Future Internet Architecture Activities

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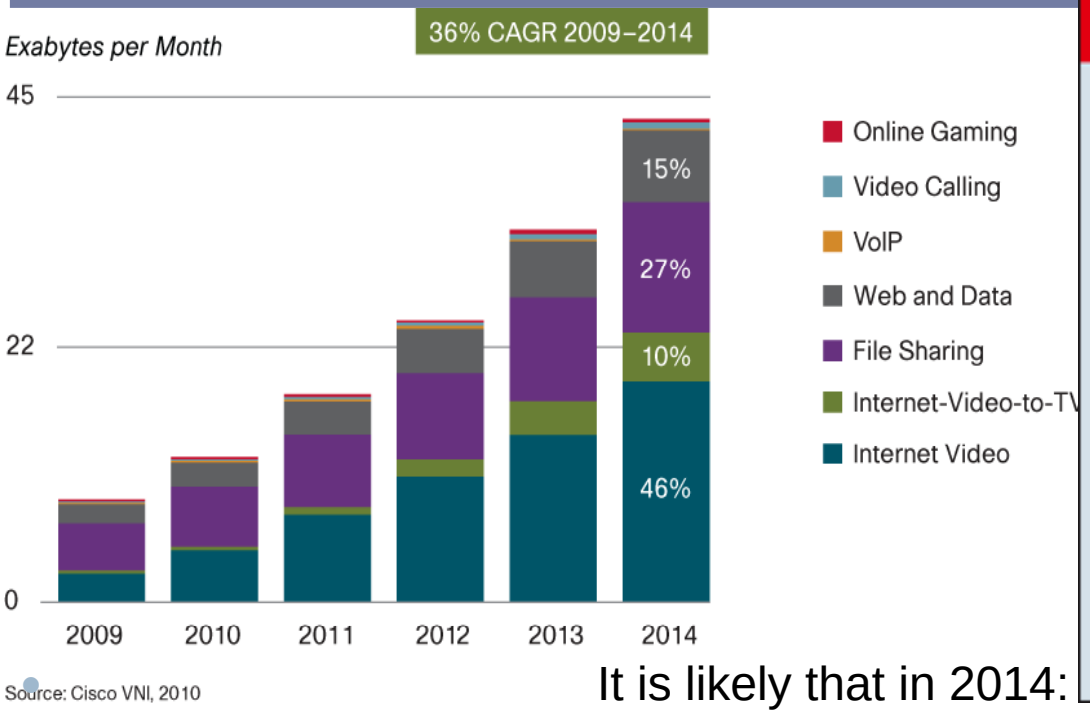
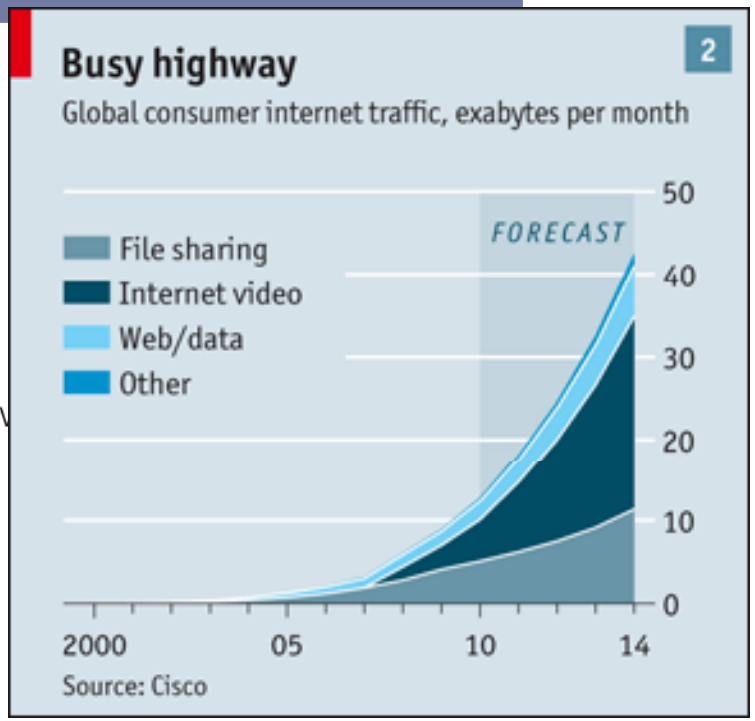
The Internet *"...is rapidly turning into a video network..."*



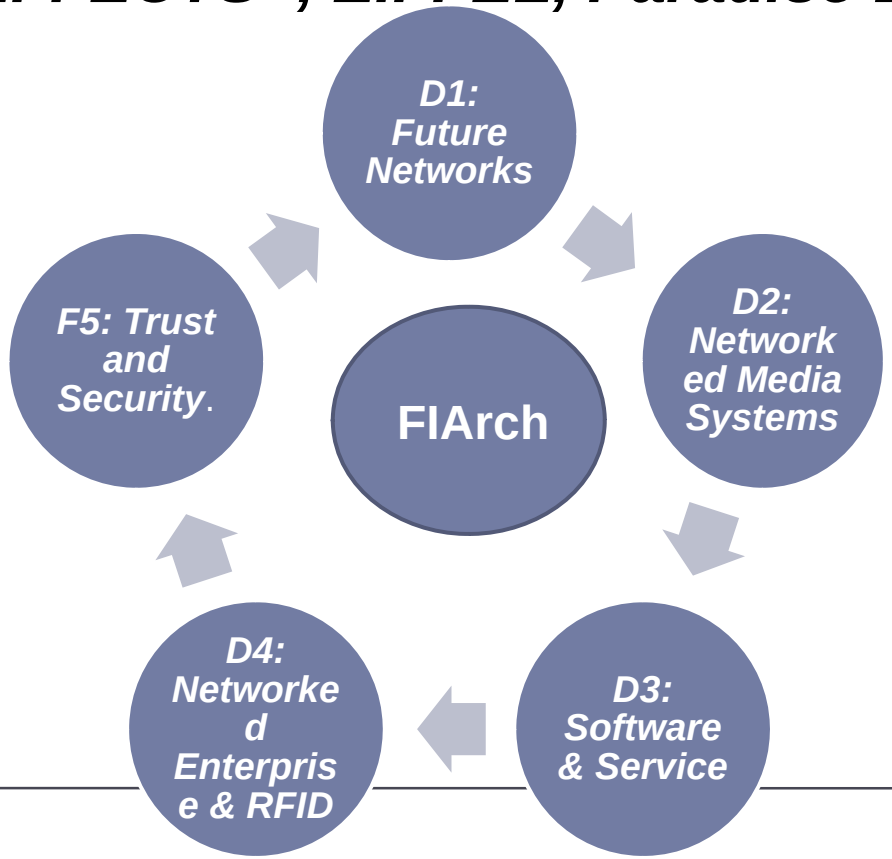


It is likely that in 2014:

- The **number of Internet nodes** will grow to more than 100 billion.
- Out of the 42 Exabytes (10^{18}) per month of consumer Internet traffic**, 56% will be due to Internet video**
- The average monthly consumer Internet traffic will be equivalent to 32 million people streaming Avatar in 3D, continuously, for the entire month.

What is FIARch Group

- ***An Experts Reference Group (ERF)***
- ***Coordinated by CSA: NextMedia, Chorus+, IOT-I, SOFI, SESERV, EFFECTS+, EIFFEL, Paradiso 2***



Participants

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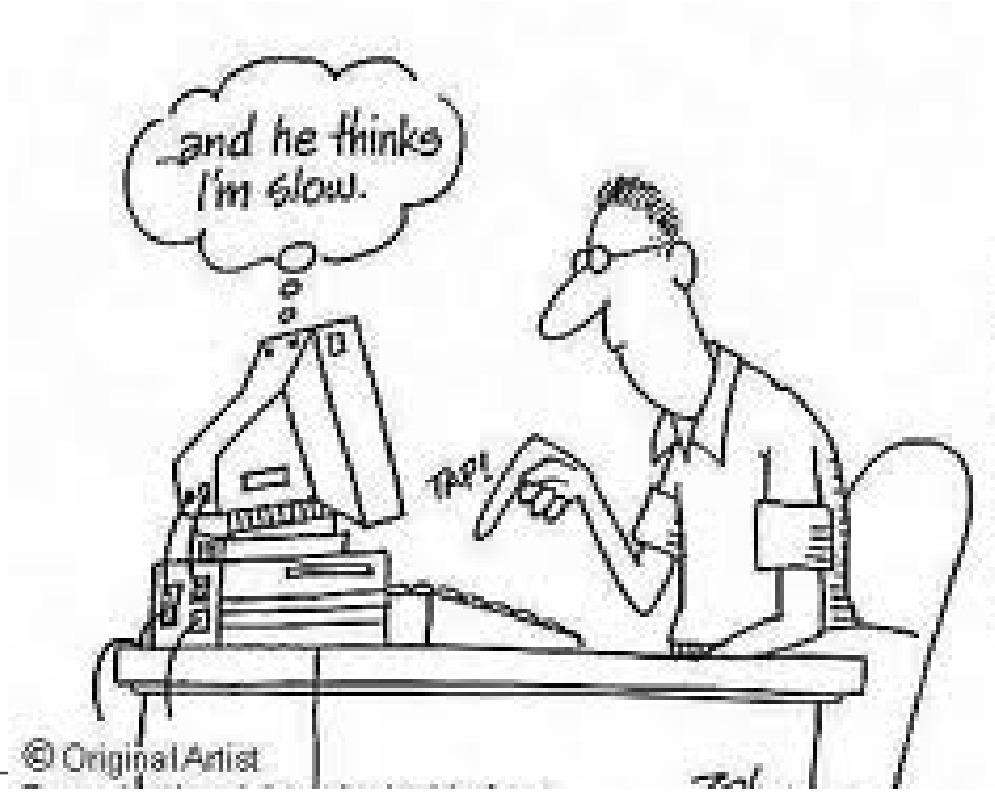
Vito Morreale	Engineering

Activities ... so far

- Fundamental Internet Limitations, March 2011
- http://ec.europa.eu/information_society/activities/foi/research/fiarch/index_en.htm
- ***"data"*** to refer to any organized group of bits a.k.a. data packets, data traffic, information, content (audio, video, multimedia), etc

Processing and Handling Limitations

- ***Data Processing/handling***: refers to forwarders (e.g. routers, switches, etc.), computers (e.g., terminals, servers, etc.), CPUs, etc. and handlers (software programs/ routines) that generate and treat data.



Storage Limitations

- ***Data Storage***: refers to memory, buffers, caches, disks, etc. and associated logical data structures.

Transmission Limitations

- ***Data Transmission***: refers to physical and logical transferring and exchange of data.

Control Limitations

- ***Control of processing, storage, transmission of systems and functions***: refers to the action of observation (input), analysis, and decision (output) whose execution affects the running conditions of these systems and functions.

Cross area + operational Limitations

Design Objectives
High Level Objectives

- Accommodate unanticipated **user expectations**
- Become the common and global **information exchange**
- Be **scalable** to provide cultural, scientific and technological exchange among different regions and cultures, and within single communities.
- Be **ubiquitously accessible and open**.
- Be **secure**, **accountable**, and **reliable**.
- Support **mobility**, have **widespread ubiquitous coverage**
- Support means for various **performance adaptability**.
- Support the **innovative business models**
- Offer a **service addressing mechanism** independent from the physical location
- Be **carbon neutral and sustainable**.

Design Objectives
Low Level Objectives

- **Accessibility** (open by means of various/heterogeneous interfaces)
- **Accountability** (of resource usage and security without impeding user privacy, utility and self-arbitration)
- **Manageability** (distributed, automated, and autonomic operation)
- **Diagnosability** (root cause detection and analysis)
- **Transparency**
- **Distribution of processing, storage, and control functionality and autonomy** (organic deployment)
- **Scalability** (including routing and addressing, number of shared infrastructure nodes, management system)
- **Reliability** capacity to perform what it is expected with a growing number of users with increasing heterogeneity.
- **Robustness/stability**, resiliency, and survivability
- **Security**
- **……**

Conclusions (so far..)

- ***Extensions, enhancements and re-engineering of today's Internet protocols may solve several challenging limitations.***

- ***Yet, addressing the fundamental limitations of the Internet architecture is a multi-dimensional problem. Improvements in each dimension combined with a holistic approach of the problem space are needed.***

Next Step: Design Principles

- **Which design principles your project is currently addressing /relying on?**
- **Which design principles of Internet does your project challenge and for which reasons?**
- **Which design objectives can't be achieved by application of current design principles?**
- **Do you plan investigation on new principles or modification of existing principles ?**
- **Which design principles (or adaptation of existing principles) would be required to address your design objectives ?**

However.....

- “In searching for Internet architectural principles, we must remember that **technical change is continuous** …
- In this environment, some architectural principles **inevitably change** … The principle of **constant change** is perhaps the only principle of the Internet that should survive indefinitely. ….
- The purpose of this document is not to lay down dogma about how Internet protocols should be designed, or even about how they should fit together. Rather, it is to convey various guidelines that have been found useful in the past, and that may be useful to those designing new protocols or evaluating such designs.”

RFC1958 (June 1996)

Next Steps

- Future Internet Design Principles
  - 17 March: Call for position papers published
  - 29 April: Contributions
  - 10 May: Compilation & Grouping – Circulation
  - 13 May: 1st PhC (to be agreed).
  - 18 May: 1st Draft
  - 23 May: F2F meeting in Brussels: (BU25, 0/S1), agree on the next steps.

Future Media Internet Architecture Think-Tank

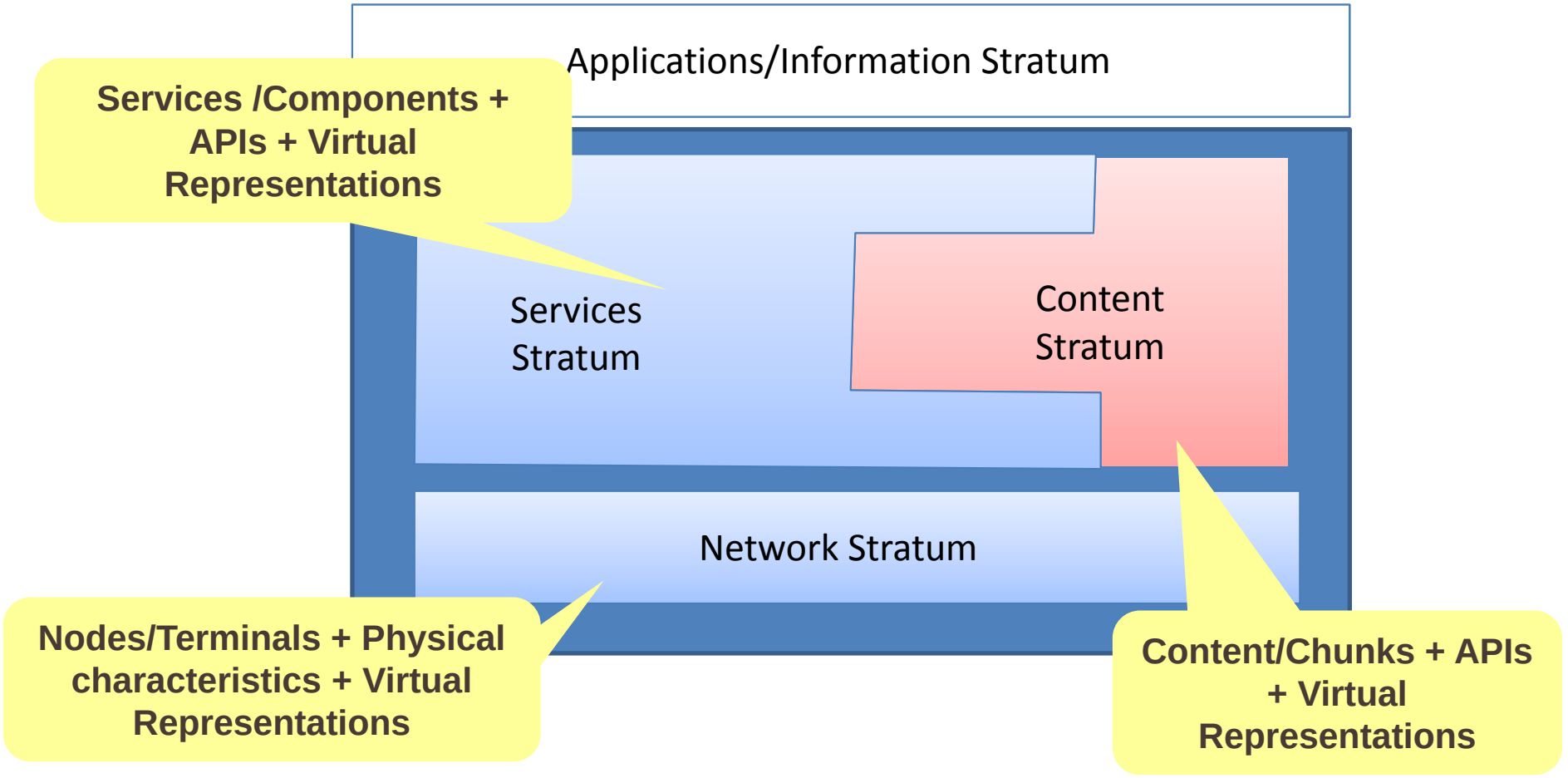
- ***The Future Media Internet is the FI viewpoint that covers the creation, composition, delivery and consumption of media over the Future Internet ecosystem***

- *COAST*
- *ENVISION*
- *iSEARCH*
- *OCEAN*
- *nextMedia*

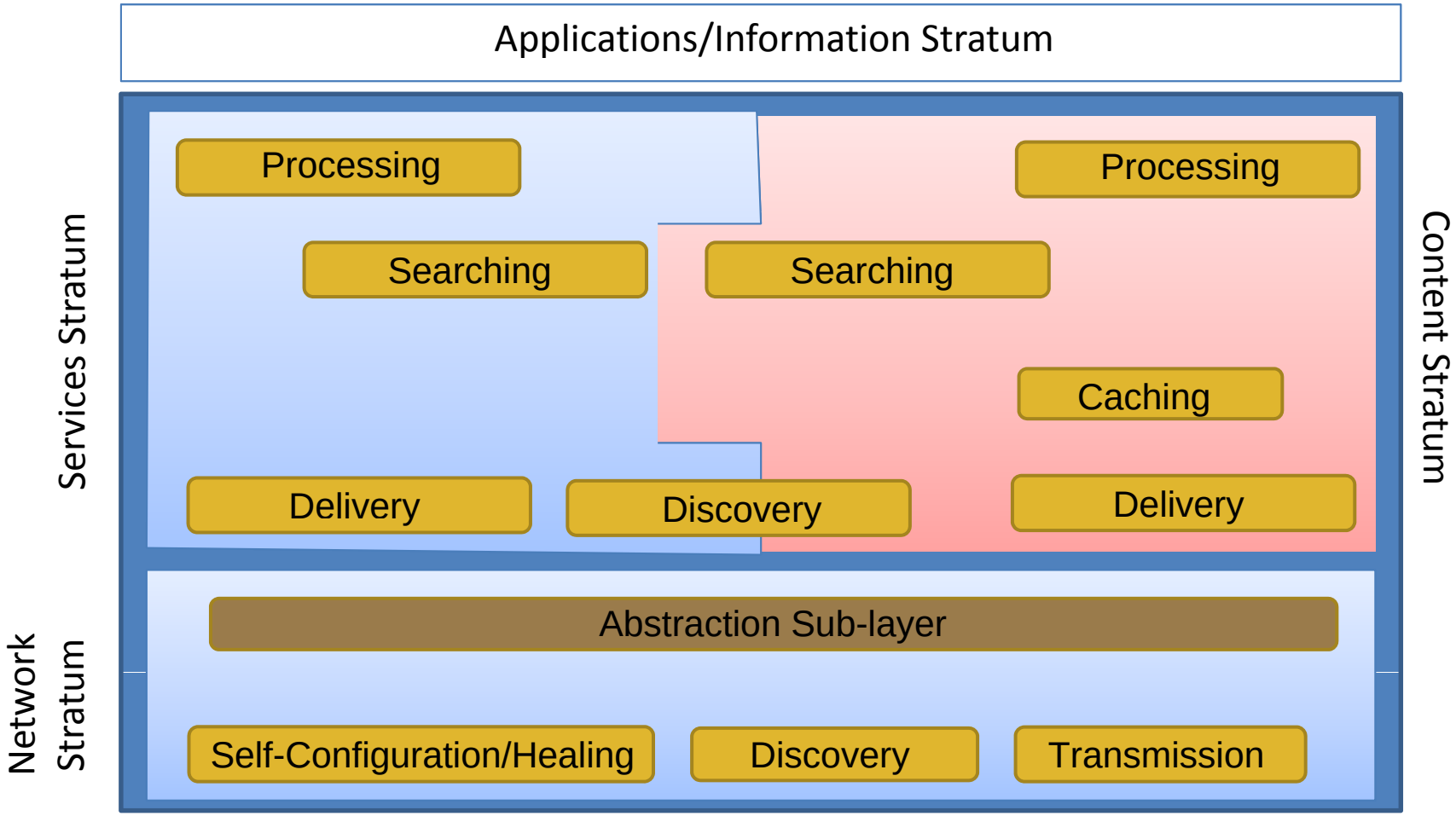
- *4WARD*
- *NEXOF-RA*
- *IoT-A*
- *Nanodatacenters*

- *Van Jacobson (PARC, US)*
- *Giovanni Pau (UCLA, US)*
- *Gonzalo Camarillo (Ericson, Fi)*
- *Pablo Rodriguez (TID, ES)*
- *Thomas Steiner (Google, DE)*
- *Amar-Djalil Mezaour (Exalead, FR)*

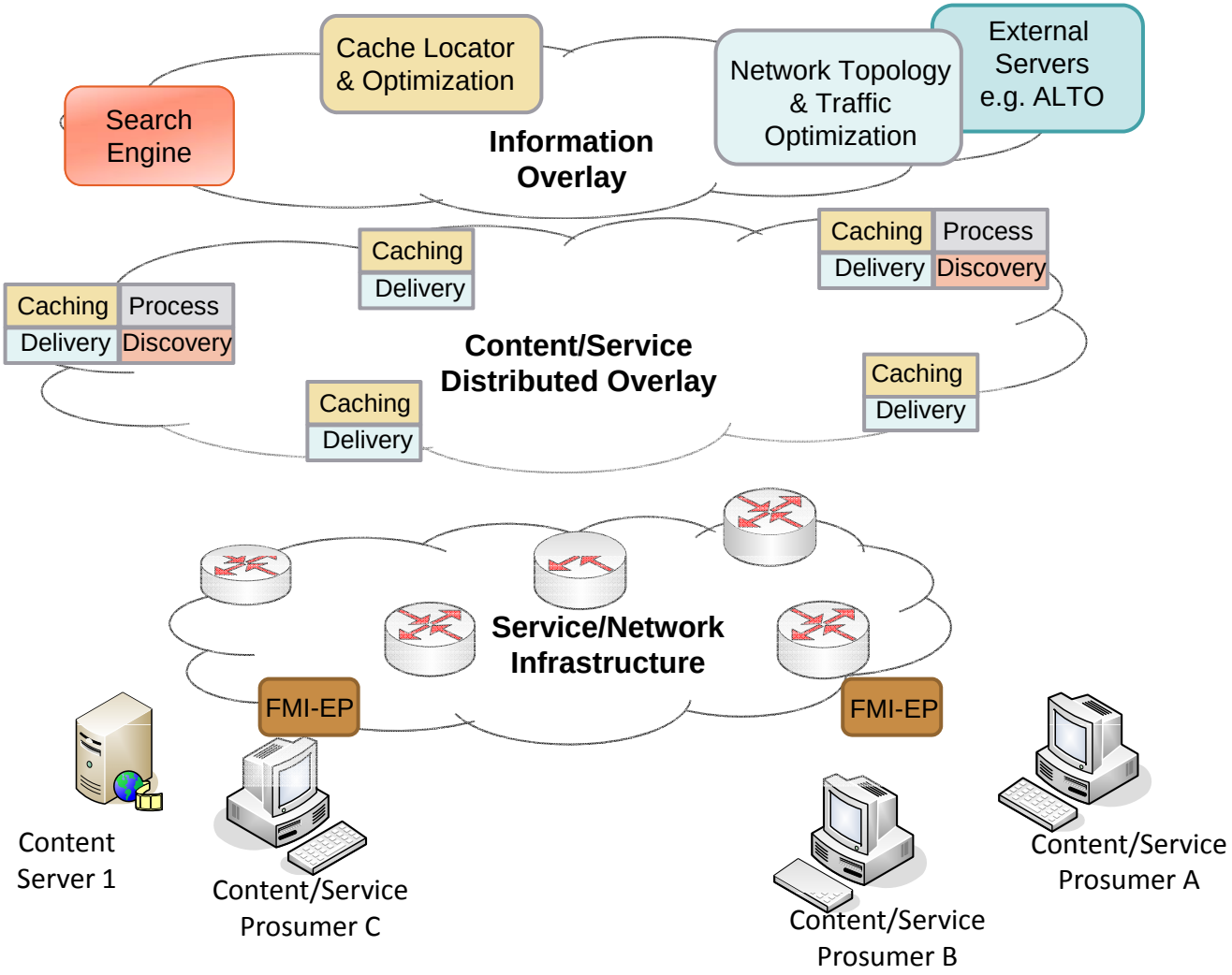
FMIA-TT


Applications/Information Stratum
Services /Components + APIs + Virtual Representations
Services Stratum
Content Stratum
Network Stratum
Nodes/Terminals + Physical characteristics + Virtual Representations
Content/Chunks + APIs + Virtual Representations

FMIA Protocol Stack



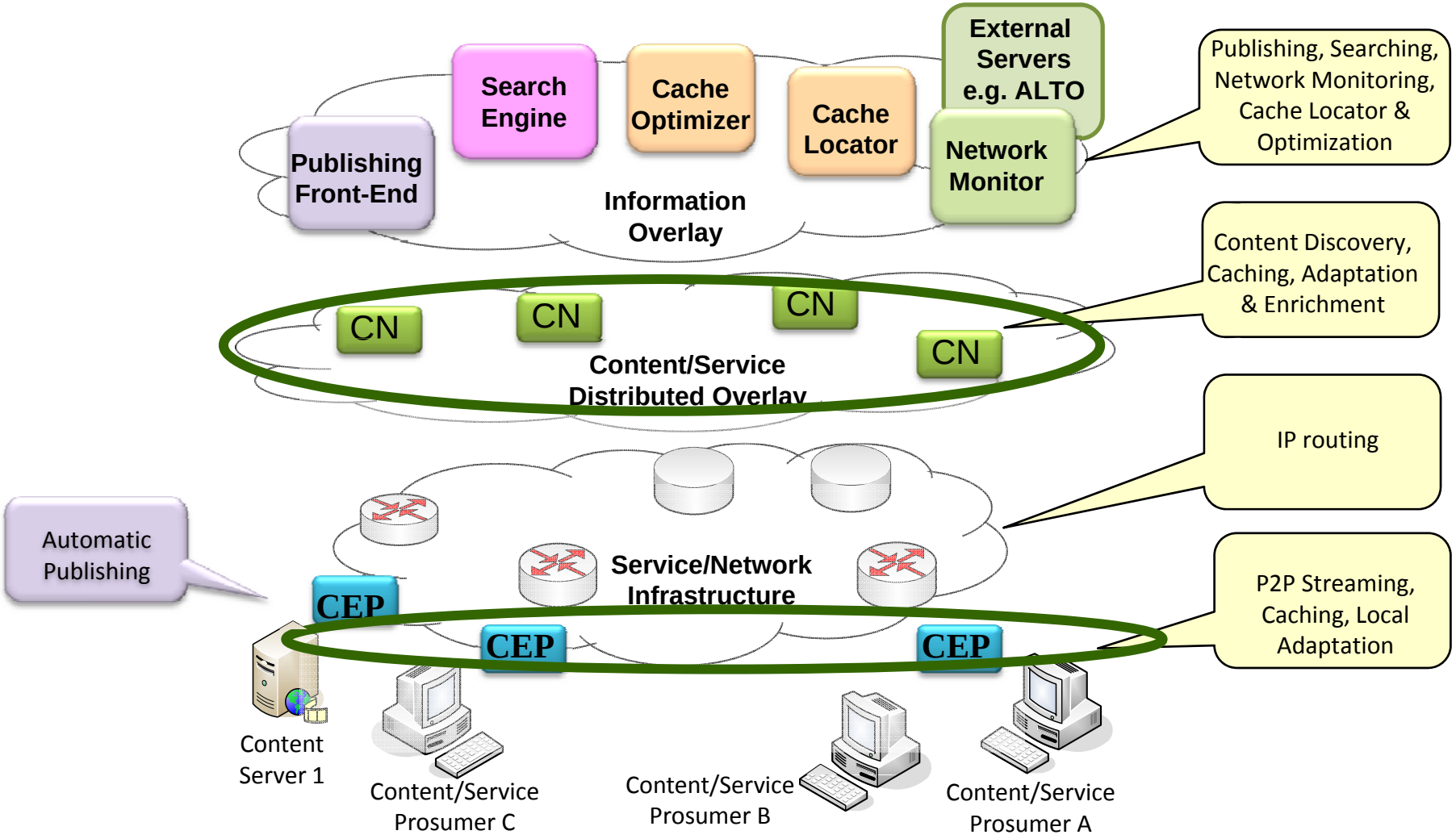
FMIA Proposed Reference Network Architecture



Status & Next Steps

- March 2011: Future Media Internet Architecture Reference Model (V1.0)
- 20 April: Open for public comments
- 15 June: F2F meeting in Brussels
- Sept 2011: Refinement and Finalization

Reference Implementation COAST



IETF:
Content Delivery Networks Interconnect (CDNI)

- Proposes the creation of a group which will standardize how separated Content Delivery Networks (CDN) can interconnect to each other CDNs to enable the delivery of content between the participating CDNs.
- The interconnection of CDNs means:
  - the exchange of **content information** (meta-data) between CDNs
    => which CDN offers what content and at what conditions (e.g., price, allowed regional distribution);
  - **operational information**, such as log files
  - the **exchange of content** amongst CDNs
  - **request routing** amongst CDNs.
  -
-

IETF:
Content Delivery Networks Interconnect (CDNI)

- Schedule:
  - 1st Year: Problem statement, use cases, framework and requirements.
  - 2nd Year: The actual protocol specification.
- 80th IETF Meeting (Prague)
  - CDN Interconnect (CDNI) Problem Space/Statement: Interconnection of intra-CDN (same administration domain) and inter-CDN (different administration).
  - Use Cases for CDNI
  - CDNI Video Publisher Use cases
  - CDNI Requirements
  - CDN Interconnection (CDNI) Experiments

Thank you

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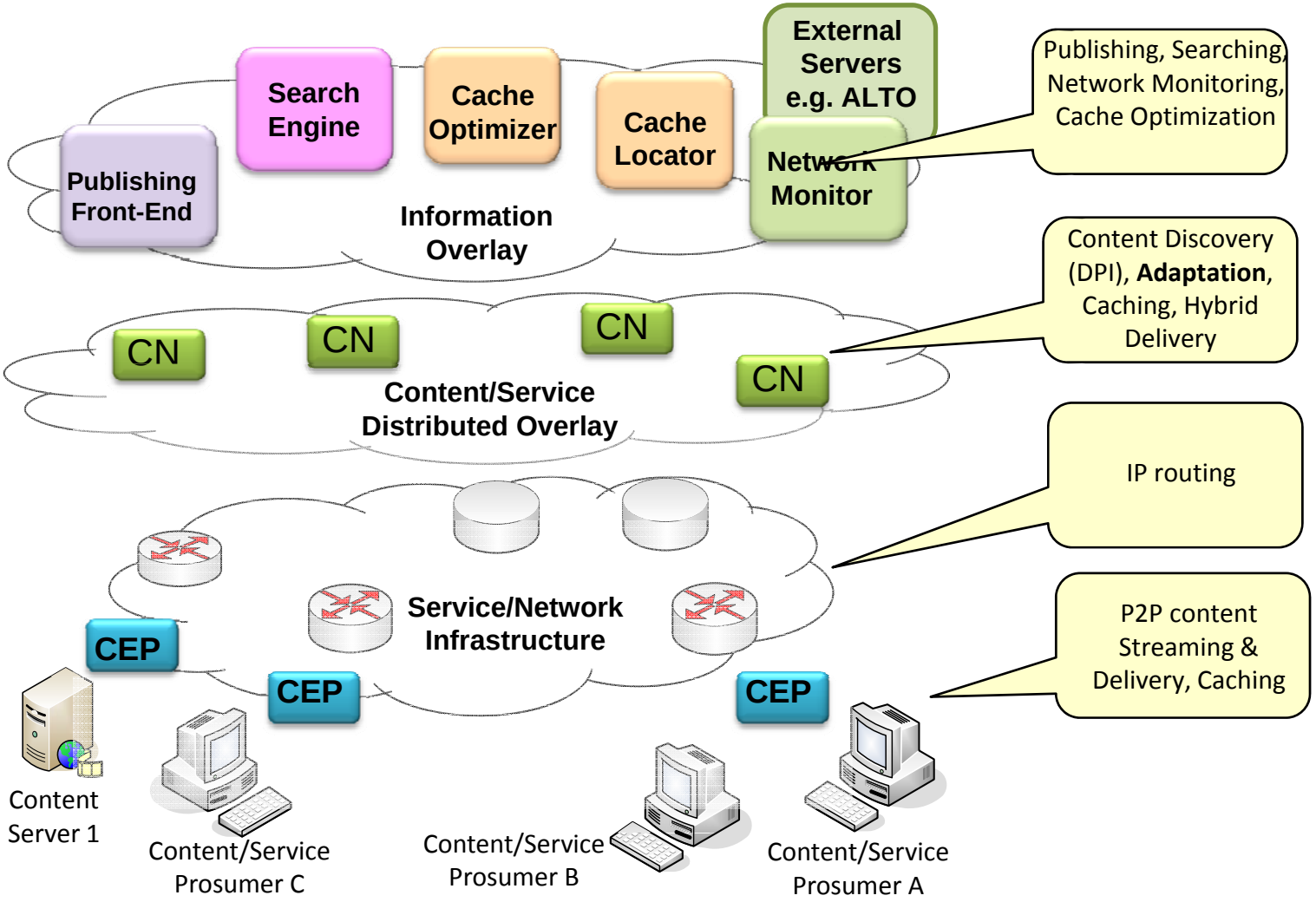
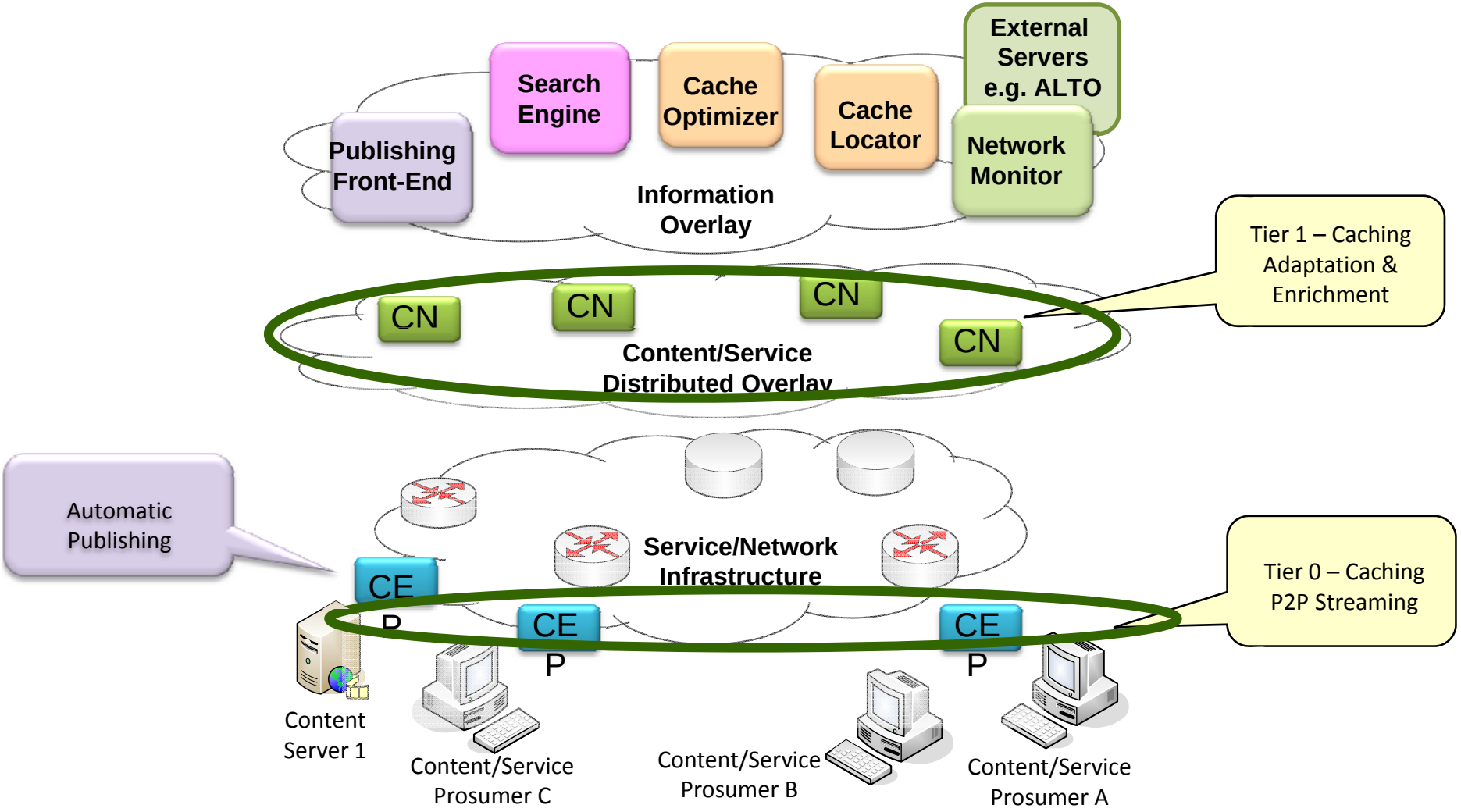
Reference Implementation COAST




External Servers e.g. ALTO
Search Engine
Cache Optimizer
Cache Locator
Network Monitor
Publishing Front-End
Information Overlay
Tier 1 – Caching Adaptation & Enrichment
CN
CN
CN
CN
Content/Service Distributed Overlay
Automatic Publishing
Service/Network Infrastructure
CE
P
CE
P
CE
P
Tier 0 – Caching P2P Streaming
Content Server 1
Content/Service Prosumer C
Content/Service Prosumer B
Content/Service Prosumer A