Panel "Technical Aspects for Internet's Future Social Promises"

NexComm, 24th April 2013 Venice

Panelists:

Dr. Dieter Claeys Ghent University, Belgium dieter.claeys@telin.ugent.be
Dr. Rita Girão-Silva INESC-Coimbra, Portugal rita@deec.uc.pt
(Moderator)Prof. Alex Galis University College London, U.K. a.galis@ucl.ac.uk

Future Internet : Future Social Promises

Scope:

- Is this FI technology / technical aspect good for society?
- Economically reasonable?
- For a networking technology / technical aspect:
  - Lists and describes methods to assess socio-economic effect of the technology
  - Analyze potential tussles among parties
  - Some interfaces/mechanisms are too integrated, and difficult to improve because too many parties are involved
  - Helps design/select appropriate technology for Future Networks

Presentations:

- Views on Queueing models: predicting queue lengths and waiting times
- Views on Routing of the data: selecting paths in a network along which to send network traffic
- Views on Softwarization of the network: machine-readable instructions that direct a network to perform specific operations

Views on Softwarization of the Networks

NexComm, 24th April 2013 Venice Keynote

Prof. Alex Galis
University College London
a.galis@ucl.ac.uk
www.ee.ucl.ac.uk/~agalis

Future Internet – some differences

Current Internet Infrastructure = Network of Interconnected uncoordinated connectivity infrastructures, connecting people, devices and computers.

Ossification: reaching crisis level

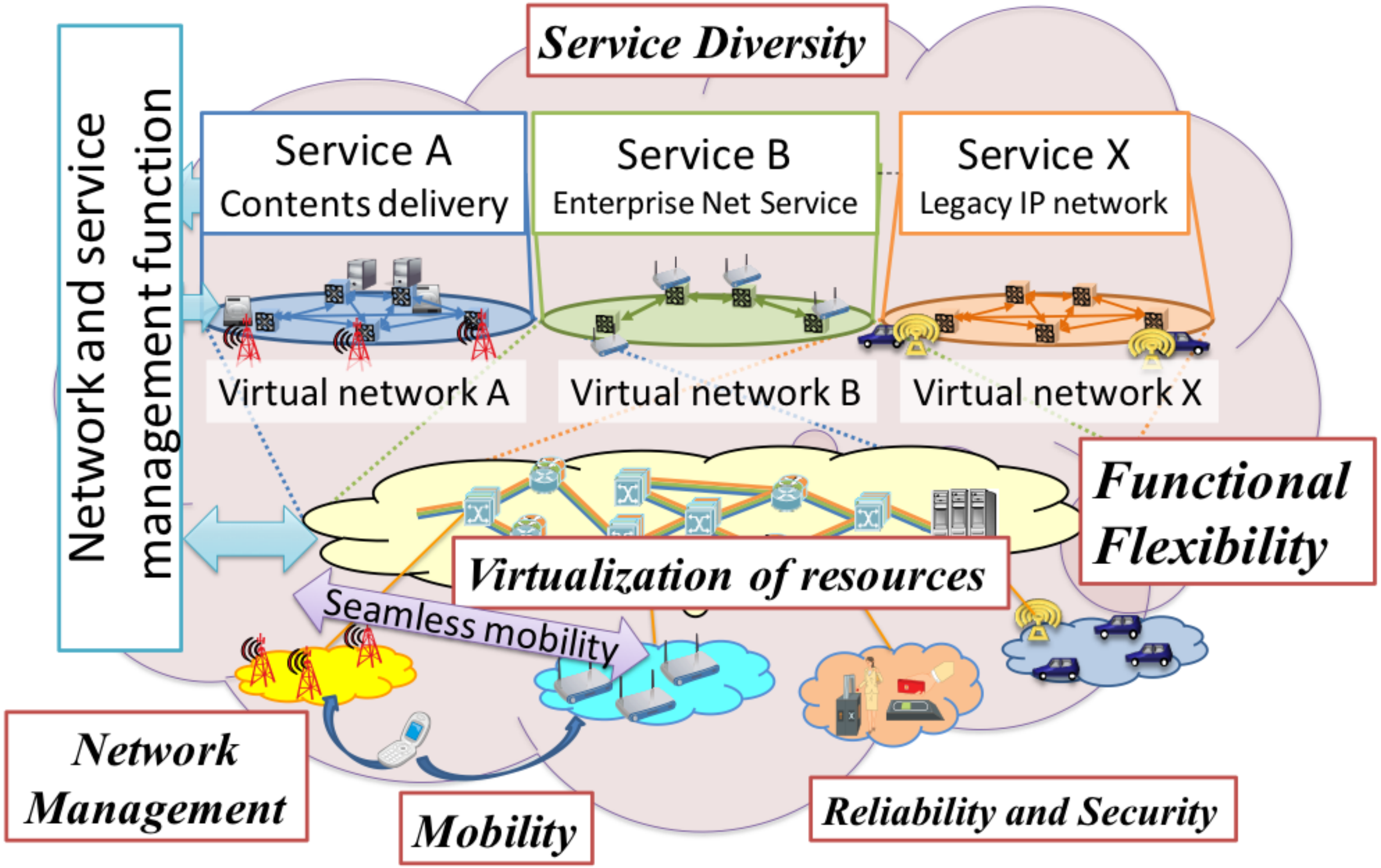
A lot of missing and interrelated features; missing enablers for integration and orchestration of Nets, Services, Content, Storage

Substantial barriers to innovation with novel services, networking systems, architecture and technologies

Future Internet Infrastructure = A Softwarization of the Network

- Service-aware connectivity infrastructure connecting and orchestrating the future Internet of people, content, clouds, devices, computers and things
- Unlike the original Internet set of standards, which merely focus on technical connectivity, routing, and naming, the scope of the Future Internet recommendations, standards, and guidelines should encompass all levels of interfaces for Services as well as technical virtual and physical resources.
- They should further support the complete lifecycle of applications and services that are primarily constructed by recombining existing elements in new and creative ways.
- New architecture becomes necessary when balance among important issues varies (e.g. Life system costs Vs. Node costs; upsurge of new services and new end-user devices)

Future Networks



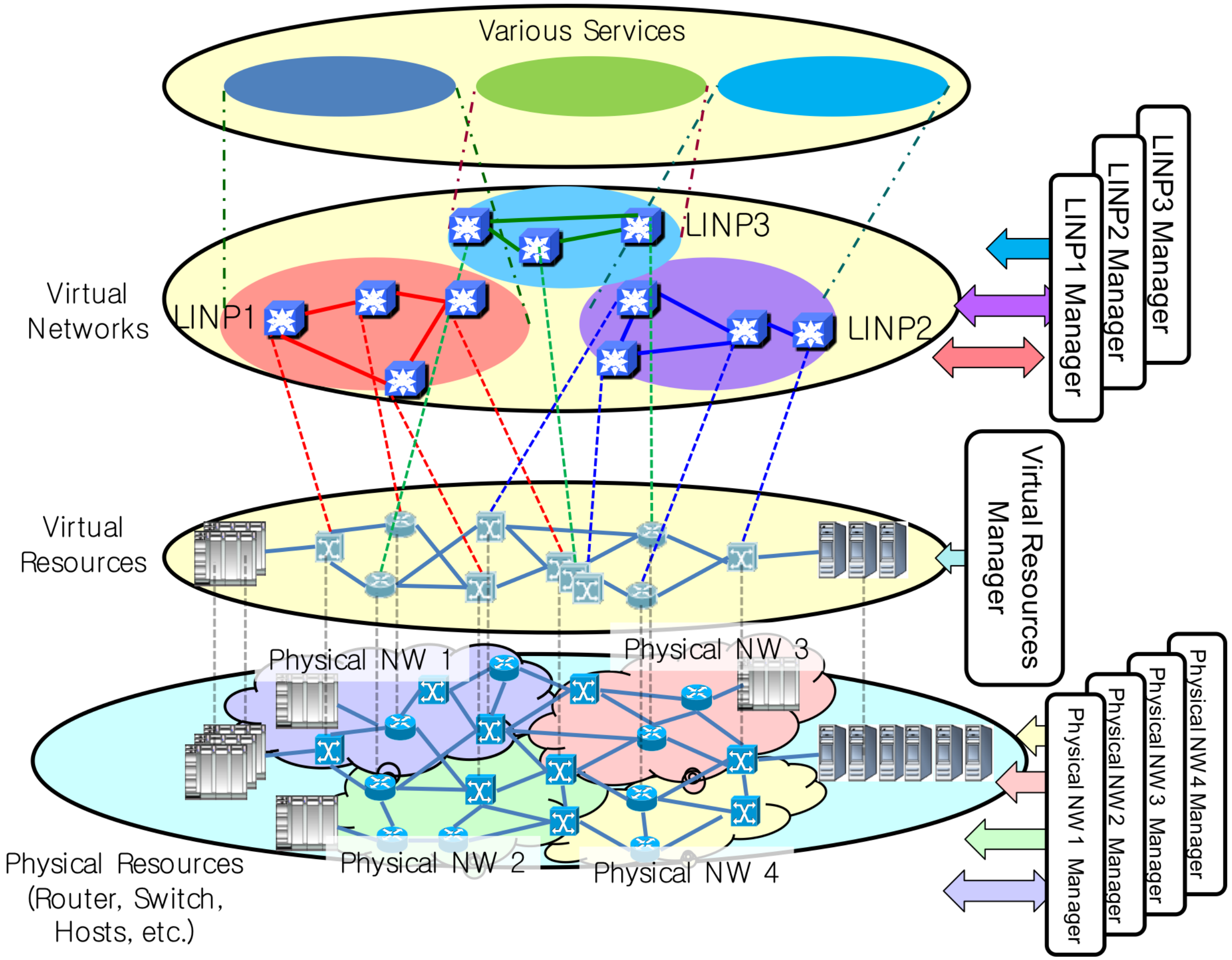
Future Network Virtualization

Network virtualization is required to be capable of providing multiple virtual infrastructures those are isolated each other.

The virtualized infrastructures may be created over the single physical infrastructure

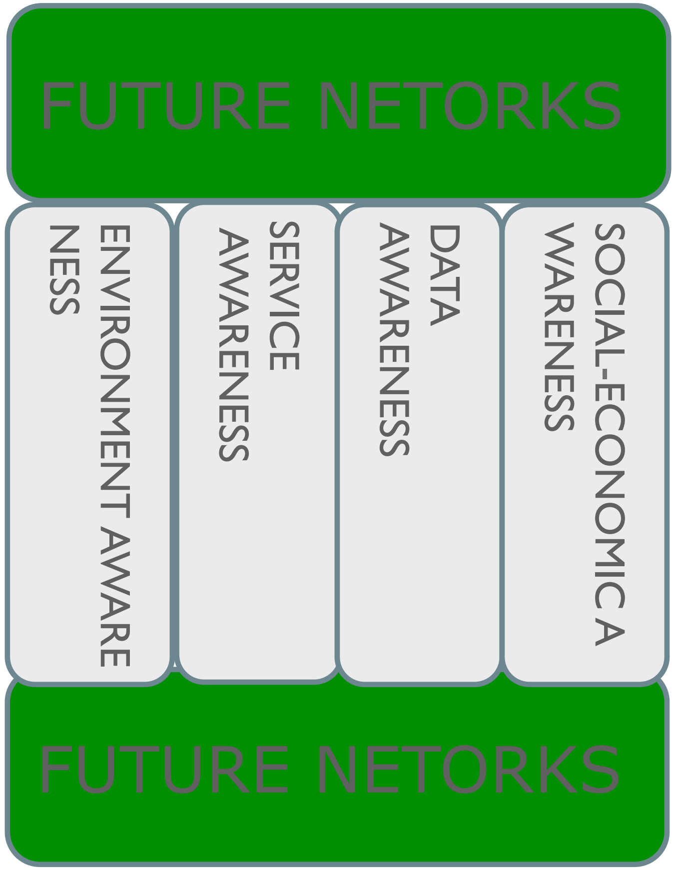
Each virtual network is isolated each other and is programmable to satisfy the user's demand on the functionality and amount

User's demand is conveyed to Logically Isolated Network Partition (LINP) manager which is required to coordinate infrastructures so that appropriate network resource is provided to the user



Future Networks - Four Objectives

- **Environment awareness**
  - **FNs should be environmental friendly.**
- **Service awareness**
  - **FNs should provide services that are customized with the appropriate functions to meet the needs of applications and users.**
- **Data awareness**
  - **FNs should have architecture that is optimized to handling enormous amount of data in a distributed environment.**
- **Social-economic awareness**
  - **FNs should have social-economic incentives to reduce barriers to entry for the various participants of telecommunication sector.**

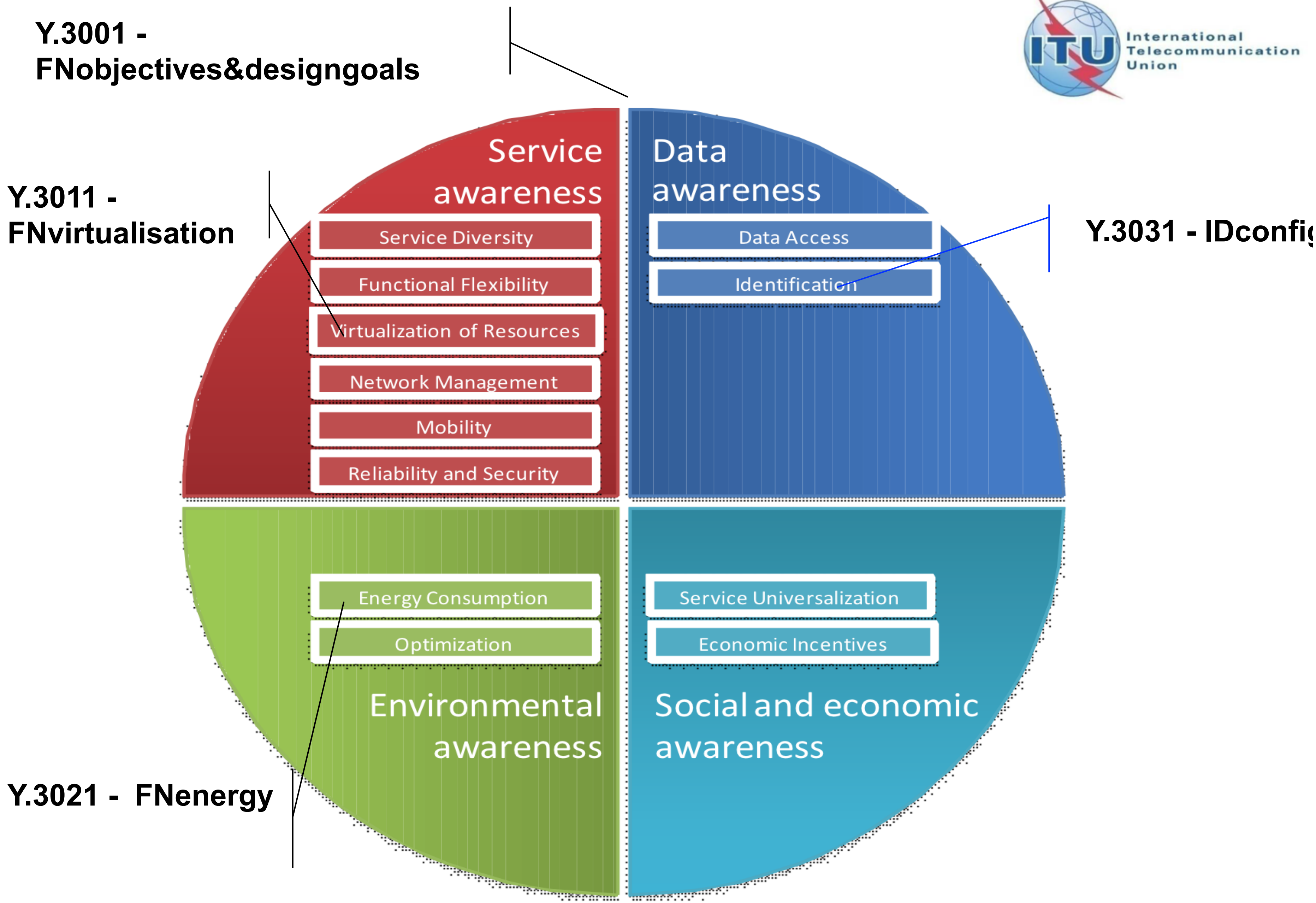


How to Change

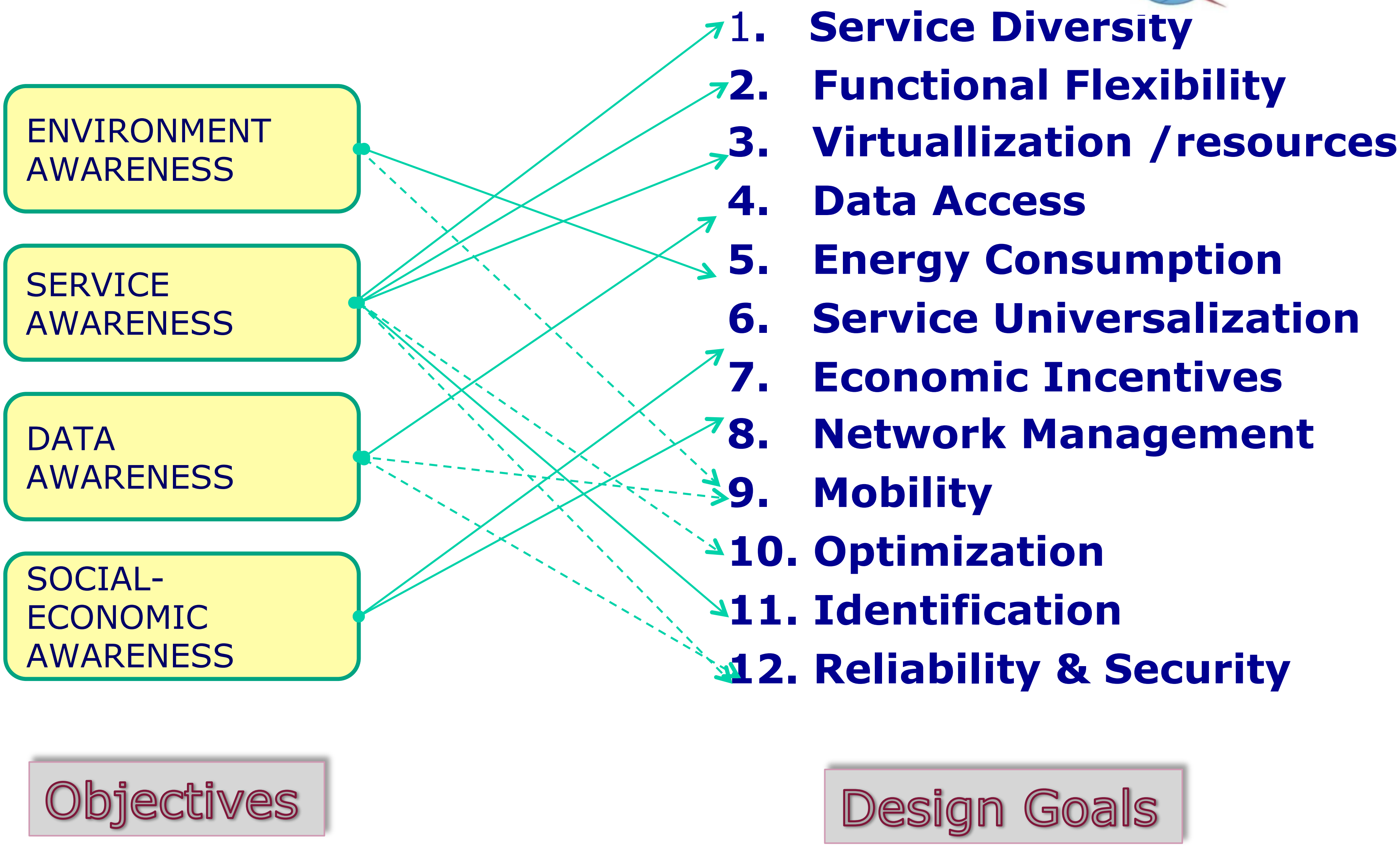
Approaches:

- Parallel Internets; Progressive changes; “Clean” slate and evolutionary
- Network of networks → system of coordinated service networks
- Virtualization of resources (Networks, Services, Content, Storage)
- Programmability
- Increased self-managebility as the means of controlling the complexity and the lifecycle costs
- Softwarization and Programmability

Future Networks : Objectives Vs. Design Goals



Future Networks : Objectives Vs. Design Goals



Concluding Remarks

Current Internet = Network of Interconnected uncoordinated networks – "infrastructure where intelligence is located at the edges"

- **Simple network layer ;Services are realised at the end-hosts**
- **KISS Principle : "Keep it Simple, Stupid" (i.e. today optimisation is tomorrow's bottleneck) source: D. Isenberg**

Software Enabled Networks **- Infrastructure where the intelligence is embedded and enabled**

Substitute KISS principle with ***KII principle : "Keep it intelligent"*** **(i.e. today fundamental is tomorrow's secondary) source A. Galis**

UNIVERSITEIT GENT

FACULTY OF ENGINEERING AND ARCHITECTURE

Queueing theory

Dieter Claeys

PESARO 2013 panel discussion

STOCHASTIC MODELLING AND ANALYSIS OF COMMUNICATION SYSTEMS

SMACS

Queueing theory

- Discipline in applied probability
- Study all kinds of situations where
  - Customers arrive
  - Wait in queue
  - In awaitance of service
- Methodology:
  - Develop queueing model
  - Deduce performance measures
  - Evaluate application via performance measures

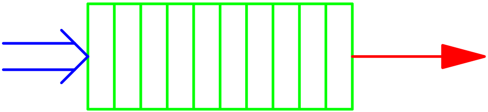
Queueing model - telecom

Queueing model

- Customers arrive
- Wait in queue
- In awaitance of service

Telecom

- Packets arrive
- Wait in buffer
- In awaitance of transmission



Queueing theory vs. simulation

- Mathematical model instead of imitation in software
- Cannot capture all features
- Demonstrates parameter dependence clearly
- Requires fewer time and memory

$\Rightarrow$ Quick fundamental insights

Batch service

- Customers are served in group instead of individually
- Examples:
  - Elevator
  - Transport
  - Group screening
  - Telecom: aggregate packets before transmission
- My focus
  - Mathematical study of models (customer delay)
  - Group screening

- New application: requires lot of resources
- Investments necessary to alleviate bottlenecks in routers
- Queueing theory:
  - Formulas that explicitly show the benefits of the cost made
  - Tool to make trade-off between extra performance and cost
- Important for users: want quality, but do not want to pay too much

Panel: "Technical Aspects for Internet's Future Social Promises"

Some Aspects on Routing in Future Communication Networks

Rita Girão-Silva

DEEC-FCTUC INESC-Coimbra

CTRQ 2013 / PESARO 2013 / COCORA 2013 – NexComm 2013

Venice, Italy April, 21-26, 2013

Routing – Some hints on recent work regarding future communication networks

- IPv4 addresses: growth at an alarming rate over the last few years, bringing problems due to the shortage of addresses.
- IPv6 addresses: removes the address shortage problem and allows special handling of applications with Quality of Service (QoS) requirements, but can bring routing scalability issues.
- The routing scalability problems have to be solved, in order to enable the continued growth of the Internet and still allow the Internet Service Providers (ISPs) to operate with acceptable upgrade intervals.
- New paradigms in routing may be necessary...

Routing – Some hints on recent work regarding future communication networks

- New paradigms in routing may be necessary...
  - A new network layer protocol named Identifier-Locator Network Protocol v6 (ILNPv6) [Atkinson:10]: the 16-byte IPv6 address is replaced with a combination of a 64-bit identifier (to identify a node) and a 64-bit locator (to identify a (sub)network and it is used to route data packets to the destination node). The ILNPv6 addresses the routing scalability problem through the elimination of provider independent addresses from the global routing system.
  - Introduction of a mapping system into the routing architecture: the prefixes of an edge network are mapped to the IP addresses of all the routers this edge network is attached to. Each data packet is delivered by encapsulating it with the IP address of one of the routers that the destination network is attached to. Examples of different mapping system designs are in [Massey:07], [Menth:10] and [Jakab:10].

Routing – Some hints on recent work regarding future communication networks

- New paradigms in routing may be necessary...
  - A new overall routing architecture design
    - In [Pan:10], a multiple-tier realm-based framework is presented. Depending on the functionality and resource dependency relationship in the architecture, entities are divided into different tiers, typically application/user/data/service (tier 3), networking end-hosts (tier 2) and routing infrastructure (tier 1). Realms are entities of the same tier grouped together, according to their common affiliation or policies. An identifier is assigned to an object and depending on which tier the ID holder belongs to, the ID will be of a specific type, User-ID, Host-ID or Routing-infrastructure-ID.
    - In [Khare:10], the proposed solution achieves routing scalability by means of routing aggregation, where the unnecessary topological details about remote portions of the Internet are removed from routing tables. Route aggregation can be implemented with increasing scopes, starting from a router and then within a network and then gradually expanding to include more and more networks.

Routing – Some hints on recent work regarding future communication networks

- New paradigms in routing may be necessary...
  - A new overall routing architecture design
    - Construction of routing architectures that do not require all the information representing all the endpoints [Strowes:12]: use of compact routing in a "smarter" architecture that limits the visibility of the destination to only a small subset of the network.

Concluding remarks

Solving some of the current problems in terms of routing scalability will be very important for the deployment of new and improved services in the Internet. Without profound changes in the routing infrastructure, the growth of the Internet at the current rates might not be possible in the future.

References

- [Atkinson:10] R. Atkinson, S. Bhatti, S. Hailes. Evolving the Internet Architecture Through Naming, *IEEE Journal on Selected Areas in Communications*, 28(8):1319-1325, Oct. 2010.
- [Jakab:10] L. Jakab, A. Cabellos-Aparicio, F. Coras, D. Saucez, O. Bonaventure. LISP-TREE: A DNS Hierarchy to Support the LISP Mapping System, *IEEE Journal on Selected Areas in Communications*, 28(8): 1332-1343, Oct. 2010.
- [Khare:10] V. Khare, D. Jen, X. Zhao, Y. Liu, D. Massey, L. Wang, B. Zhang, L. Zhang. Evolution Towards Global Routing Scalability, *IEEE Journal on Selected Areas in Communications*, 28(8):1363-1374, Oct. 2010.
- [Massey:07] D. Massey, L. Wang, B. Zhang, L. Zhang. A Scalable Routing System Design for Future Internet, *IPv6'07*, Kyoto, Japan, Aug. 31, 2007.
- [Menth:10] M. Menth, M. Hartmann, M. Hofling. FIRMS: a Mapping System for Future Internet Routing, *IEEE Journal on Selected Areas in Communications*, 28(8): 1326-1331, Oct. 2010.
- [Pan:10] J. Pan, R. Jain, S. Paul, C. So-in. MILSA: A New Evolutionary Architecture for Scalability, Mobility, and Multihoming in the Future Internet, *IEEE Journal on Selected Areas in Communications*, 28(8):1344-1362, Oct. 2010.
- [Strowes:12] S. D. Strowes. Compact Routing for the Future Internet, PhD Dissertation, School of Computing Science, College of Science and Engineering, University of Glasgow, Feb. 2012.