The Future Internet Research Plan in Korea

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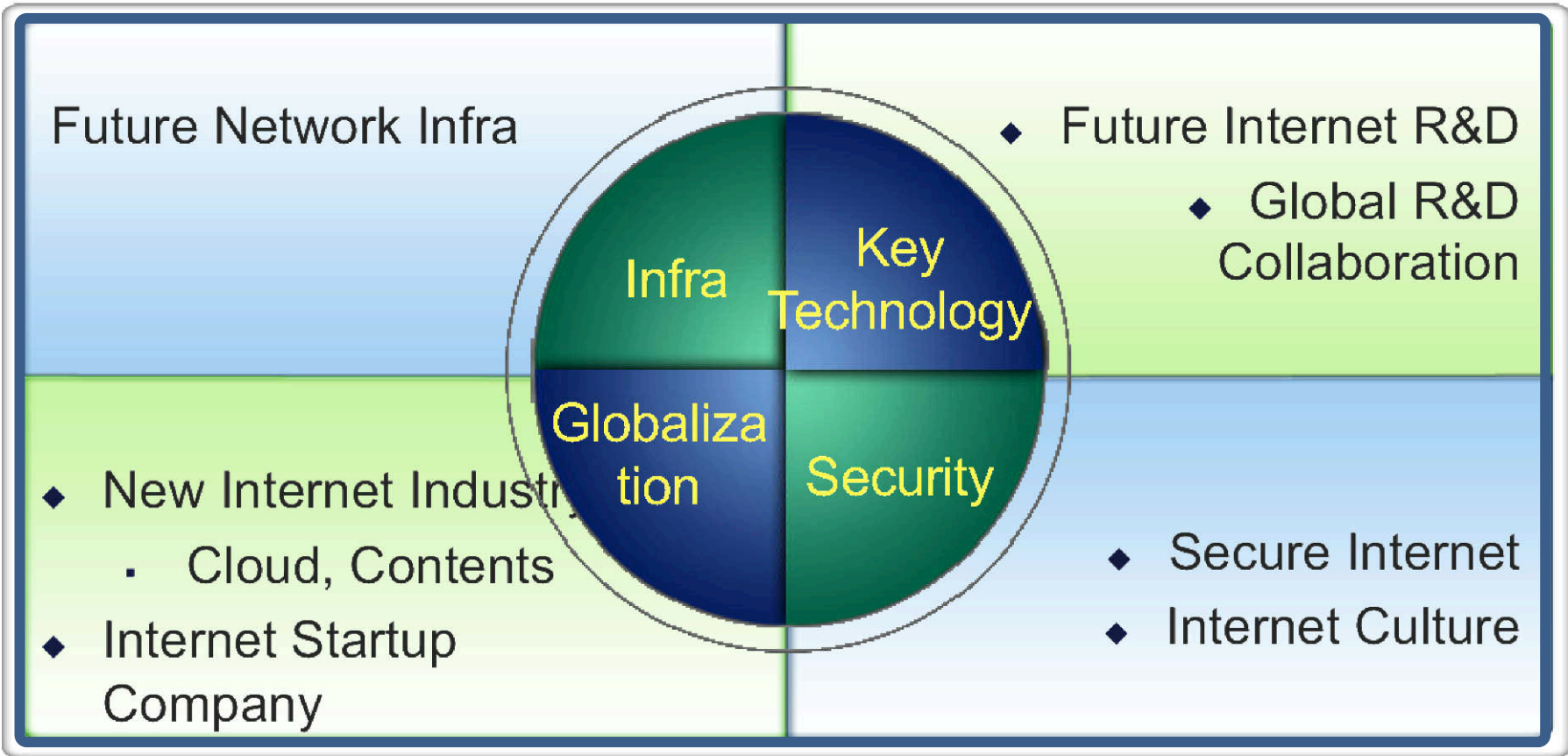
Contents

- Internet Plan for future in Korea

- Internet in Korea

- Smart Networks

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- Conclusions

Internet Plan for future in Korea

- Korea Communications Commission (KCC)
  - National Agenda: Long term big national initiative
    - Future Internet Promotion Committee : 2010.6 ~
- Internet Plan for future:
  - Report to President of Republic of Korea at 29th June 2011

Vision & Strategy

Total Investment

Government $500M, Private sector $37B for 5 years

Future Network Infra

Future Internet R&D
- Global R&D Collaboration

Infra

Key Technology

Globalization

Security

- New Internet Industry
  - Cloud, Contents
- Internet Startup Company

- Secure Internet
- Internet Culture

Future Network Infrastructure

100 times faster Internet until 2020
- Investment $7B/year from ISP -

Network Infra

- 4G Service
  - LTE : Seoul '11 ⇒ Nationwide '14
  - WiBro

- Gigabit Internet '12
  ⇒ 10Gbps '20

- Network Infra structure for Video
  and High volume contents
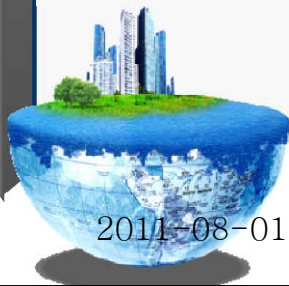 oriented Internet service: '20

Frequency band

- Available bandwidth :
  - Two times more

- Analog TV Channel
  (108MHz) , White space

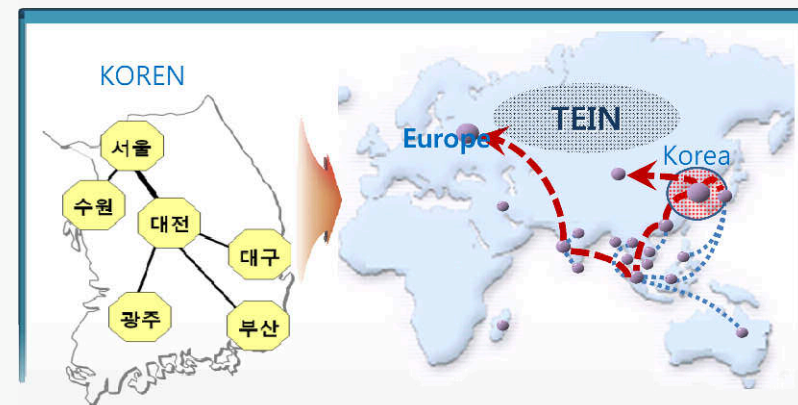# Future Internet R&D, Global Collaboration

Future Internet Technology

- Investment: $250M 2011 ~ 2015

- Mobility, Trustworthy, CCN…

- Green Internet

- Next Generation User Interface, Semantic web

Global Testbed

- KOREN
  - 10~20Gbps ➡ 100Gbps
  - Univ./RI ➡ open to industry and public

- TEIN center
  * TEIN : Trans Eurasia Information Network

Internet in Korea

- Number of Internet users: 34.4 M

- Penetration: 77.8%

 - Building & Apt. built since 1995

    - Broadband Certification System

Security Problems

- There has been quite frequent
  - DDoS Attacks from …
  - GPS Jamming from …
  - Hacking: bank, ISP (3 days ago)

- "Security" is the most critical problems in Korea.

Traffic Explosion

- Traffic of 2010 vs. Traffic of 2020
  - Wired line 18 times:
  - Wireless line: 1253 times
- In the year 2020: 90% of traffic will be Video
- Average Growth rate of Internet traffic: 34% exponentially
  - 2014: total traffic will reach to 47.2EB* per month
  - 2020: 273.1EB per month

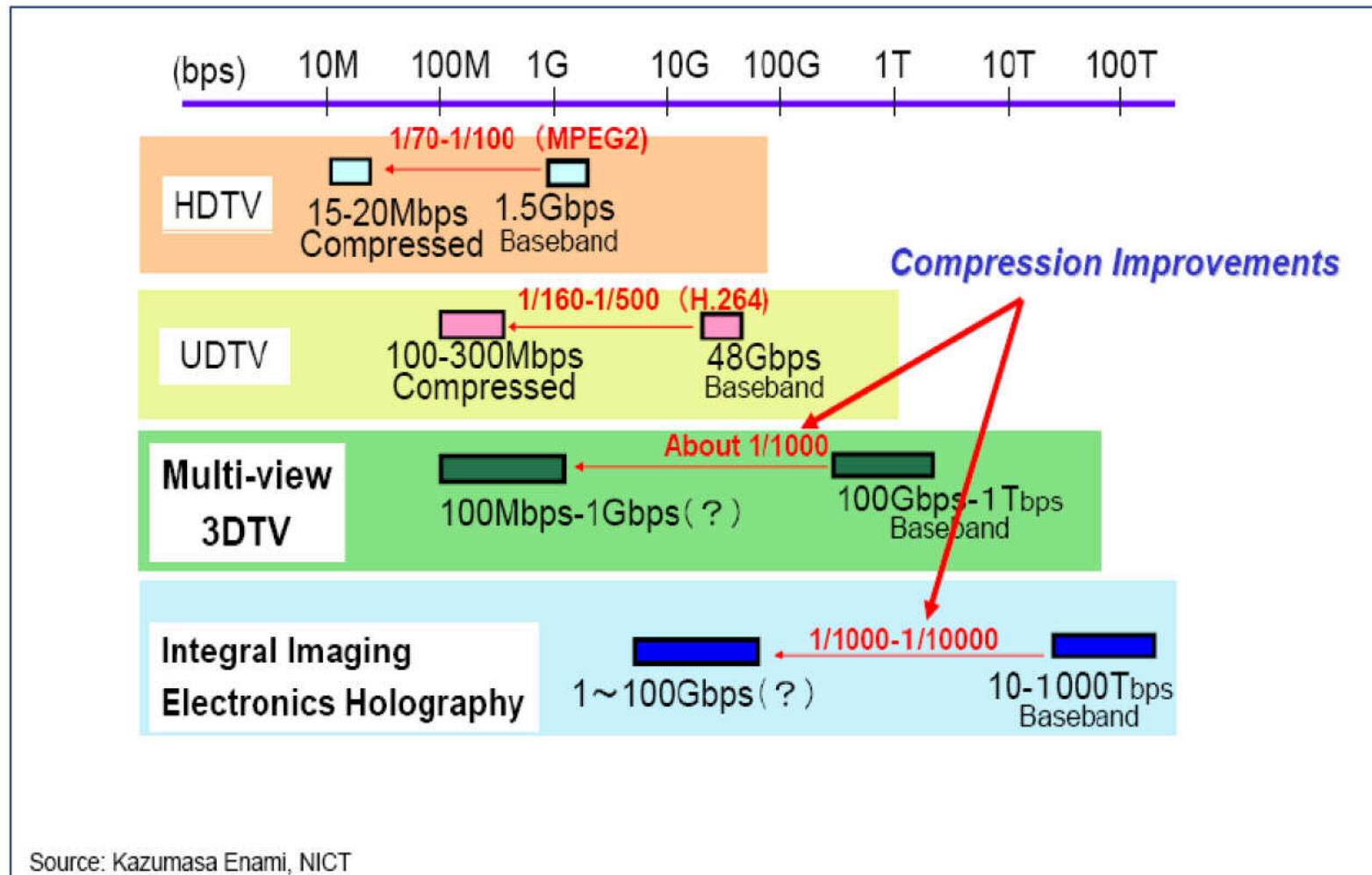 * EB (Exa Byte) = 10^{18} Byte
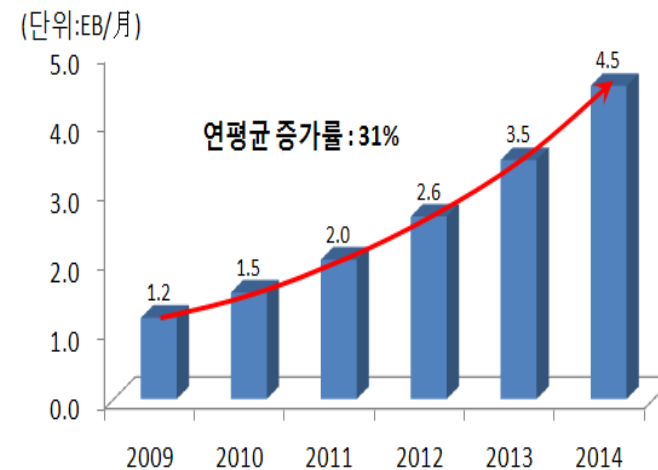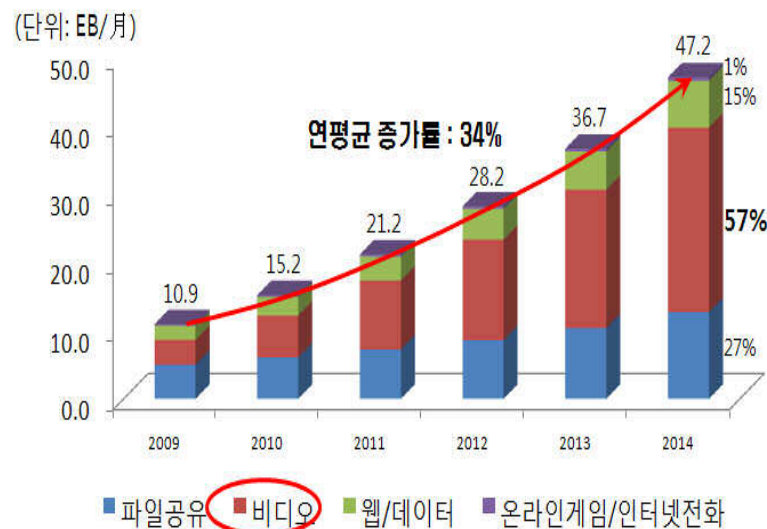
Internet annual growth rate of Korea(Source: ISP's of Korea)

Wired/Wireless Gigabit Internet

- Why Gigabit?
  - High Resolution or 3D Video traffic: ~ 40% growth rate per year
  - Smart TV, Smart Phone, IPTV, Wireless Internet, Wi-Fi, P2P, Data centers, cloud servers
  - Paradigm shift
    - PAST: Mainframe, Dumb terminal, Voice communications
    - Present: Distributed Computing, Intelligent devices, Multimedia com.
    - Future: Centralized Cloud, Thin client, Realistic Communications

- Gigabit Internet
  - Gigabit Internet Commercialization : 2012
  - 10G Gigabit Internet Trial: 2016
  - Take advantage of Broadband Access Environment of Korea

Required Bandwidth for future video services

Source: Kazumasa Enami, NICT

Traffic Explosion

- Traffic explosion => Revenue explosion?
  - Nope! Revenue stays or even decrease!

- Internet traffic growth at about 50% per year
- Cost reduction of router per Mbit/s 15 % per year
- Revenue per Mbit/s falls steeper (22 % per year)
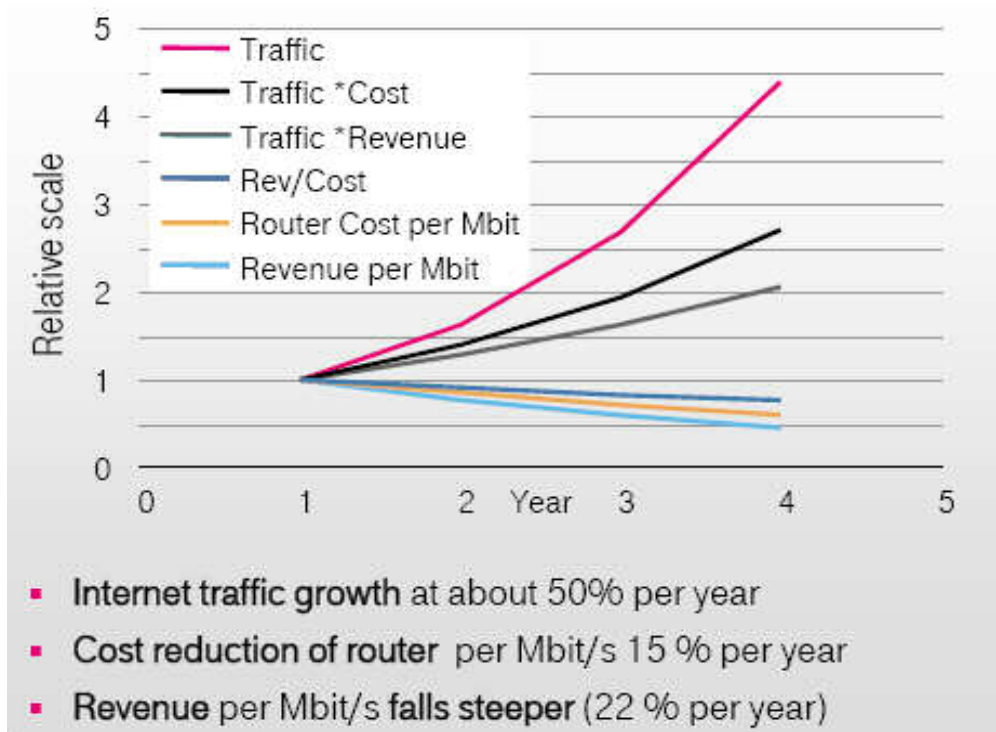
Source: Deutsche Telekom

2006

Backbone traffic   Revenue
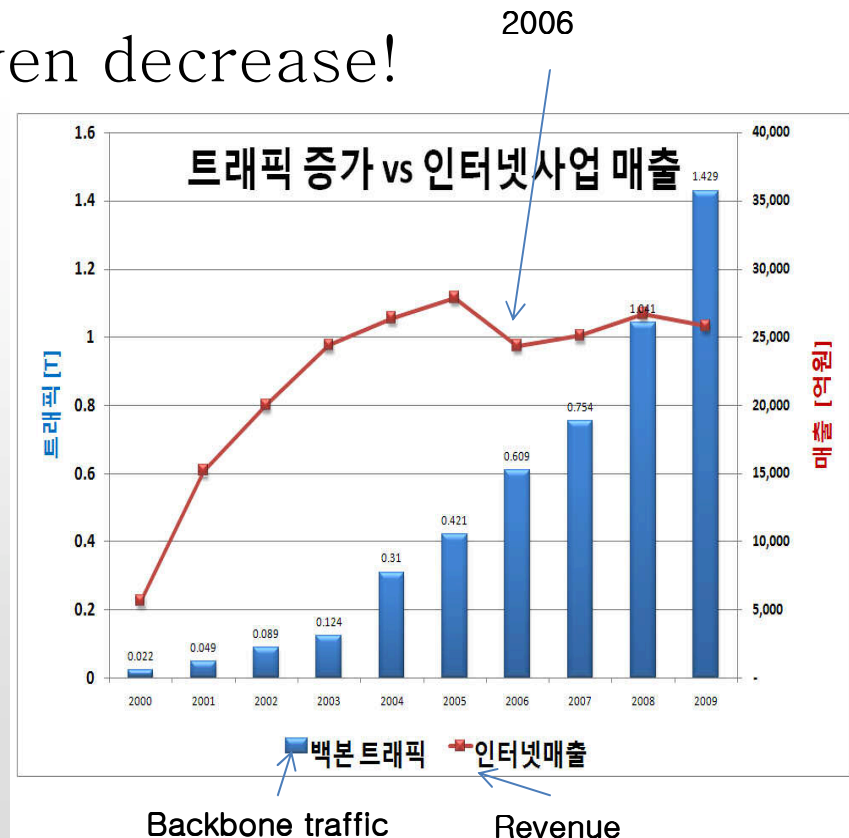
Source: KORNET Korea

Future of the Internet

- From dumb pipe to Smart pipe for smart services
- Service + Future Network: Smart Energy, Smart Transport, Smart Health, Smart Living, Smart education: Through Cloud Services: Data protection is Key issue
- From protected garden to open space
  - IPTV: protected garden under NGN => smart TV => Smart mobile device + Dumb TV
- Sharing: App, Content, Knowledge…..: prosumer
  - Open platform for win-win eco-system. + IPR for player

Services
Services
Services

The Internet

Dumb pipe

Services
Services
Services

IP convergence

NGN

Service
Ser
Services

Future Network
Future Network

Smart pipe
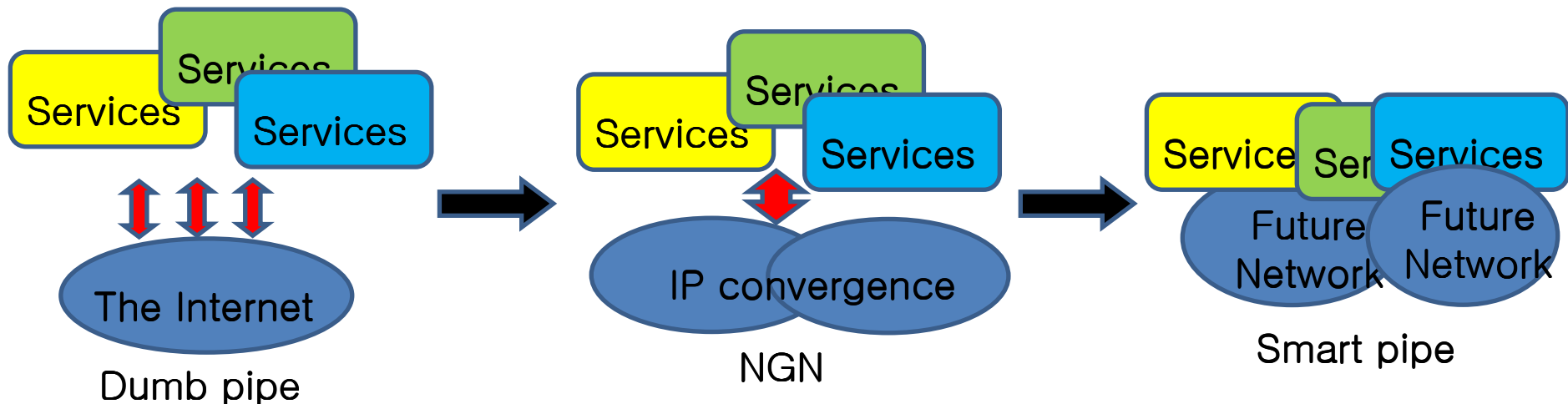
Can a Network be fit for all services?

Evolutionary or Clean Slate?

- **Plant the seeds that enable future research experiments***
  - Testbed
  - Insights from clean slate research help guide the ongoing evolution

- **Internet as evolving ecosystem***
  - Internet monitors, estimation of traffic flow,

- **Better network**
  - Additional value > Transition cost
  - Market will decide.

- **Additional value > Transition cost ? =>**
- **Need intelligent & composable open architecture**
  - Smart network, Smart node: "fit for purposes"

* Jennifer Rexford, Constatine Dovrolis "Future Internet Architecture: Clean-Slate Versus Evolutionary Research" Communications of the ACM Sep. 2010

Smart Network

- Which services will open the customer wallet?
  - ◆ Fair competition between ..
    - ✧ Ecosystem player: TGIF
    - ✧ Media, e-commerce..: Skype, Amazon, e-bay
    - ✧ End node devices: Apple, Nokia, Samsung
    - ✧ Operator, equipment: ISP

- ◆ An approach for operator: Dumb pipe => Smart pipe
  - ➢ Smart Network: (Content) + Service + Network Integration
  - ➢ Revenue creation => Investment to Infra => Cheaper Internet price
  - ➢ How can we make it competitive?
    - ❖ Smart network node contains processing/storage/specialized forwarding/secure channel/signal processing/ functions for highly efficient applications:
    - ❖ Smart work, Cloud networking etc.,,
- • Open platform for all => innovative/creative Internet services

Smart Network

Web 3.0
Ecosystem

Semantic Web | **Application platform** | Linked open Data

Smart Network app. platform

Legacy Internet service, IMS

Smart Network services

Future Internet

: Smart node

: PTN

Cloud Server

Smart Network

Backbone

Network Virtualization

WDM-PON, OFDM

4G/5G

wireless

Super WiFi

wired

Enterprise Network

FTTH ~10Gbps

Future Internet R&D

Real time

Spontaneous Services
Virtual-real space Interaction

IoT

Smart Work

Smart TV

Cloud Federation

Future Internet Architecture

Content Centric

Cloud

Mobility

Trustworthy

SMART NETWORK

Giga Internet

BcN

Non-IP

IP

Project: Future Internet Architecture

Overview

◆ Coordination among Future Internet Related Projects

◆ Develop an Integrated Polymorphic Network Architecture

◆ Design Trustworthy Communication Infrastructure

◆ Collaborate with Foreign Future Internet Research Groups
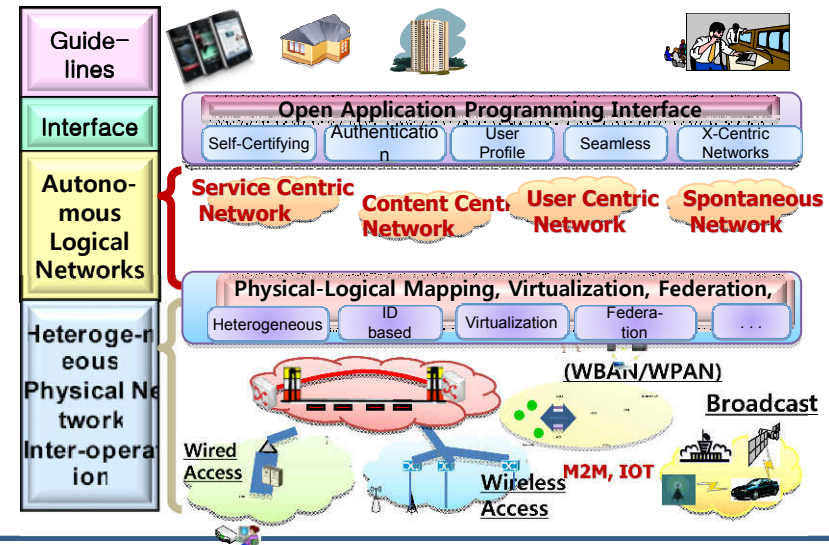
- **Project title :** Development of Future Internet common conceptual architecture and inter-operation techniques for trustworthy communication

- **Project coordinator :** Dr. Woojik Chun, ETRI (wjchun@etri.re.kr)

- **Duration :** Mar. 2011 – Feb. 2014 (3 year)

Project: Future Internet Architecture - mobility

Overview

- **Design new architectures to address envisioned future mobile and network diversity environment**
  - **Developing MOFI and INAF**
    - **MOFI (Mobile Oriented Future Internet)**
  - **Designed for mobile environment & network diversity**
  - **Refer http://www.mofi.re.kr**
    - **INAF (InterNetworking Architecture for Future networks)**
  - **Designed for service interworking b/w legacy Internet and FIs**

- **Project title : Study on Architecture of Future Internet to Support Mobile Environments and Network Diversity**

- **Project coordinator : Heeyoung JUNG, ETRI(hyjung@etri.re.kr)**

- **Duration : 1 Mar. 2010~28 Feb. 2013 (3 years)**

Project: Future Internet Architecture - NDN

Overview

1) NDN Architecture Design
   - Content Routing (Name Resolution), Content Caching Strategy
2) NDN over Wireless Networks
   - Mobility support, Collaborative transmission, Service delegation
   - Develop NDN base station
3) Testbed & application service

NDN Service Framework
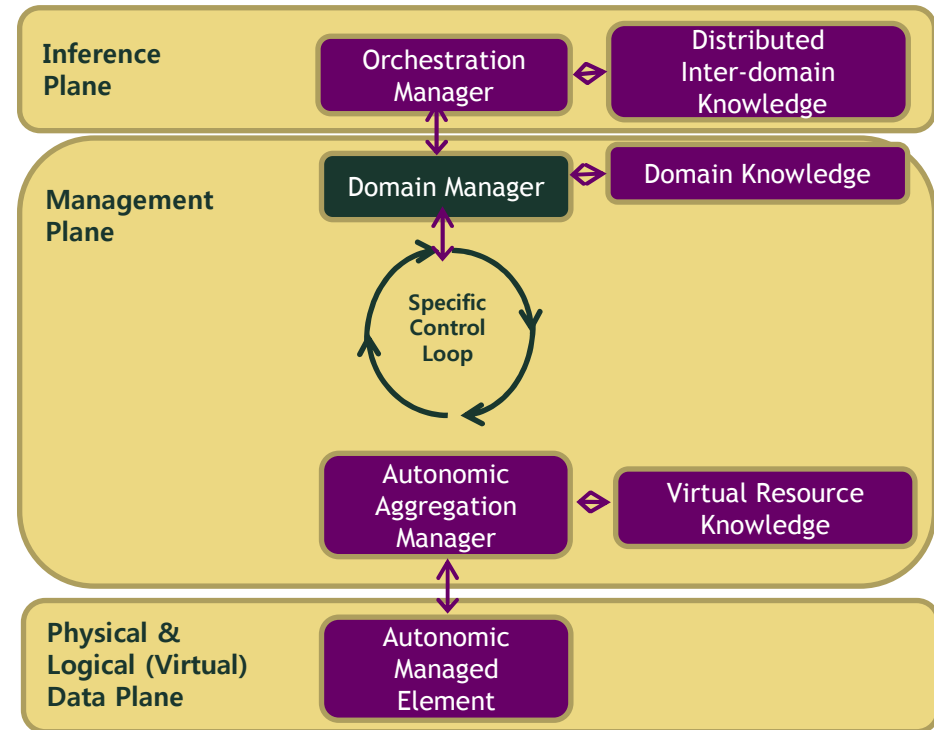
CCN Routing

NDN over Wireless Networks
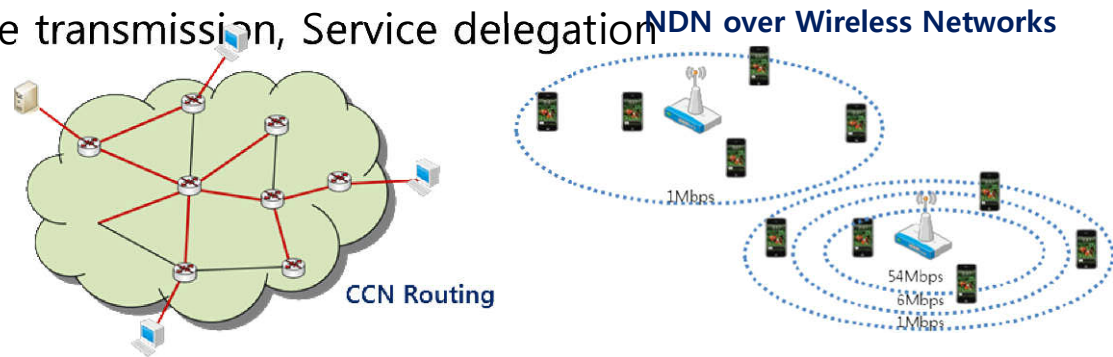
Project title : Fundamental Research on In-network Caching and Routing for Named-data Networking

Project coordinator : Seoul National University

Duration : 2011.3.1-2014.2.28 (36 months)

Project: Future Internet Architecture - management

Overview

To define <u>a holistic autonomic management architecture</u> that encompasses both the Evolutionary Approaches and the Revolutionary approaches to overcome the legacy management limitations

- A novel knowledge representation mechanism, based on models and ontologies,
- A distributed architecture that separates the functions of the data, control, and management planes
- An extensible architecture that dynamically adapts the behavior of managed devices
- A set of protocols for distributing, querying, retrieving, and managing semantic data

Inference Plane
Orchestration Manager ⬌ Distributed Inter-domain Knowledge

Management Plane
Domain Manager ⬌ Domain Knowledge
Specific Control Loop
Autonomic Aggregation Manager ⬌ Virtual Resource Knowledge

Physical & Logical (Virtual) Data Plane
Autonomic Managed Element

- **Project title : Highly Manageable Network and Service Architecture for New Generation**
- **Project coordinator : Taesang Choi (ETRI, Future Internet Architecture Research Team)**
- **Duration : 2010.3.1 ~ 2013.2.28**

Project: Future Internet Architecture – Testbed

○ **Overview**

- **Objectives**

  - **Network Virtualization R&D**
  - **Network Programmability R&D**
  - **Development of Programmable Network Virtualization Platform**
  - **PC based Platform Development for Dynamic Service Control**

- **Project Results**

  - **Functional Development of NP based Network Virtualization for Data Plane**
  - **Programmable Network Virtualization Platform 1.0**
  - **Platform Establishment in KOREN's FI-testbed**

○ **Project title :** **Development of the Core Technology and Virtualized Programmable Platform for Future Internet**

○ **Project coordinator :** **Yang, Sun Hee (shyang@etri.re.kr)**

○ **Duration :** **Mar. 1, '09 ~ Feb. 28, '14 (5 years)**

Project: Future Internet Architecture - Testbed

Overview

- **Objectives**
    - R&D for Virtualized Network Control Framework
    - R&D for Federation of Various Physical Networks(GENI, AKARI, FP7/FIRE etc.)
    - R&D for OpenFlow Switching @ FiRST Platform
    - KOREN/KREONET Evolution to Virtualized FI Testbed

- **Project Results**
    - FiRSTProNET 1.0 : Virtualized Network Control Solution
    - CF(Control Framework) Federation Adaptor : S/W adaptor prototype

Project title : Future Internet Testbed Construction for International Federation and Collaboration

Project coordinator : Yang, Sunhee (shyang@etri.re.kr)

Duration : March 1, 2010 ~ February 28, 2014 (4 years)

Project: Future Internet Architecture - DTN

Overview

Using DTN technology, seeking solutions for the problems
• Base stations are overloaded by data exploration of smartphone usage (we call the solution as DTN-Cellular)
•The communication is inefficiency between sensor network and Internet (DTN-Sensor)
-Keywords : Mobility Patterns, Access Patterns, Energy Efficiency AP/Sensor/Mobile Scanning, Data Offloading, Incentive Routing, Pricing Mechanism.

- Project title : Delay-Tolerant Network (DTN) technology for wireless cellular and sensor networks

- Project coordinator : Yung Yi (KAIST) with Song Chong (KAIST), Kyungsoo Park (KAIST), Seungjae Han (Yonsei Univ.)

- Duration : 2011.3.1 ~ 2014.2.28 (3 Years)

Project: Future Internet Architecture – IoT Service

⊙ Overview

To provide <u>Future Internet Service Platform</u> providing user-centric services, which are closely related to users's daily life and work in <u>Smart Internet of Things(IoT) Environments</u>
Limitations of existing approaches:
▪Location, temporal information-based context-awareness
▪Context Inference from small-scale semantics collected from limited number of sensors
▪Pre-defined service composition
▪Simplex information and service provision without concerning physical world
Key ideas:
▪To efficiently collect and manage large-scale semantic sensor data from various IoT sensors
▪To provide context-awareness based on complex of social, spatial, and temporal perspectives
▪To proactively support user's various goals by composing cyber and physical services
▪To provide an interaction of cyber-physical services referring physical constraints of IoT actuators

⊙ **Project title : Smart IoT-based Spontaneous Service Composition**

⊙ **Project coordinator : Lee, Dongman (KAIST, dlee@cs.kaist.ac.kr)**

⊙ **Duration : March 1, 2011 ~ February 28, 2014 (3 years)**

Project: Smart Work

◯ Overview

1) Tele-presence Service Platform
   - Collaboration architecture, Control method, Prototype System
2) Adaptive & Immersive User Interface
   - Dynamic UI, Audio mixing & echo-free
3) Security
   - Secure execution environment for mobile devi

- ◯ **Project title :** **Development of Immersive Smart Work Tech. for Collaboration**

- ◯ **Project coordinator : ETRI**

- ◯ **Duration :   2011.3.1-2015.2.28 (48 months)**

Project: Smart Network

Overview

1) Design architecture of smart node

2) Cloud Networking
   - high reliability cloud networking
   - smart node virtualization

3) Overlay-based content delivery smart networking control
   - contents delivery and routing
   - contents copy/cashing and search engine
   - content-based traffic control

- **Project title : R&D on Smart Node Technology for Cloud Networking and Contents Centric Networking**

- **Project coordinator : Hoyoung Song ETRI(hsong@etri.re.kr)**

- **Duration : 2011.3.1 ~ 2014.2.28 (3 Years)**

Project: on-going projects on the Internet

	Project Title	Duration	Coordinator
1	Development of the core technology and virtualized programmable platform for Future Internet	''09.3 ~ '14.2	ETRI
2	Future Internet Test-bed Construction for International Federation and Collaboration	'10.3 ~ '14.2	ETRI
3	Study on Architecture of Future Internet to Support Mobile Environments and Network Diversity	'10.3 ~ '13.2	ETRI
4	High Speed Virtual Router that Supports Dynamic Circuit Network	'10.3 ~ '15.2	Yonsei Univ.
5	Development of Future Internet common conceptual architecture and inter-operation techniques for trustworthy communication	'11.3 ~ '14.2	ETRI
6	R&D on Smart Node Technology for Cloud Networking and Contents Centric Networking	'11.3 ~ '14.2	ETRI
7	Low-Noise and Multi-Wavelength optical sources for high speed optical networks	'09.3 ~ '14.2	KAIST
8	Large-scale wireless-PON convergence technology utilizing network coding	'09.5 ~ '14.2	KAIST
9	Coherent optical OFDM technologies for next generation optical transport networks	'08.11 ~ '13.10	ETRI
10	High-capacity WDM-PON system for next-generation multi-service applicable access platform	'10.3 ~ '14.2	ETRI
11	CASFI (Collect, Analyze, and Share for Future Internet): High-Precision Measurement and Analysis Research	'08.3 ~ '13.2	KAIST

Project: on-going projects on the Internet

	Project Title	Duration	Coordinator
12	Development of Real-time Traffic's Integrated Control Platform for Clean Internet and Fair Interconnection Environment	'09.3 ~ '13.2	ETRI
13	Research on Ubiquitous Mobility Management Methods for Higher Service Availability	'08.3 ~ '13.2	Korea Univ.
14	Delay-Tolerant Network (DTN) Technology for Wireless Cellular and Sensor Networks	'11.3 ~ '14.2	KAIST
15	Fundamental Research on In-network Caching and Routing for Named-data Networking	'11.3 ~ '14.2	Seoul Univ.
16	Development of group service and service continuity control technology in the broadcast and telecommunication converged Environment	'09.3 ~ '12.2	ETRI
17	Development of Customer Oriented Convergent Service Common Platform Technology based on Network	'09.3 ~ '14.2	ETRI
18	Research and development of composite context based adaptive service path configuration technology	'10.3 ~ '13.2	ETRI
19	Smart IoT-based Spontaneous Service Composition	'11.3 ~ '14.2	KAIST
20	Study on Acoustic Convergence Codec and its Control Technology for FMC	'08.3 ~ '12.2	ETRI
21	R&D on Multi-layer Optical Network Control Platform Technology	'08.3 ~ '12.2	ETRI
22	Novel Study on Highly Manageable Network and Service Architecture for New Generation	'10.3 ~ '13.2	ETRI
23	**Development of Immersive SmartWork Tech. for Collaboration**	'11.3 ~ '15.2	ETRI

Global Collaboration

- Europe, CJK, USA

- Korea – EU collaboration
  - Korea Government – EU meeting at July 7 to 8, 2011 in Seoul
  - Consortium for Call 8?
    - 5 areas including FIRE, FI services
  - EU ISTAG meeting in Brussels
    - ISTAG: The Information Society Technologies Advisory Group
  - G-Lab, France, Spain

- Subjects?
  - Various Future Internet Architecture
  - Smart Networks
  - Experiment Environments
  - Future Internet Services

Conclusion

- Internet Traffic explosion
  - Video, mobile
  - Revenue Creation

- Future of the Internet Services
  - Cloud computing
  - Smart Pipe

- Global Collaboration