two alternative solutions
 - Solve it in architecture
 - Solve it in application layer (low efficiency)
- Problem Essence
 - The thin waist “IP” does not take security into account



SOFIA (Service-Oriented Future Internet Architecture)



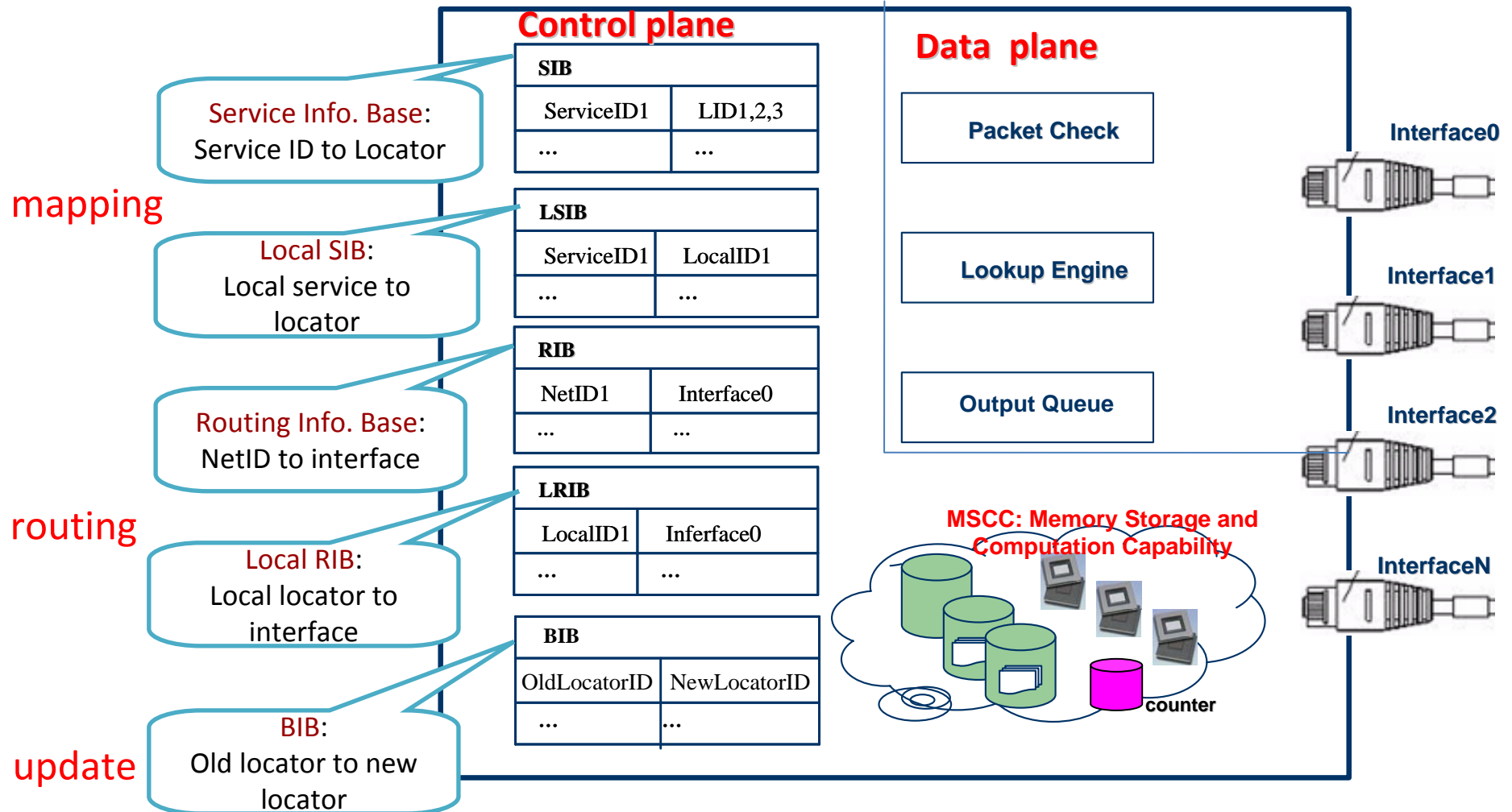
SOFIA Network: an example



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



Solution to the Scalability Problem

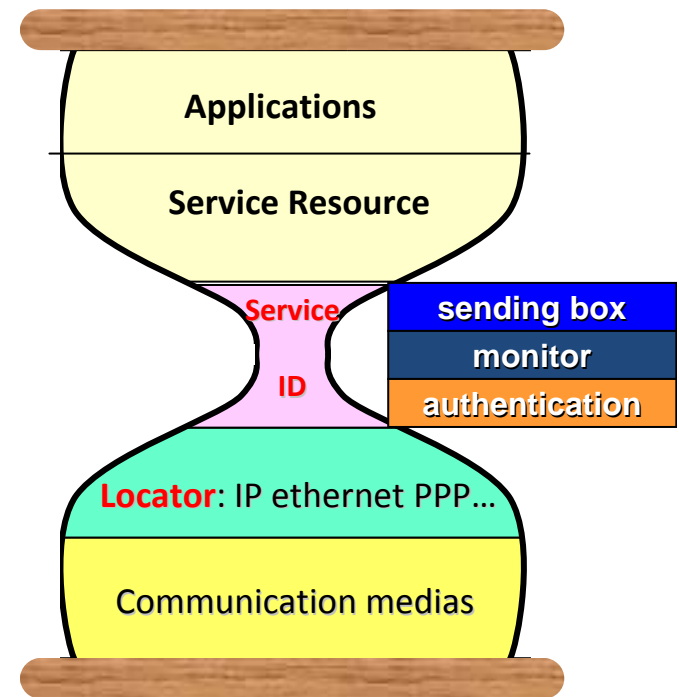
- **Add intelligence (storage and computation capacities) to network:** service migration to implement service localization
- **Context-aware routing and transfer** (leverage the intelligence)
- **Separation** of identifier and locator

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



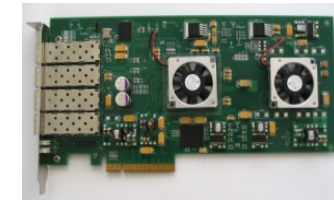
SOFIA Protocol Stack

Router Prototype

- Based on **PEARL**
 - PEARL: A Programmable Virtual Router Platform [1]



Server Based



Hardware Cards: FPGA+TCAM

[1] “PEARL: A Programmable Virtual Router Platform”, *IEEE Communication Magazine, Future Internet Architectures: Design and Deployment Perspectives*, 2011, 49(7): 71-77.

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

Zhenyu Li
zyli@ict.ac.cn

<http://fi.ict.ac.cn>