The future of internet

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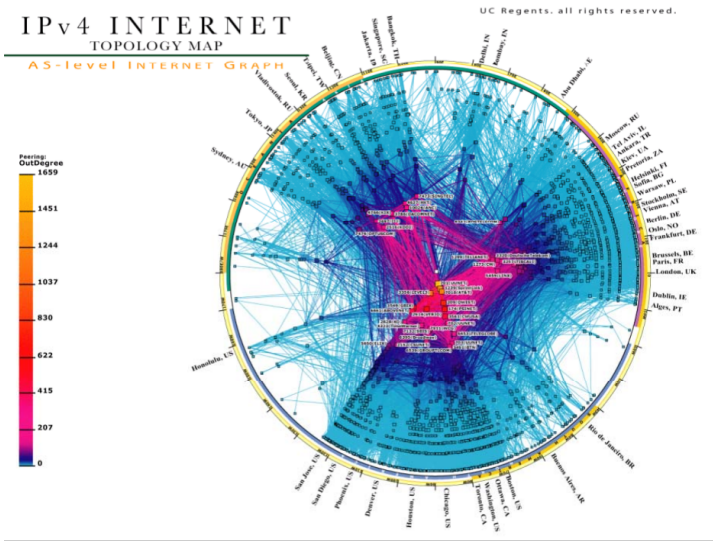
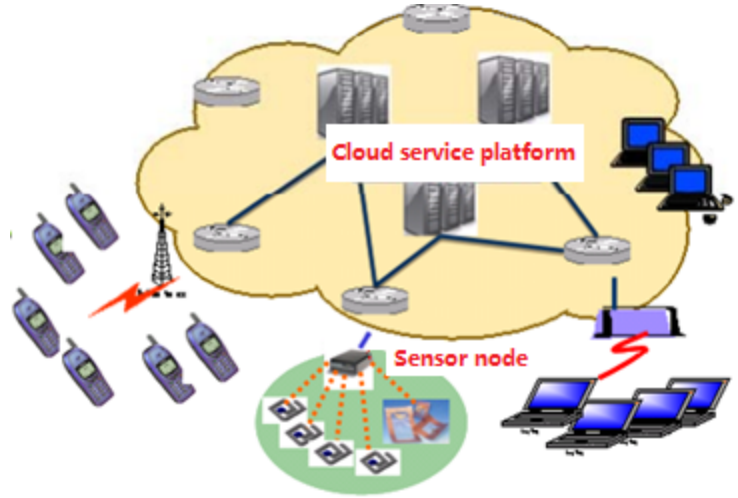
Summary

The length of speepch：10 minutes

Target Audience：people who interest to the future development of the Internet

Internet - indispensible





Wireless communication、transmission and computing technology are developing rapidly

- Optical transmission、wireless communication、clould computing、mobile computing、virtualization

Numerous new applications

- Internet of things、society internet、wideband video service、3DTV

The problems of IP-based internet become more and more severe, and a lot should be done to keep up with new developmets.

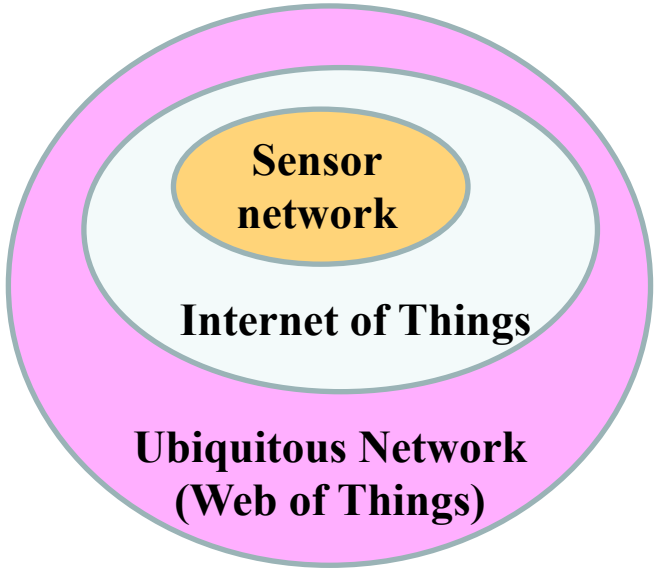
Internet developments－from sensor internet to internet of things and ubiquitous network

Commonly, the internet of things is constructed on traditonal internet. In this situation, the internet of things is equvalent to VPN.

Global internet，while industry or regional characterized internet of thing。

Rather than network, internet of things is a kind of service or application, as it is the extension for internet application.

Sensor network uses sensors as the sensing element, and there is no need to be built on internet.



The Internet of things use sensors, RFID, GPS, CCD camera, infrared scanner, the two-dimensional code ect. as sensing elements. It connects things and human beings by Internet. Objects in the network are addressable, communication-capable and controllable.

Ubiquitous network treat objects as addressable, semantics, onfigerable resource. By connecting things and human beings, it provides information acquisition, transmission, storage, analysis, cognition services on-demand. Also, it emphasis natural man-machine interaction, integration of heterogeneous networks and intelligent application.

Major problems of internet

Network sustainability facing severe challenges	• Internet traffic explosively increases, and route table grows superlinearly; • Rate of flow growth is far higher than that of chip processing capacity (Moore's law)； • IPV6 deployment will make the problem more serious.
More and more serious internet security problem	• People pay more attention to the network security due to 'Snowden' event； • America issued 'international strategy for cyberspace' and 'action strategy for cyberspace'; • MIIT formulated and promulgated '12th Five Year Plan for internet industry'。
QoS security is uncontrollable	• Real-time newtowrk status informantion can not tested, cognized and interacted.; • Lack of OAM based on traffic engineering and resource management； • Lack of self diagnosis, self repair and self recovery.
Green and energy-saving	• Promotion of equipment capacity and processing rate results in higher working frequency and more complex manufacture craftwork; • Immature integration technology leads to the increase of power consumption, resulting in power supply system and cooling system facing serious challenges; • According to incomplete statistics, network power consumption accounts for about 5.5% of total global consumption, and energe-saving becomes a technical problems that must be solved.

Problem solving：reborn

- Every technique system has its life cycle.
- The complexity of network applications is not concerned while IP network system designed. So that the problems cannot be completely solved by improving existing construction。
- The idea of reborn：break free from IP, construct a fresh network system。

Internet is a great success, while…

- Could the internet meets the needs of the future if we improve existing design by the method of increasment?
- Whats the needs for the internet and what the internent looks like in the next 10 to 15 years?
- The purpose of drawing a blueprint is looking further into the future.
- How to compsite a gloable internet if we start from the very beginning?
- Revolut for emancipating the mind instead of revolution.

Clark, Massachusetts Institute of Technology

Goal for the next generation of internet-reliability, mobility, association, ubiquitous

Broadband, mobile, ubiquitous **Security, availability, reliability**

Security and rubustness	Mobile Pervasive computing	Out physical and Cyber space	Autonomous networking
Secure internet	**Mobile internet**	**Internet of things**	**Ubiquitous network**

Design new naming/addressing/identification systems and network management models out of the range of existing data-switching, packet-switching and circuit switching systems.

Capability:	Capability:	Capability:	Capability:
High availability and reliability for data access	Available access anytimg and anywhere	Real time access for information from physical world	Access for dynamic and challenging enviromnet information

Greater efforts on developing network techniques –US/EU/JAPAN

US

FIND

- Research funding program aiming at establishing future Internet architecture
- Clean-slate approach
- Focusing on comprehensive research of network architecture design
- Many small projects are adopted and converged to a few full-scale architectures. Those architectures will be examined on GENI infrastructure.

GENI Initiative

- Succeeding to the result of Planet Lab
- Programmable
- Aiming at innovation by fundamental reconsideration of service architecture to overcome problems of current Internet
- Research scopes: Security, Mobile / Wireless, Sensor NW, etc.
- Trying to secure budget from MREFC
- International collaboration is also in a scope.

EU

FP7

- R&D funding program to support to secure technological improvement and competitiveness of universities and companies in Europe

< Related projects>

1. The network of the future
2. Service and software architectures, Infrastructures and Engineering
3. Secure, Dependable and Trusted Infrastructure
4. Networked Media

GÉANT2

- Giga-bps R&D network covering all over Europe area, funded by EU committee.
- Interconnecting 34 NRENs in EU.
- Over 3,000 research organizations in Europe can share information about research activities.
- Migration to GEANT3 is planned in 2008; improving bandwidth and functionality.

Japan

AKARI

NICT promotes NWGN research activity "AKARI Architecture", aiming at implementation of NWGN via establishing new NW architecture / design and experiments. The concept paper of NWGN architecture was published in Apr 2007. NICT established Strategic Headquarter for NWGN R&D in Oct 2007 to build up strategic roadmap of R&D and to promote it.

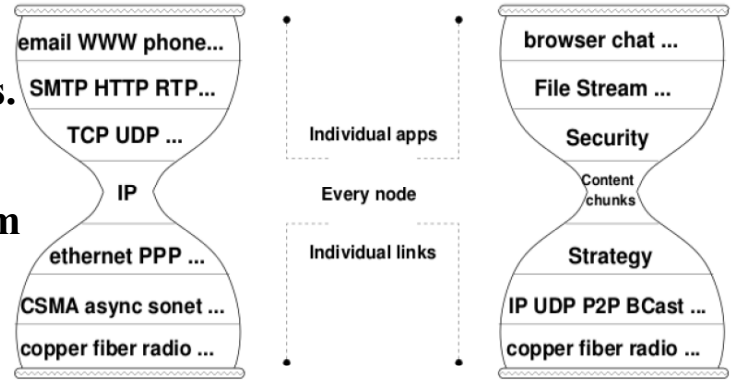
JGN2 → JGN2plus

- R&D testbed network operated by NICT with nation-wide access points, utilized to R&D activities and experiments through collaboration of industry, academia and government.
- Contributing to human resource development in ICT area via experience of practical experiments.
- NICT modifies existing JGN2 network and starts operation of "JGN2plus" from next fiscal year, as a testbed for NWGN researches, R&D of NW technology, etc.

Major efforts- US GENI

NDN （Named Data Network）

- Content-centric， change from where to what.
- Locate content by “content name” instead of address.

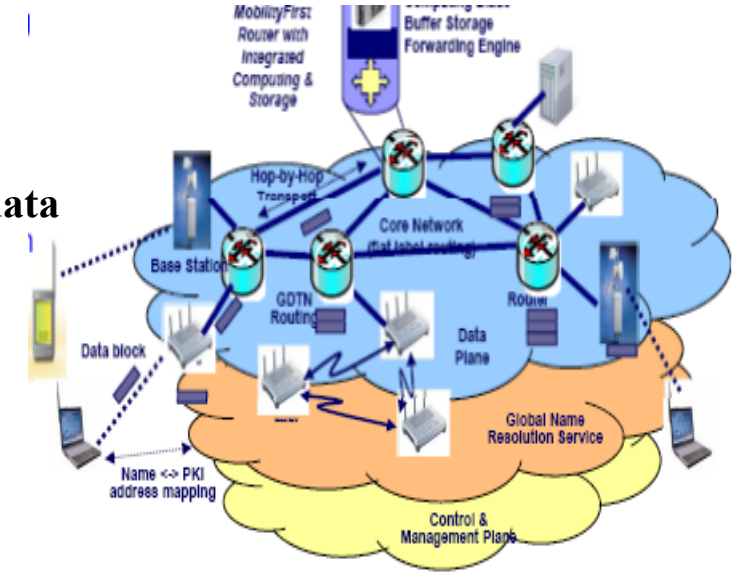


XIA

- Embedded security and reliable mechanism in system level.

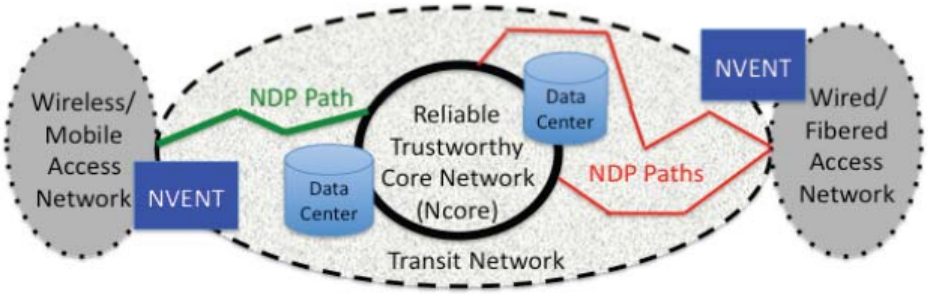
Mobility First

- Separate lable with address, support mobile computing.
- Router nodes cache and shield link interuption problems.



Nebula

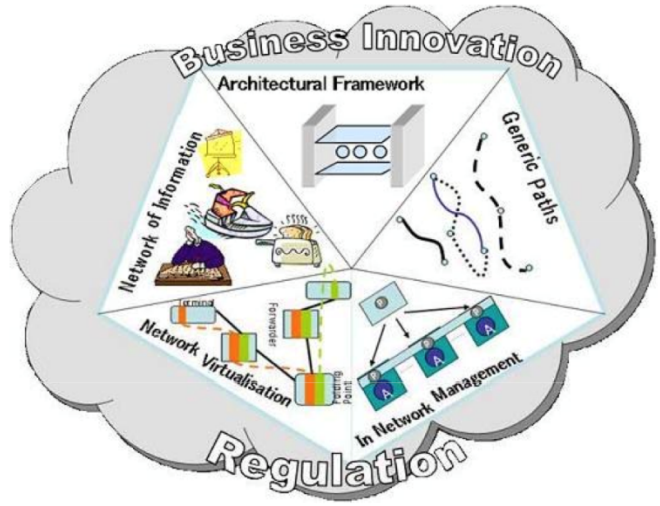
- Construct a reliable core network to connect all the data centers.



Major efforts - EU

FIRE（Future Internet Research and Experimentation）project

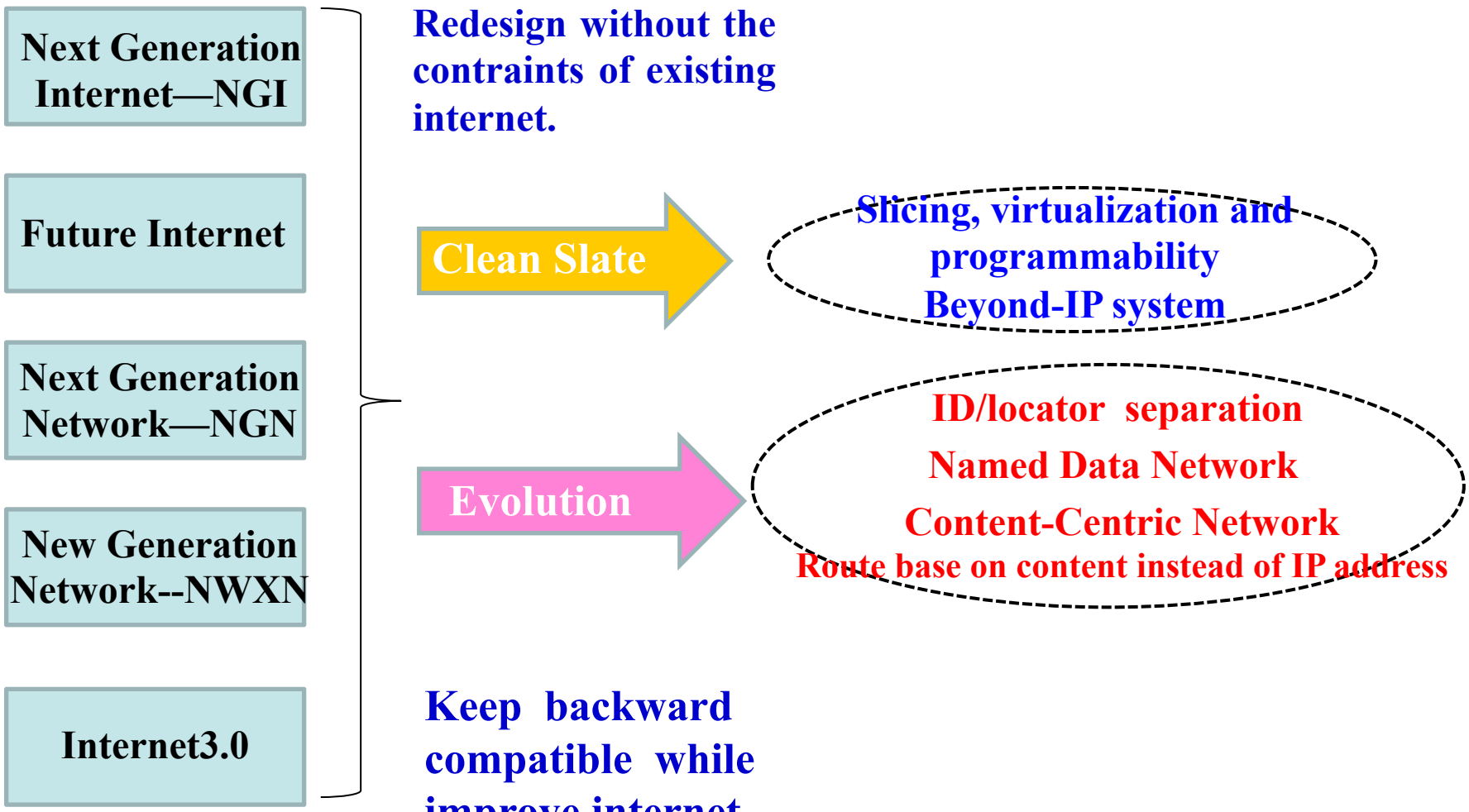
Main components of the research：construction of new network system and protocols, solutions for internet growing scale/complexity/mobility / security/permeablility, vertifing above features on physical and virtual entwork by running extensive tests.



FP7 Other Future Internet projects(100+)

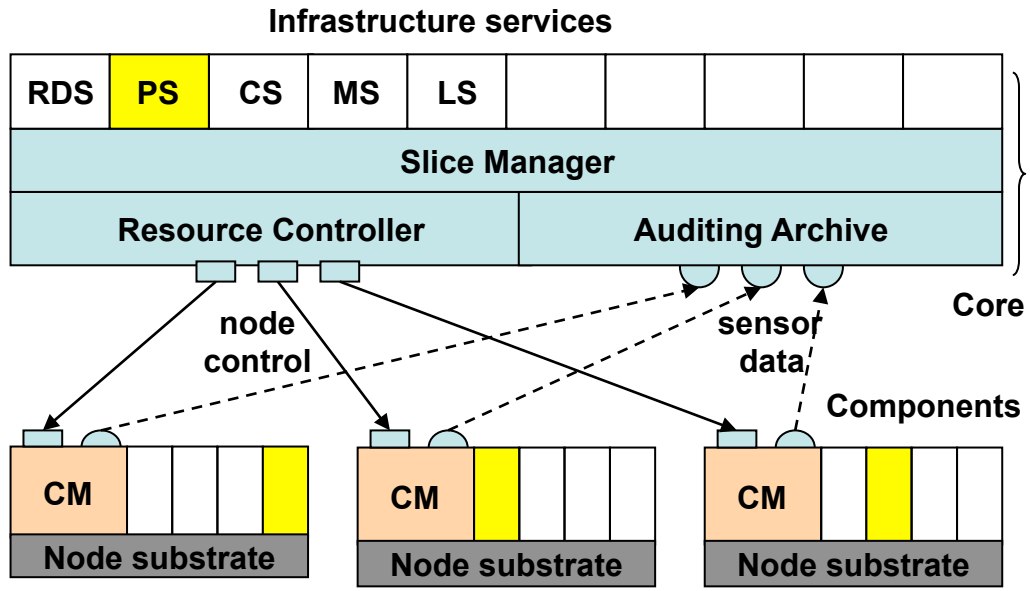
2020 3D Media	CHORUS	FAST	N-CRAVE	SAPIR	SOCRATES
4NEM	COIN	FORWARD	NESSI 2010	S-CUBE	SWIFT
4WARD	CONTENT	INTERSECTION	OPEN	SEA	TA2
ADAMANTIUM	CuteLoop	IRMOS	P2P NEXT	SENDORA	TAS3
AGAVE	DICONET	iSURF	PanLab / PII	SENSEI	TECOM
ASPIRE	E3	m CIUDAD	PERSIST	SERVFACE	THINK-TRUST
AUTOI	eCRYPT II	MASTER	PetaMedia	Service WEB 3.0	VICTORY
AVANTSSAR	EFIPSANS	MobileWeb2.0	PICOS	SHAPE	WOMBAT
AWISSENET	EIFFEL	MOBITHIN	PRIMELIFE	sISI	
CASAGRAS	eMOBILITY	MOMENT	PRISM	SMOOTH-IT	
CHIANTI	EURO-NF	NAPA-WINE	RESERVOIR	SOA4ALL	

Next generation of internet – improving or revolution？



Slicing, virtualization and programmability

- US GENI and FIND project proposed a design idea of slicing, virtualization and programmability. The idea suports different services to share physical entity by logical separation, for the purpose of transmitted resource corresponding to QoS.



- Slicing

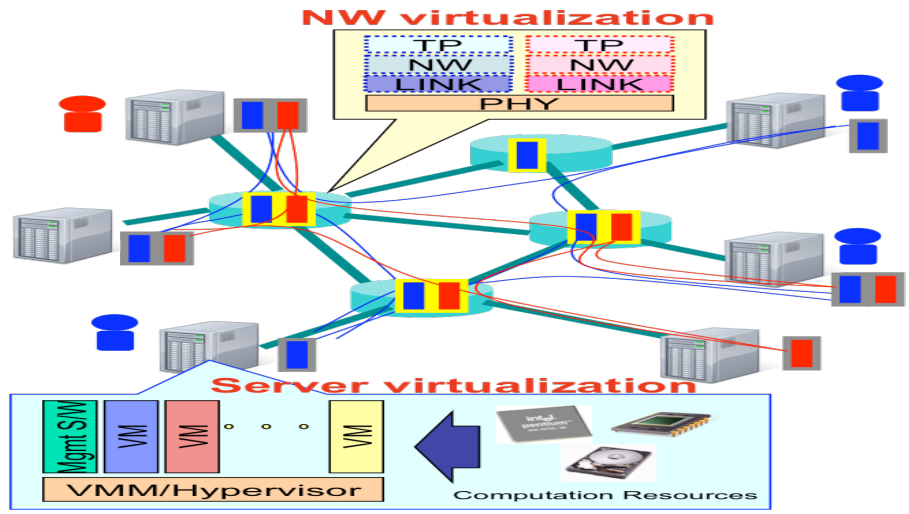
  Embadding to physical layer

- Virtualization

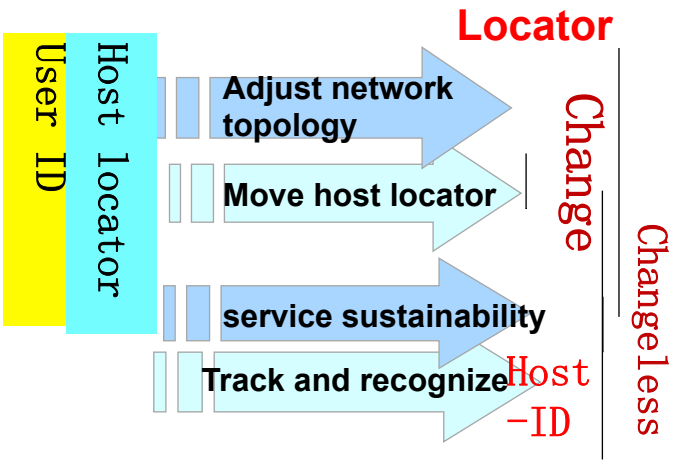
  Reusing system on public facility

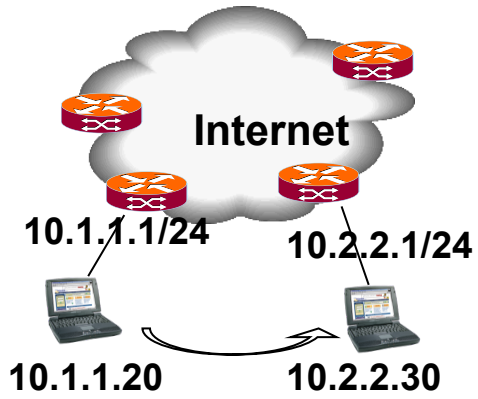
- Programmability

  Open to new designs

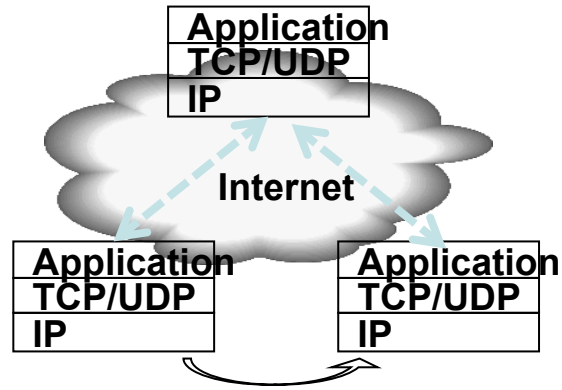


From ID/Locator combination to ID/Locator separation



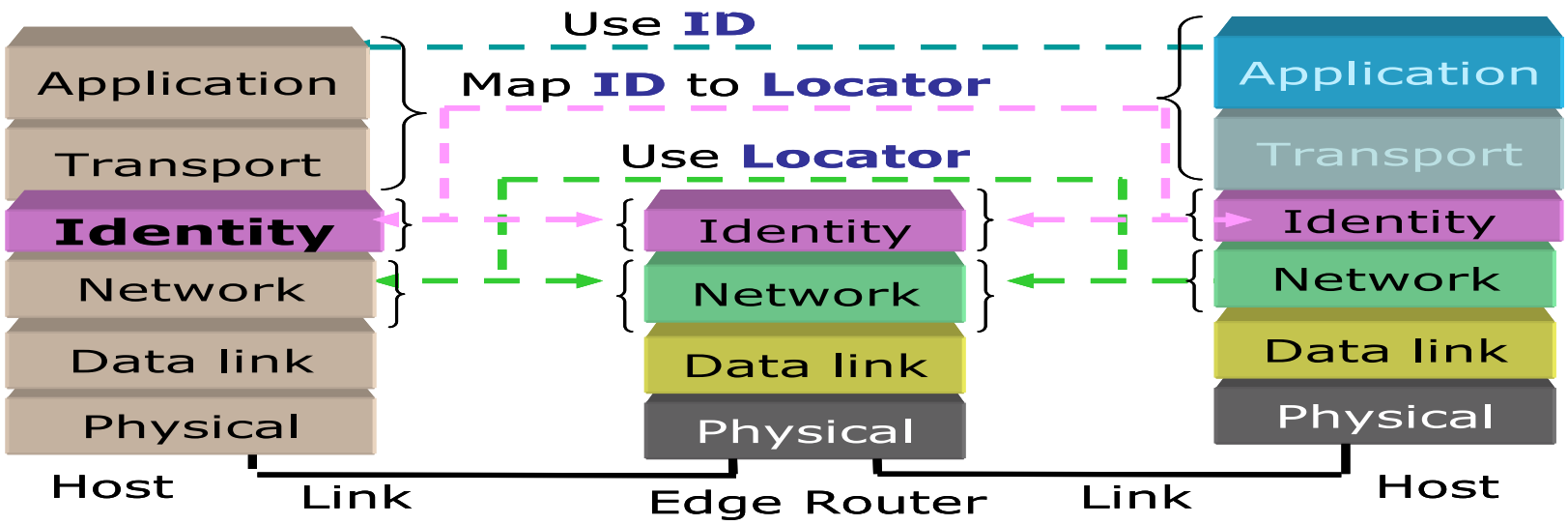


Must change IP address to select route and packet correctly.



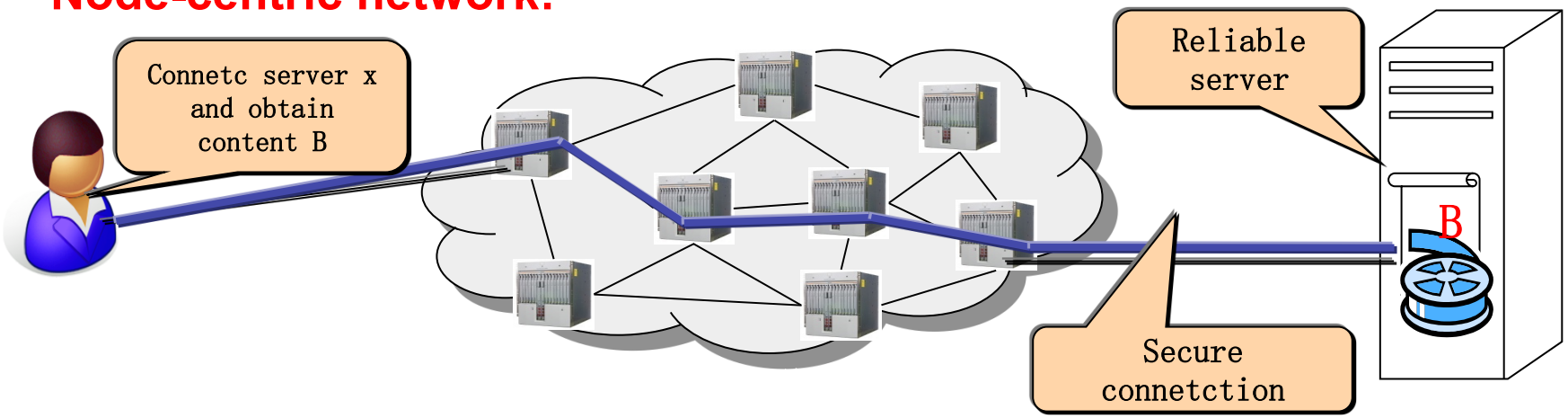
Must maintain IP address for service sustainability.

Separate ID with locator



From node-centric to content-centric

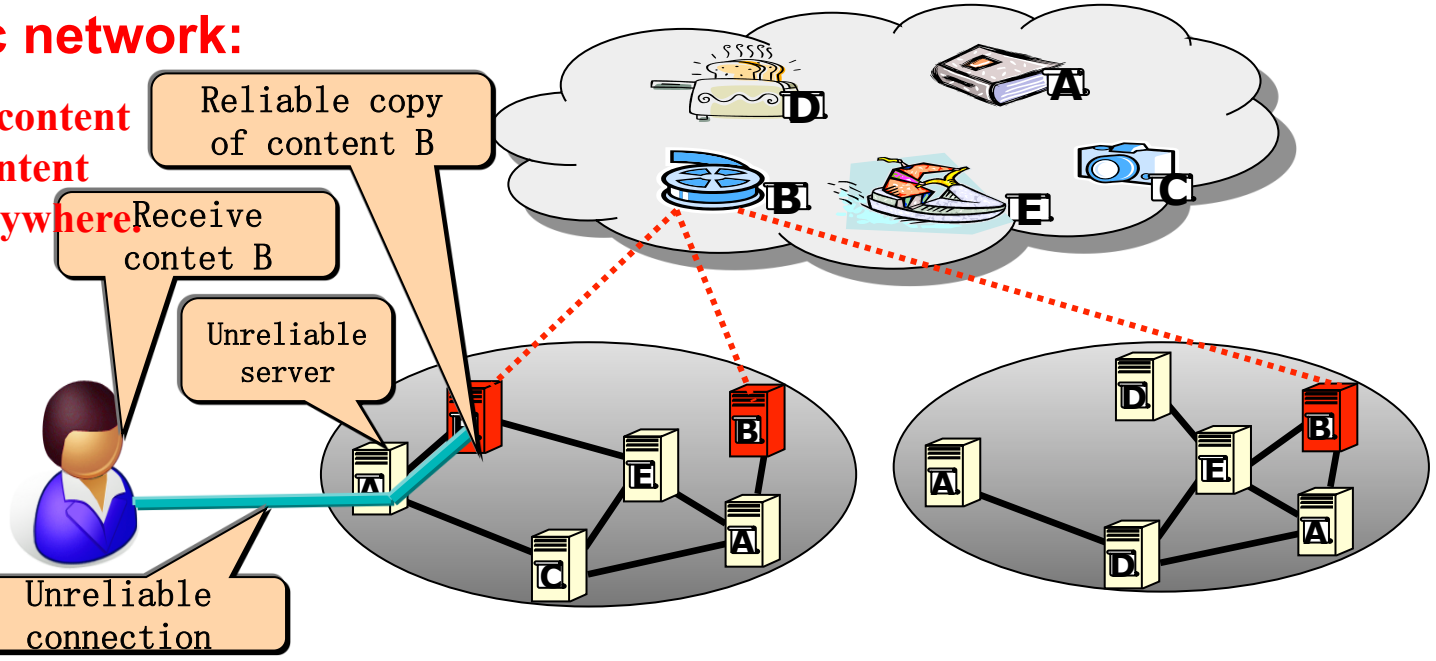
Node-centric network:



Content-centric network:

Selecting route base on content instead of IP adress. Content could be transmitted anywhere.

Content is focused instead of location

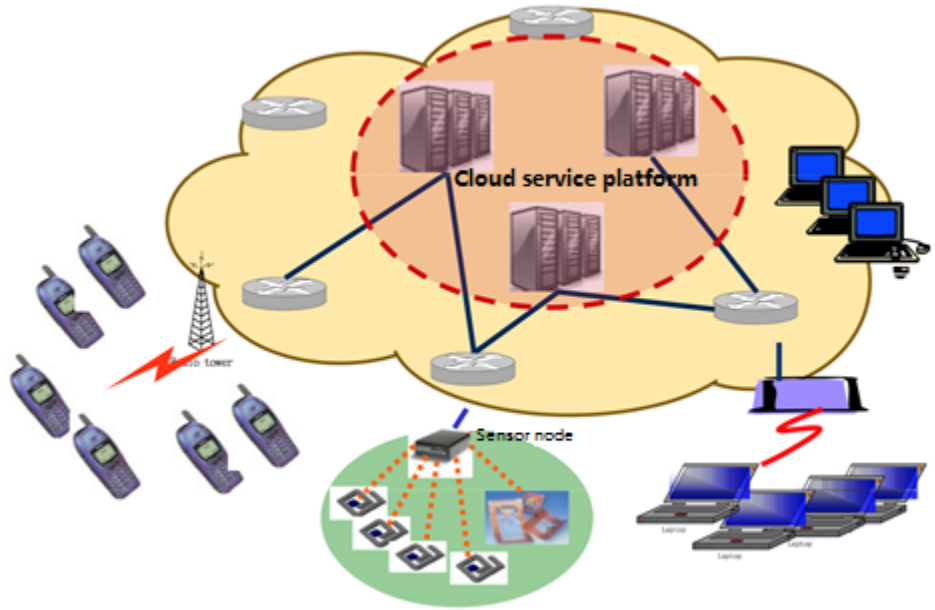


Related research in China

„ **Reseach on new network system and mechanism – SOFIA (Service-Oriented Future Internet Architecture): 2012-2016**

SOFIA Members:

CAS ICT, BUPT, Tsinghua University, China Unicom, CNIC , ISCAS, Hunan University, PLA University of Science and Technology, CUPT, Xidian University



Network is not only an infrastructure of transmission and switching, but also a service pool (transmission, switching, storage, computing)

CENI: China Environment for Network Innovations

- At phase 1 twelve cities (Nanjing, Bejing, Shanghai,Guangzhou,Tianjin, Chongqing, Haerbing, Wuhan, Xi'an, Chengdu, Hefei, Shenzhen ETC.) are setted with switching nodes, optical infrastructure, quantum communication equipment and fibre circuits to compose a national network.
- The principle of city-choosing is that research institutions, univercities and companies participating the experiment in the field must be included.

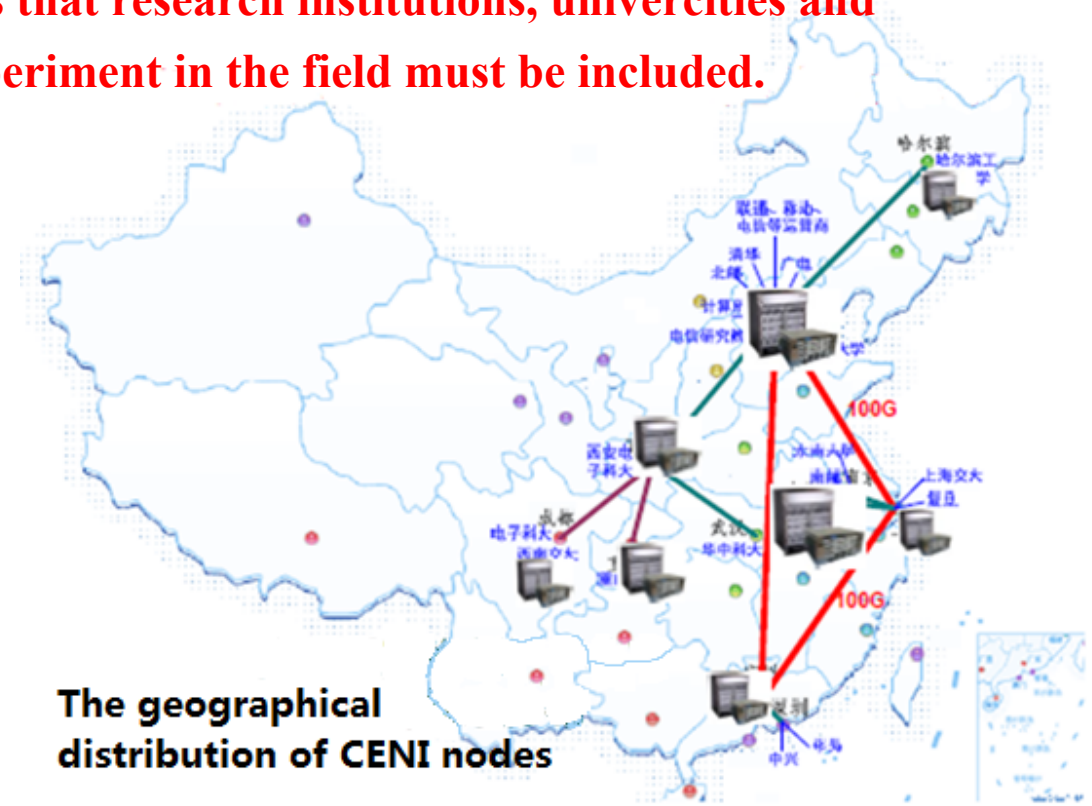
Plateform:

open source 、

virtulized、

programmable、

reconfigurable



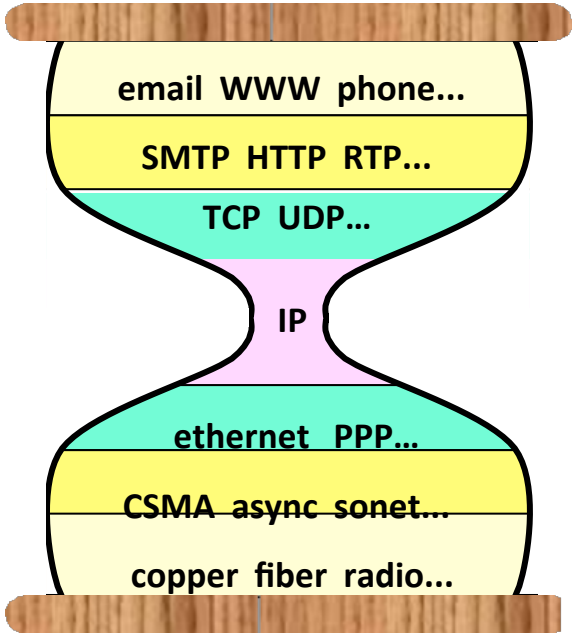
The geographical distribution of CENI nodes

CENI：Service-Oriented Future Internet Architecture

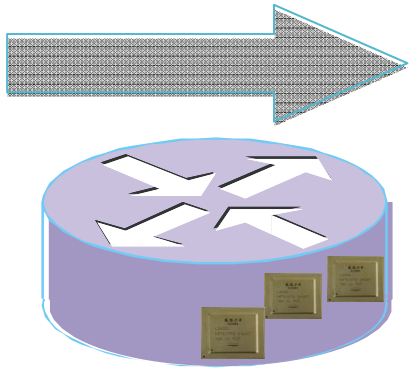
IP addresses connection

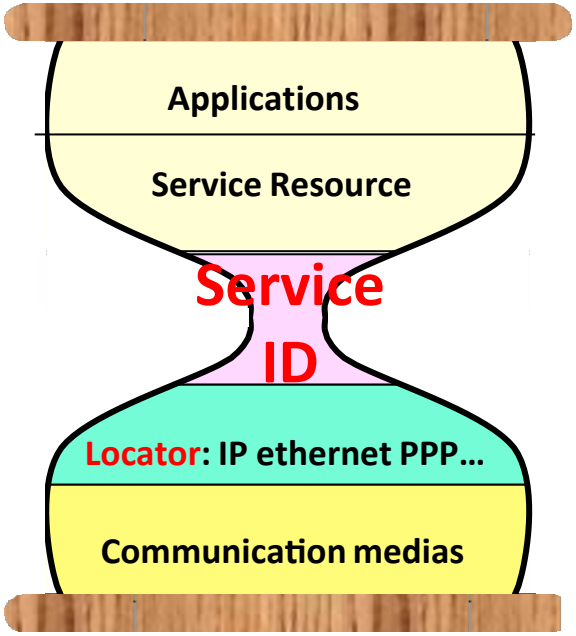
Evolution

User and server connection



TCP/IP protocol stack





SOFIA protocol stack

SOFIA——Service-Oriented Future Internet Architecture

Characteristic and innovation of CENI platform

1、**Virtualization**：providing computing/storage/communication resource virtualization in physical/link / network layers, meeting QoS and security level requirements, with the ability of parallel experiments

2、**Programmability**：providing programmable interfaces in all layers, meeting innovation requirements in both control plane and data plane, more convenient and flexible in rapid protocol promition, new protocol deployment, function expansion, service process customization.

3、**Congnization and measure**: provide network performance measure/self sensing/accurate positioning at the chip level besides software measure, meeting several customized meansure requirements and the uniform colllection, analysis and storage of data.

4、**Network management**：Resource management mechanism with combinization of centralized and distributed, intelligent scheduling of network resource, nearby delivery and configuration of content resource

5、**Integration and interworking:** supporting integration with optical network, spacial network and existing network, as well as interconnection and interworking test with GENI, FIRE, JGN+ and other test beds.

6、**Green energy-saving**：fully consider the network energy-saving technology form chip/equipment/network levels, to achieve higher performance using lower power consumption.

With the innovations above, CENI platform will reach the advanced level in the world. Moreover, the platform is excellent in measure, integration and interworking, resource management, green energy-saving aspects.

Thanks