



# Future Internet Standardization

**August 26, 2008**

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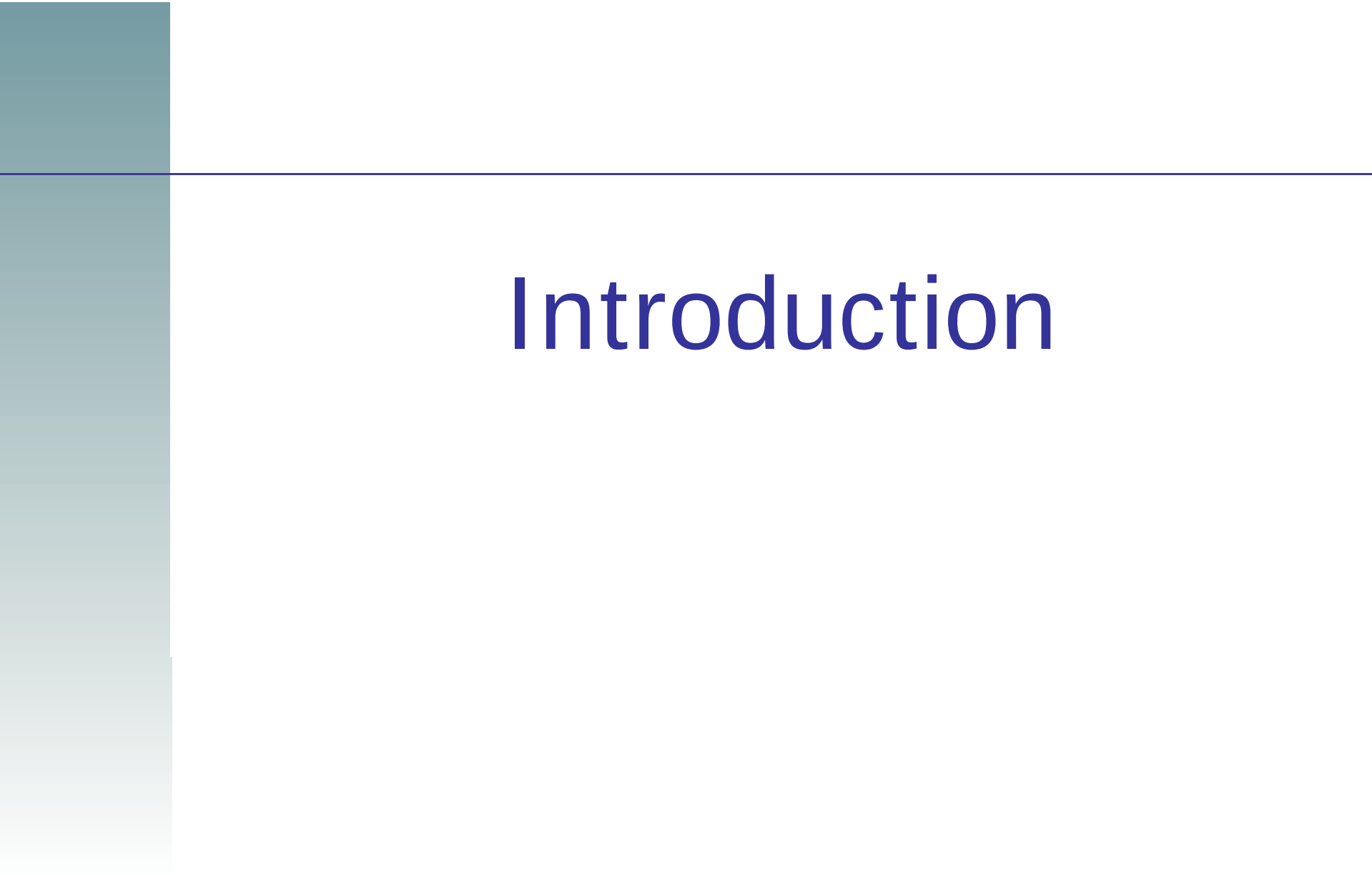
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Future Internet Summer Camp 2008/ Asia Future Internet Summer School

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# Introduction

# Introduction

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- Demands for Future Internet Standardization is emerging
- New study items on Future Internet are proposed in the international standardization bodies such as:
  - ITU-T SG13
  - ISO/IEC JTC1/SC6 WG7
  - IETF and IRTF
  - IEEE
  - etc.

# Introduction

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- How to standardize Future Internet without knowing what it is ?

# Introduction

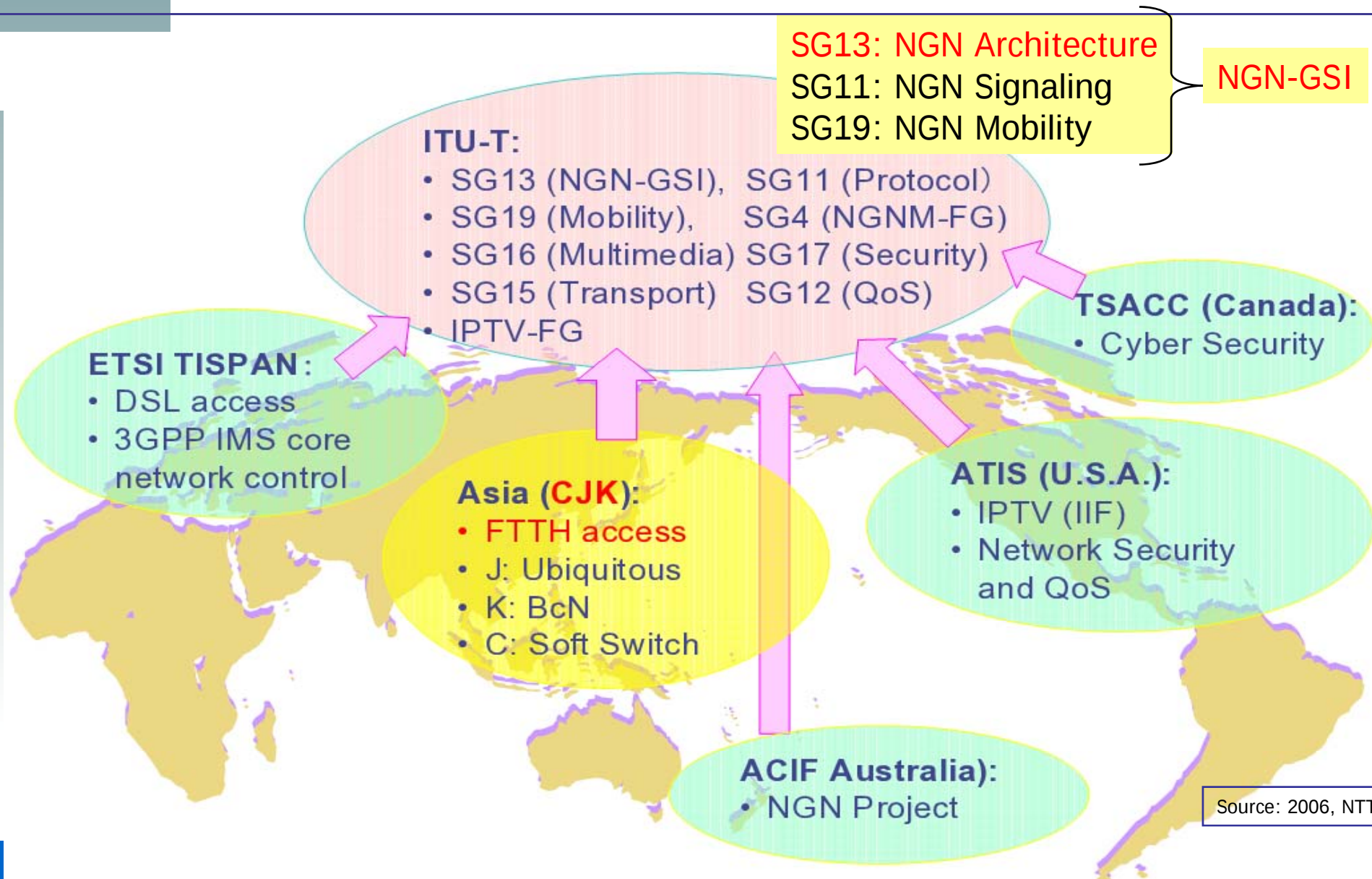
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- Proposed study items on Future Internet
  - Problem Statement
  - Goals and General Requirements
  - Gap Analysis
  - etc.
- Liaison between International Standardization Bodies

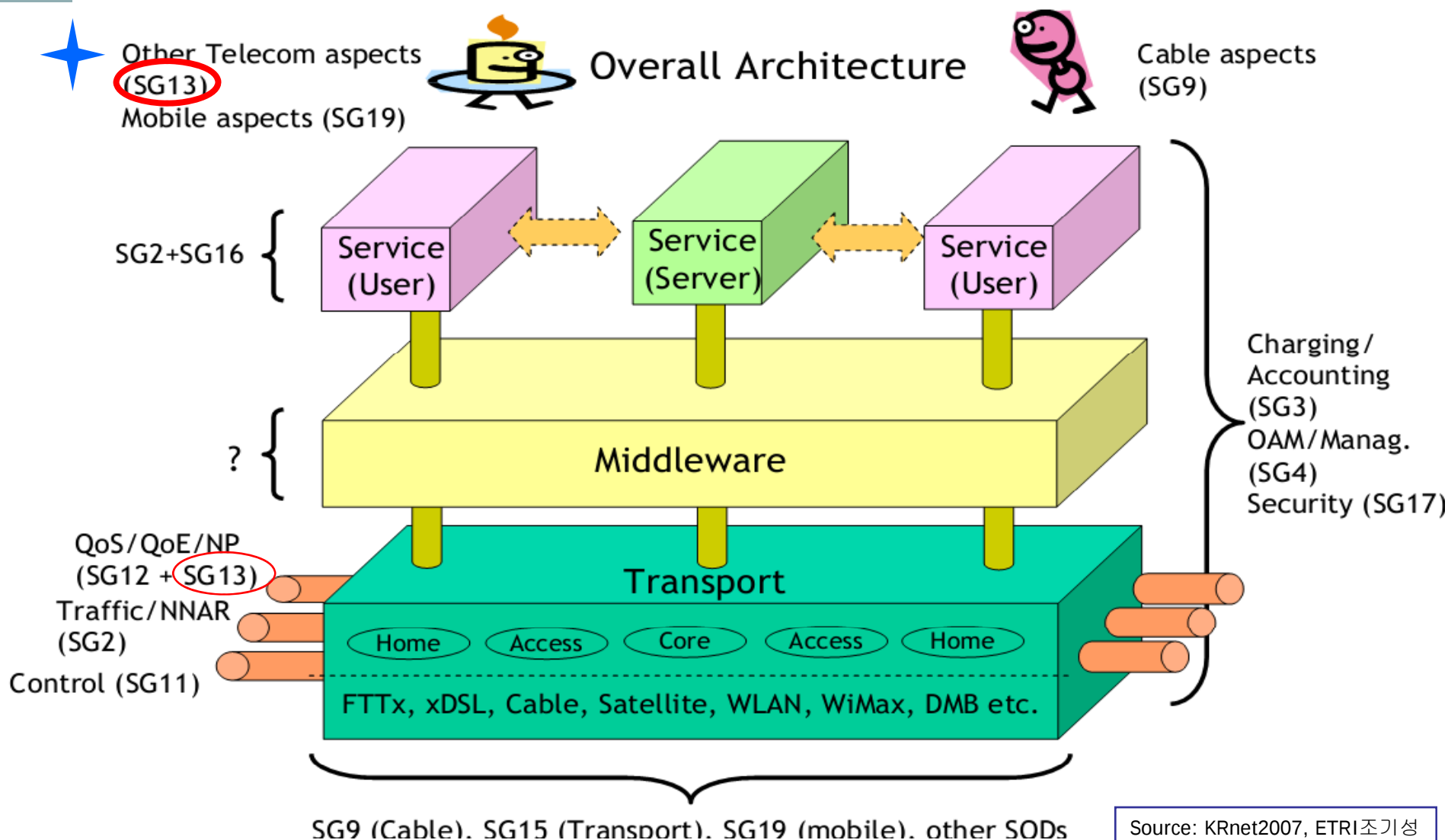
# Future Network in ITU-T SG13

- Overview of ITU-T SG13
- New Proposals on Future Network
  - Motivation/ Questions/ Design Goals/ Gap Analysis
- Perspectives in ITU-T SG13

# NGN-related Standardization



# ITU-T NGN-related Standardization

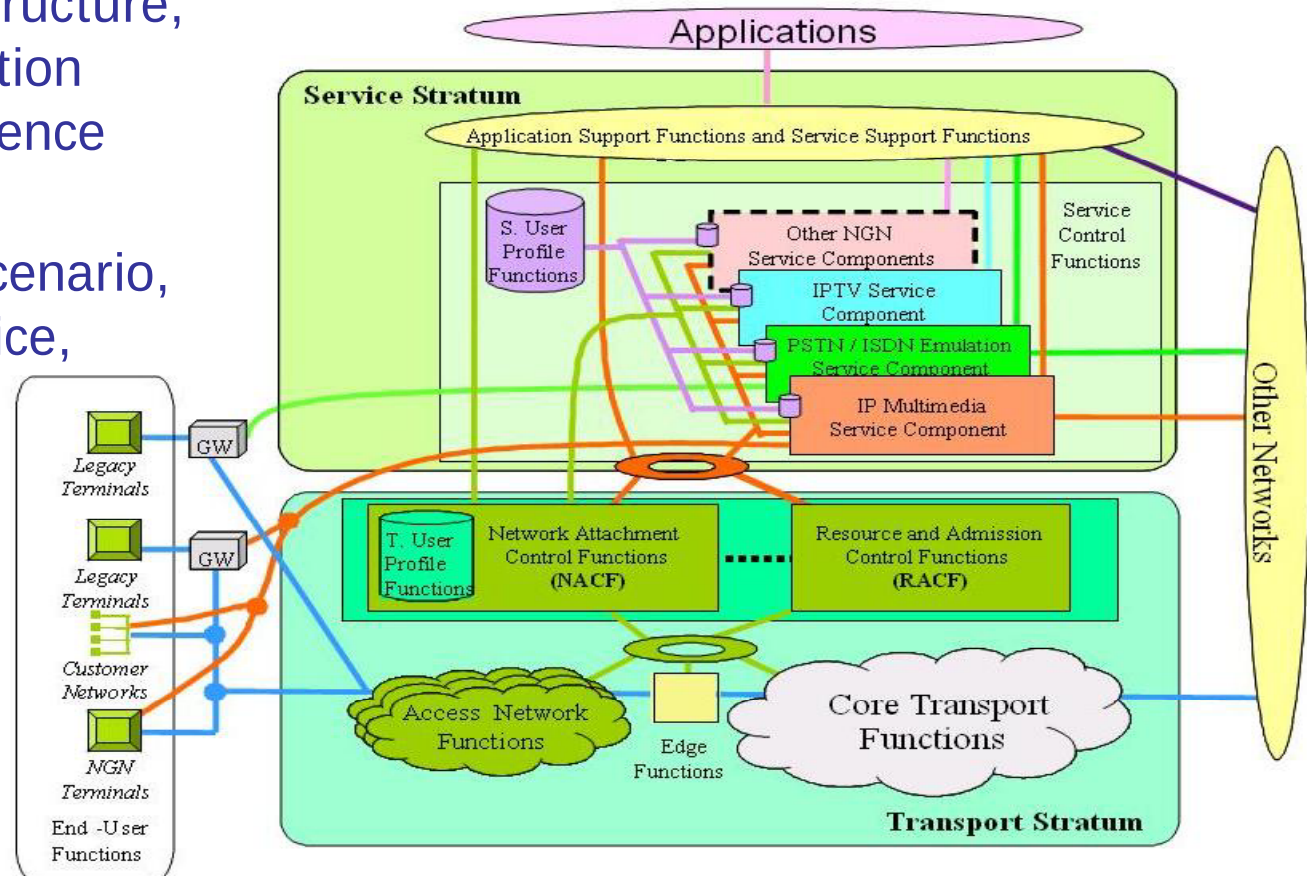


# ITU-T SG13 Architecture

- SG13 Scope (NGN)

- NGN Functional Structure, Framework, Evolution Strategy, Convergence
- NGN release plan, Implementation scenario, Network and Service, Interoperability, IPv6, Mobility, Network Convergence and Public data network, and NGN-related study coordination

Lead Study Group of NGN



\* Note: Gateway (GW) may exist in either Transport Stratum or End User Functions.

# ITU-T SG13 Questions

| Questions                                             | Title                                                                              |
|-------------------------------------------------------|------------------------------------------------------------------------------------|
| <b>WP 1/13 - Project management and coordination</b>  |                                                                                    |
| <a href="#">1/13</a>                                  | Project coordination and release planning for NGN                                  |
| <a href="#">11/13</a>                                 | General network terminology                                                        |
| <a href="#">13/13</a>                                 | Public data networks                                                               |
| <b>WP 2/13 - Functional architecture and mobility</b> |                                                                                    |
| <a href="#">3/13</a>                                  | Principles and functional architecture for NGN                                     |
| <a href="#">6/13</a>                                  | NGN mobility and fixed-mobile convergence                                          |
| <a href="#">9/13</a>                                  | Impact of IPV6 to an NGN                                                           |
| <a href="#">10/13</a>                                 | Interoperability of satellite with terrestrial and Next Generation Networks (NGNs) |
| <a href="#">15/13</a>                                 | NGN security                                                                       |
| <b>WP 3/13 - Service requirements and scenarios</b>   |                                                                                    |
| <a href="#">2/13</a>                                  | Requirements and implementation scenarios for emerging services in NGN             |
| <a href="#">7/13</a>                                  | Network and service interworking in NGN environment                                |
| <a href="#">8/13</a>                                  | Service scenarios and deployment models of NGN                                     |
| <a href="#">12/13</a>                                 | Frame Relay                                                                        |
| <a href="#">14/13</a>                                 | Protocols and service mechanisms for Multi-service Data Networks (MSDN)            |
| <a href="#">16/13</a> (new)                           | Requirements and framework for enabling COTS components in an open environment     |
| <b>WP 4/13 - QoS and OAM</b>                          |                                                                                    |
| <a href="#">4/13</a>                                  | Requirements and framework for QoS for NGN                                         |
| <a href="#">5/13</a>                                  | OAM and network management for NGN                                                 |

# Proposals for Future Network in SG 13

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- Motivation
- Questions
- Design Goals
- Gap Analysis

# I. Motivation (1/3)

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- The Future Network (FN), which is anticipated to provide futuristic functionalities beyond the limitation of the current network including Internet, is getting a global attention in the field of communication network and services.
- We see growing concerns about the following aspects on current network, including IP based networks:
  - Scalability, ubiquity, security, robustness, mobility, heterogeneity, Quality of Service (QoS), re-configurability, context-awareness, manageability, data-centric, network virtualization, economics, etc.
- These topics will be the requirements for FN, which will **meet future services** and **overcome the deficiencies** of the current IP based network.

# I. Motivation (2/3)

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- **Two Design Choices**
  - Incremental Design : A system is moved from one state to another with incremental patches
  - Clean-Slate Design: The system is re-designed from scratch
- It is assumed that *the current IP's shortcomings will not be resolved by conventional incremental and "backward-compatible" style designs.*
- So, the FN designs must be made based on **clean-slate** approach.

# I. Motivation (3/3)

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- Standardization/Research efforts on clean-slate designs for FN
  - GENI, FIND projects in the US
  - FP7, FIRE projects in EU
  - ISO/IEC JTC1/SC6 will start the new work for FN from the end of 2008
- NGN is almost settled down in ITU-T SG13
  - NGN is based on all-IP technologies and incremental designs
- Therefore, we proposed a new Question on FN based on clean-slate approach for the next study period to SG13 as a lead group of future view on telecommunication network and services.

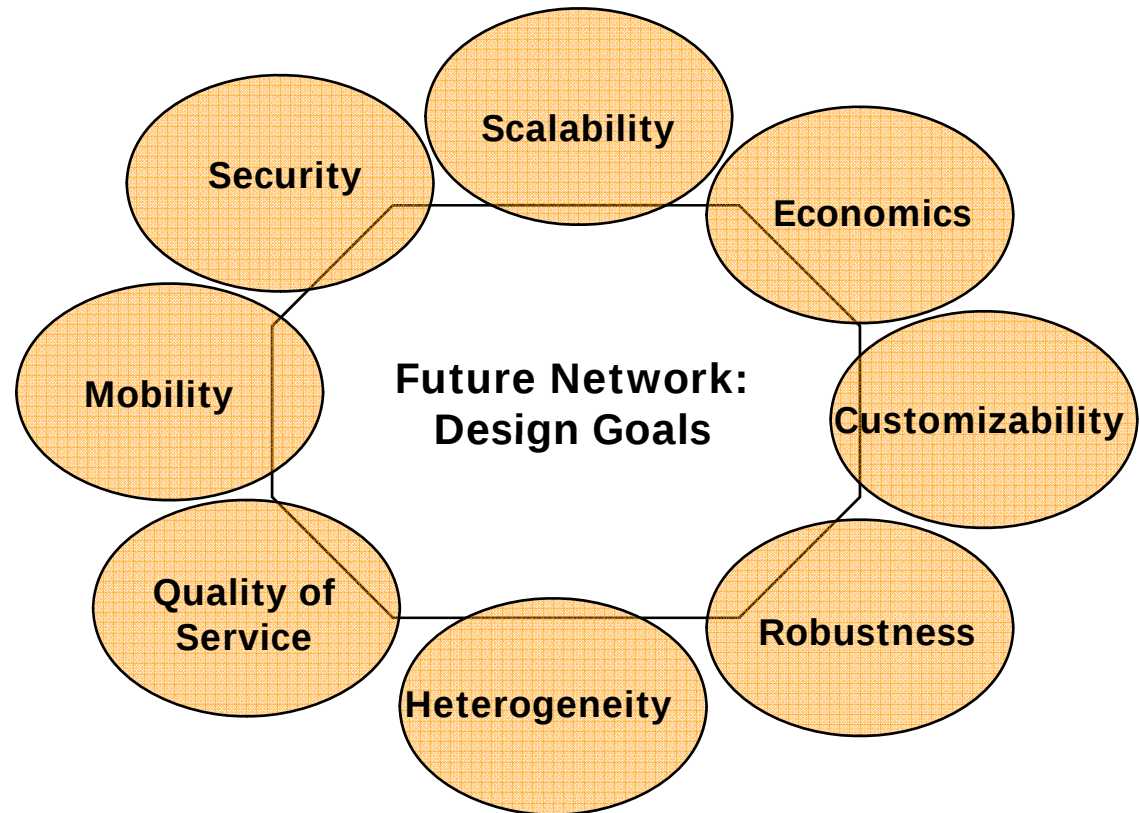
## II. Questions – Future Network

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- Study items (or deliverables) to be considered include, but are not limited to:
  - **Problem statement** on current IP-based network architecture
  - **Design goals** and general requirements for the FN
  - **Gap analysis** between existing standards and FN
  - Architectural framework for the FN (network virtualization, cross-layer communications, etc.)
  - Incorporating new communication and service technologies into FN
  - Identifying functions and capabilities to support new services for the FN

# III. New Design Goals

- Scalability
- Security
- Mobility
- Quality of Service
- Heterogeneity
- Robustness
- Customizability
- Economic Incentives



\*Work on Process

# III. Design Goals (1/4)

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## ***1) Scalability***

- Scalability issue is emerging as continuous growth of cultural demands for networking in the future.
  - Routing and addressing architecture
  - Multi-homing and Provider Independent (PI) routing

## ***2) Security***

- The FN should be built on the premise that security must be protected from the plague of security breaches, spread of worms and spam, and denial of service attacks, etc.

# III. Design Goals (2/4)

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## ***3) Mobility***

- The FN should support mobility of devices, services, users and/or groups of those as seamlessly, as it supports current wired and wireless
  - Supporting New Devices/Networks
  - Context-awareness
  - Multi-homing and Seamless Switching

## ***4) Quality of Service***

- The FN should support quality of service (QoS) from user and/or application perspectives.

# III. Design Goals (3/4)

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## ***5) Heterogeneity***

- The FN should provide much better support for a broad range of applications/services and enable new applications/services. In addition, it should accommodate heterogeneous physical environments.
  - Application/Service Heterogeneity
  - Physical Media Heterogeneity
  - Architecture Heterogeneity

## ***6) Robustness***

- The FN should be robust, fault-tolerant and available as the wire-line telephone network is today.
  - Re-configurability
  - Manageability

# III. Design Goals (4/4)

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## **7) Customizability**

- The FN should be customizable along with various user requirements.
  - Context-Aware Numbering and Content-Centric Service
  - Service-Specific Overlay Control and Service Discovery

## **8) Economic Incentives**

- The FN shall provide economic incentives to the components/participants that contribute to the networking.

# IV. Gap Analysis

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- **NGN vs. FN**

- The major differences are that any IP-based network architecture or packet switching technology is not assumed for FN, whereas NGN is based on all-IP networks and packet-based transfer.
- Also, NGN research is based on short/mid term evolutionary approach, so NGN technologies could be evolved from the current IP-based network. But FN is based on **clean-slate designs** and **long-term revolutionary** approach.

- **FPBN vs. FN**

- FPBN research focuses on how to efficiently transport packets on NGN. Even if FPBS can be also considered one of proposed solutions for future packet transport mechanism, the **scope** between FPBN and FN is completely different.
- FN does **not assume any existing transport mechanisms** such as packet switch or circuit switch. We note that FN research has broader view than FPBN.

- **IPv6 vs. FN**

- We note that requirements are very similar in some point, but many other new requirements are still missed in IPv6, for examples, Heterogeneity, Re-configurability, Context-awareness, Data-centric, Virtualization, Economics.
- These kinds of **new requirement** will not be resolved without any new trial of re-design.

# NGN vs. FN (1/2)

|                                    |                             | NGN                                                  | FN (research candidates)                                       |
|------------------------------------|-----------------------------|------------------------------------------------------|----------------------------------------------------------------|
| <b>Design Methods</b>              |                             | Incremental (backward-compatible) design             | <b>Clean-slate design</b>                                      |
| <b>Fundamental Characteristics</b> | <b>Transport Method</b>     | Packet-based transfer                                | Not assume any packet or circuit transfer                      |
|                                    | <b>Layering</b>             | Concrete layered architecture and open interface     | <b>New Layered Architecture e.g., Cross-layer architecture</b> |
|                                    | <b>Control Plane</b>        | Separation of control functions                      | New control plane (separated from data plane)                  |
|                                    | <b>End-to-end principle</b> | Not strict                                           | New principle required e.g., End-Middle-End principle          |
|                                    | <b>Scalability</b>          | A variety of ID schemes including IPv4 and IPv6      | New ID, ID/locator split, and multi-level Locator              |
|                                    | <b>Security</b>             | Layered security (e.g., L2 security, L3-IPsec, etc.) | Not clear yet                                                  |
|                                    | <b>Mobility</b>             | Generalized mobility (e.g., MIP)                     | <b>Mobility based on cross-layer design</b>                    |

# NGN vs. FN (2/2)

|                                            |                                              | NGN                                              | FN (research candidates)                                         |
|--------------------------------------------|----------------------------------------------|--------------------------------------------------|------------------------------------------------------------------|
| <b>Fundamental Characteristics (cont.)</b> | <b>QoS</b>                                   | Broadband capabilities with end-to-end QoS       | Not clear yet                                                    |
|                                            | <b>Heterogeneity</b>                         | Support for a wide range of medium, and services | Application/Service, Physical Media, Architecture Heterogeneity  |
|                                            | <b>Robustness</b>                            | Management plane                                 | Manageability, Autonomic management                              |
|                                            | <b>Network Virtualization</b>                | None                                             | <b>Re-configurability, Programmable Network</b>                  |
|                                            | <b>New Services and technologies Support</b> | Support of multiple last mile technologies       | Easy support of new service e.g., Data-centric Context-awareness |
|                                            | <b>Economics</b>                             | None                                             | New parameters                                                   |
| <b>Deployment Aspect</b>                   |                                              | Incremental migration, Integration               | New testbed and infrastructure required                          |

# IPv6 vs. FN (1/2)

|                                    |                             | IPv6                                             | FN (research candidates)                                       |
|------------------------------------|-----------------------------|--------------------------------------------------|----------------------------------------------------------------|
| <b>Design Methods</b>              |                             | Incremental (backward-compatible) design         | <b>Clean-slate design</b>                                      |
| <b>Fundamental Characteristics</b> | <b>Transport Method</b>     | Packet-based transfer                            | Not assume any packet or circuit transfer                      |
|                                    | <b>Layering and API</b>     | Concrete layered architecture and open interface | <b>New Layered Architecture e.g., Cross-layer architecture</b> |
|                                    | <b>Control Plane</b>        | Not separated from data                          | New control plane (separated from data)                        |
|                                    | <b>End-to-end principle</b> | Strict principle                                 | New principle required e.g., End-Middle-End principle          |
|                                    | <b>Scalability</b>          | Problems with scalable routing and addressing    | New ID, ID/locator split, and multi-level Locator              |
|                                    | <b>Security</b>             | IPsec for IPv6                                   | Not clear yet                                                  |
|                                    | <b>Mobility</b>             | MIPv6                                            | <b>Cross-layer design based mobility approach</b>              |

# IPv6 vs. FN (2/2)

|                                            |                                              | IPv6                                                           | FN (research candidates)                                         |
|--------------------------------------------|----------------------------------------------|----------------------------------------------------------------|------------------------------------------------------------------|
| <b>Fundamental Characteristics (cont.)</b> | <b>QoS</b>                                   | Not support within IP                                          | Not clear yet                                                    |
|                                            | <b>Heterogeneity</b>                         | Problems with support for a wide range of medium, and services | Application/Service Heterogeneity, Physical Media Heterogeneity  |
|                                            | <b>Robustness</b>                            | Fault-tolerant                                                 | Manageability, Autonomic management                              |
|                                            | <b>Network Virtualization</b>                | None                                                           | <b>Re-configurability, Programmable Network</b>                  |
|                                            | <b>New Services and technologies Support</b> | Not easy support of new service                                | Easy support of new service e.g., Data-centric Context-awareness |
|                                            | <b>Economics</b>                             | None                                                           | New parameters                                                   |
| <b>Deployment Aspect</b>                   |                                              | Incremental migration, Integration                             | New testbed and infrastructure required                          |

*\*\*work on process\*\**

# ITU SG13 Meeting Result on FN: New Question Proposal

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INTERNATIONAL TELECOMMUNICATION  
UNION

**STUDY GROUP 13**

**TELECOMMUNICATION  
STANDARDIZATION SECTOR**  
STUDY PERIOD 2005-2008

**TD 332 Rev.2 (PLEN)**

**English only**  
**Original: English**

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**Question(s):** All/13, Futures

Seoul, 14 - 25 January 2008

**TEMPORARY DOCUMENT**

**Source:** SG 13 Futures Moderator

**Title:** New Question on Future Networks

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# Questions

- **Problem statement** on current IP-based network architecture
- **Design goals and general requirements for the Future Network**
- **Gap analysis** between existing standards and/or proposals for next generation networks and the design goals and requirements for the Future Network (FN)
- **Study of Meta architectures** (network virtualization, cross-layer communications) and architectural framework for the Future Network
- **Study on how to incorporate new communication and service technologies into Future Networks**, such as wireless edge network (e.g. mesh/sensor, ad-hoc, network movement) or optical backbone network (e.g. optical switch or router).
- **Identify functions and capabilities necessary to support new services** for the Future Network
- **What enhancements to existing Recommendations** are required to provide energy savings directly or indirectly in Information and Communication Technologies (ICTs) or in other industries? **What enhancements to developing or new Recommendations** are required to provide such energy savings?

**SG13 TD 332 Rev.2 (PLEN)**

# ITU-T SG13 New Items for Next Study Period (2009-2012)

- **QUESTION O/13 – Distributed Services Networking (DSN)**

- Distributed technology such as peer to peer (P2P) and mesh technology may be used in managed peer to peer (MP2P) networks to create an overlay network which has an ability to share resources between different nodes and links within a managed network deployment. These networks should have the advantages of self-configuring, self-managing, and self-healing and should result in the provision of service with better performance and lower cost.

- **QUESTION P/13 – Future Networks**

- These topics will be considered during the development of the requirements for Future Networks, which aimed to meet future services and overcome the deficiencies of the current IP based network.

# ITU-T Perspectives

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- The final approval of the proposal as a new question will be executed in the Next ITU meeting (WTSA-08, 2008.10)
- Next Step Perspectives in ITU-T
  1. Build up new Question for FN (2009)
    - Based on Clean-slate design
  2. Deliverables : (2009~2012)
    - Design goals and requirements,
    - Architecture and Framework (Network Virtualization, Cross-layer communication, Service Scenarios, etc.)
  3. Be aligned with ISO/IEC JTC1/SC6 documents

# Future Network in ISO/IEC JTC1/SC6

- First FN Meeting
- Second FN Meeting

# History

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- I. Sep. 2007 (Paris), First Ad-hoc Meeting for Future Network
- II. Apr. 2008 (Geneva), Proposals for Future Network
- III. Nov. 2008 (Montreux) Next SC6 Meeting scheduled

# I. First Future Network Meeting

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- Ad-hoc Meeting for Future Network (Paris, 4-5 Sept. 2007)
- Agreed in considering work items that would address respectively (Document 6N13367)
  - Step 1: Problem Statement
  - Step 2: Requirements
  - Step 3: Gap Analysis
  - Step 4: Framework
  - Step 5: Architecture
  - Step 6: Individual technologies

# Clarification of Terminology

- Future network is considering the network of the future, which is not limited to the future of the Internet
- The clarification on Future network and NGN of ITU-T

| Future Network                                                                                                                                                                                      | NGN of ITU-T                                                                                                                                                                                                                |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>• Future Network is the Network of the Future</li><li>• No specific network technologies are pre-assumed</li><li>• Long-term Revolutionary Approach</li></ul> | <ul style="list-style-type: none"><li>• Packet based Technologies but assuming IP-based Network Architecture</li><li>• Evolution from the current IP-based Network</li><li>• Short/Mid-term Evolutionary Approach</li></ul> |

# Other Discussions

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- Network Architectures
  - Various approach on new network architecture to provide enhanced communication services for emerging applications
    - e.g., Self Organizing Network, Overlay Network, Configurable Network, Active Network, Context-Aware Network, etc.
  - Some of the important directions of future network architecture may be highly dynamic, distributed and configurable network based on **application context**
- Some Ideas, Concepts and Experiences from the emerging issues such as USN, Wireless Networking and NGN, may provide possible solutions for the Future Network
- Identification is one of the most important issues
- Global inter-working and harmonization issues need to be addressed
- **Revolutionary approach** must be considered for the Future Network
  - The future network should not dependent on the current emerging technologies and solutions.
  - And the backward compatibility may not be required.

## II. Second Future Network Meeting

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- Proposals in SC6 WG7 (Geneva, April 2008)
  - “Problem Statement for Future Network”
  - “Design Goals and General Requirements for Future Network”
  - “Gap Analysis for Future Network”
- Meeting Results
  - Initiation of NP (New Work Item Proposal) Ballot within JTC1
    - “Future Network: Problem Statement and Requirements”
  - Outgoing Liaison Statement
    - “Liaison from ISO/IEC JTC1 SC6 WG7 to ITU-T SG17 and SG13”

# New Work Item Proposal

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- “Future Network: Problem Statement and Requirements”
  - Market Requirements
    - ITU-T SG13 already initiated similar work on Future Network as one of the new Question for the next study period (2009-2012)
    - Similar research works on the Future Network, e.g.,
      - GENI/FIND in US,
      - FP7, FIRE project in EU,
      - AKARI, FIF, CERNET-2 in Asia nations
  - Related Work
    - ITU-T SG13 and SG17 are trying to initiate new Questions for developing the work on Future Network
  - Conformity Assessment and Interoperability
    - It is assumed that Future Network must be made on **clean slate design**

# III. Perspectives

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- Next SC6 Meeting (Montreux, November 2008)
- Start New Work from the end of 2008

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# Research Groups in IETF

# IRTF

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- Research Groups are involved in NSF FIND proposals
  - dtnrg, end2end, p2prg, rrg, etc.
- New Works are considered
  - Network virtualization RG
  - QoS policy framework RG
  - Cross-layer communication in Transport Area Working Group (TSV)

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# Related Standardization Approaches

- ITU-T SG13 DSN
- IEEE NGSON

# ITU-T SG13: Charter of O/13 – Distributed Services Networking (DSN)

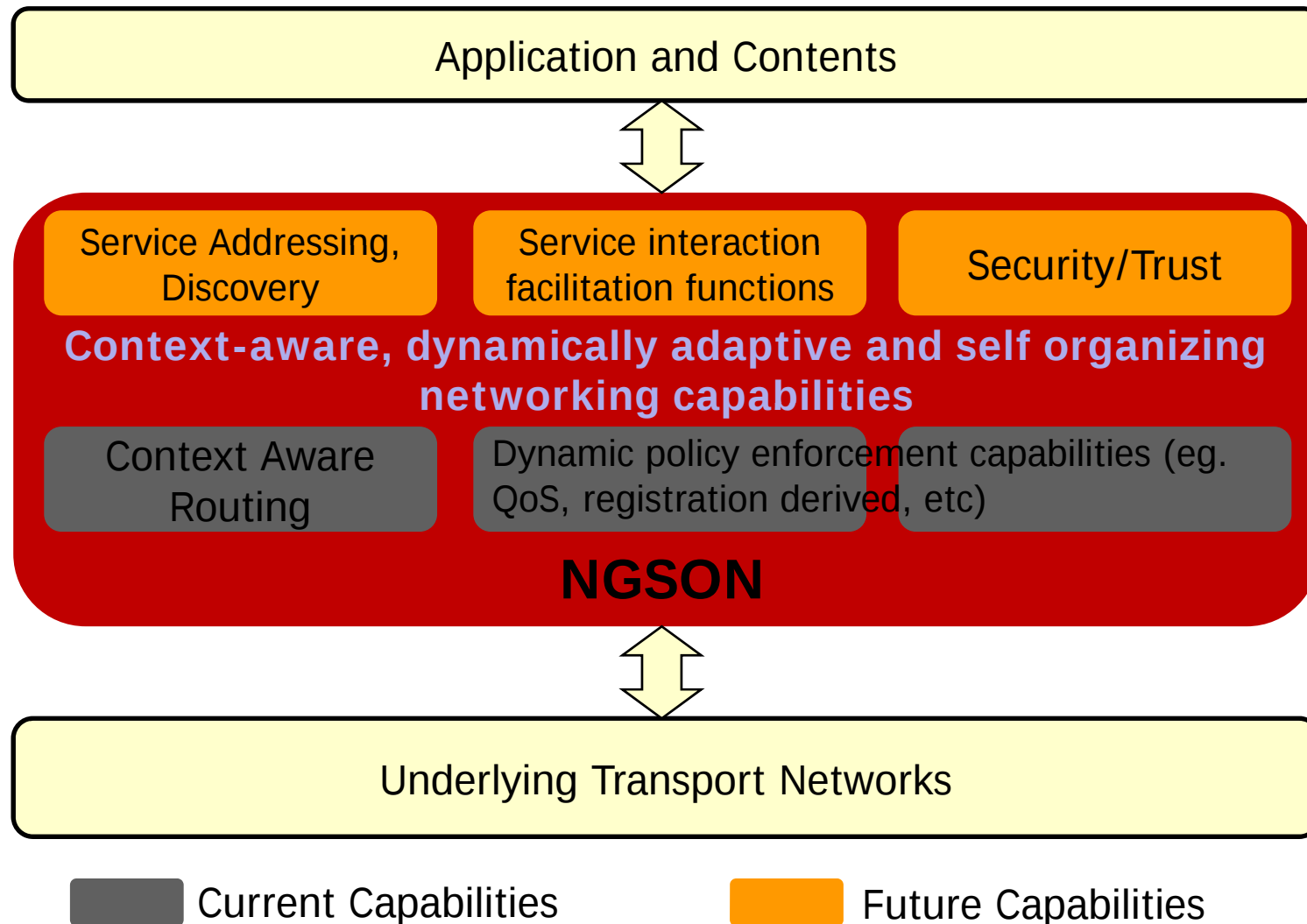
- What new service and functional requirements should be supported by a Distributed Services Network
- What architectural framework will a Distributed Services Network have?
  - Distributed service control functions
  - Distributed transport control function including resource control and access network control
  - Distributed access transport functions
  - New functions introduced by distributed technologies and features may be needed
- Impact of the distributed technologies to NGN
- Will DSN impact the provision of public interest services, e.g. Emergency Telecommunications?
- How can DSN provide a controllable and manageable network?
- How should interoperability issues between Distributed Services Networks and current networks be handled?
- What enhancements to existing Recommendations are required to provide energy savings directly or indirectly in Information and Communication Technologies (ICTs) or in other industries? What enhancements to developing or new Recommendations are required to provide such energy savings?

# IEEE NGSON

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- P1903 NGSON (Next Generation Service Overlay Network)
  - Describes a framework of IP-based service overlay networks
  - Specifies
    - Context-aware, dynamically adaptive, and self-organizing networking capabilities,
    - Including advanced routing and forwarding schemes, and
    - That are independent of underlying transport networks

# Conceptual NGSON Framework



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# Conclusion and Perspectives

# Intra-ITU Collaboration

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- NGN-GSI, SG 13
    - New Question Proposal on the Future Network (Sept. 2007, Geneva) (Initial Draft)
    - New Question Proposal on the Future Network (Jan. 2008, Seoul) (Revised Draft)
  - SG 17
    - New Questions on “Future Open System Communications Technology” (Jan. 2008, Seoul)
- ➔ Collaboration under SG 13 is decided
- SG 17 decided (Apr. 2008)

# Inter-Organization Collaboration

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- ISO/IEC JTC1/SC6
  - Initiation of Collaboration with ITU-T SG13 and SG17 (Geneva, April 2008)
- ITU-T
  - It may be almost aligned with possible activities for the next study period of ITU-T (2009-2012)

# Global Collaboration

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- CJK Meeting
  - 8th CJK Standards Meeting
    - Collaborate on Future Network and discuss about gap analysis (Mar. 31 – Apr. 2 2008, Okinawa)
- Plan for Research Item Proposal
  - Network virtualization
  - Cross-layer communication
  - Diverse models of the end-to-end principle

# Next Step

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It is the time for  
your contribution!

# Contact

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