FIArch Group

Fundamental Limitation of Current Internet

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The Internet Today

- T
- for Christmas shopping ideas
- e products and prices on-line
- most equivalent to the
- r prices

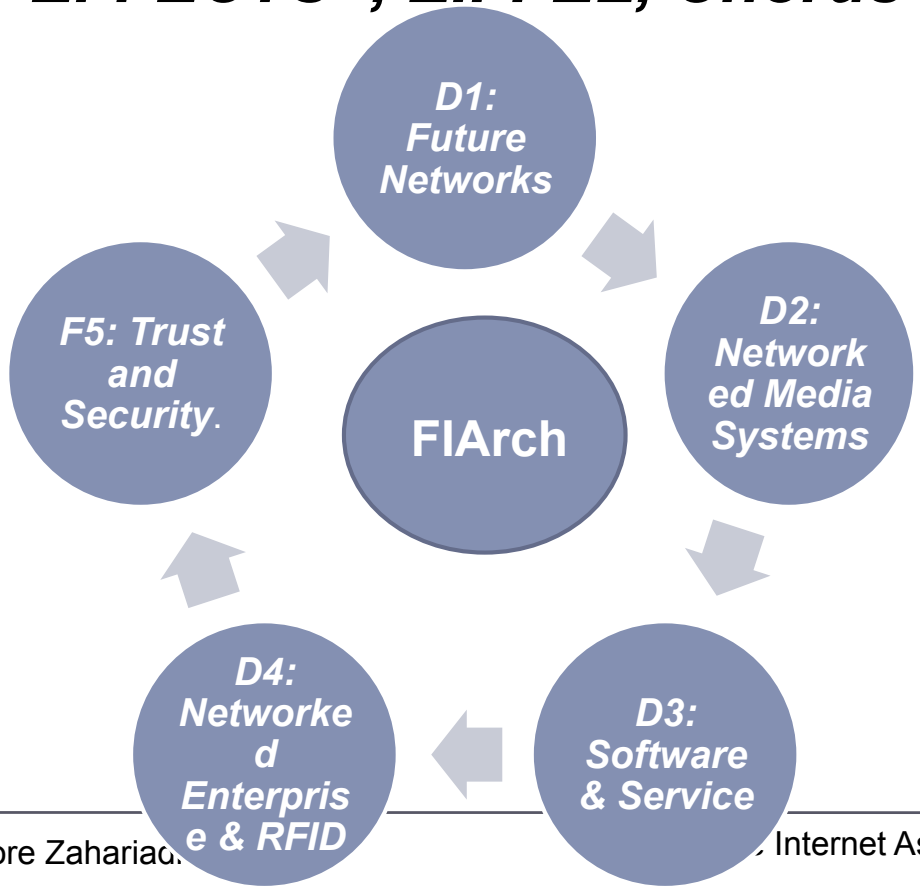
The Internet Today

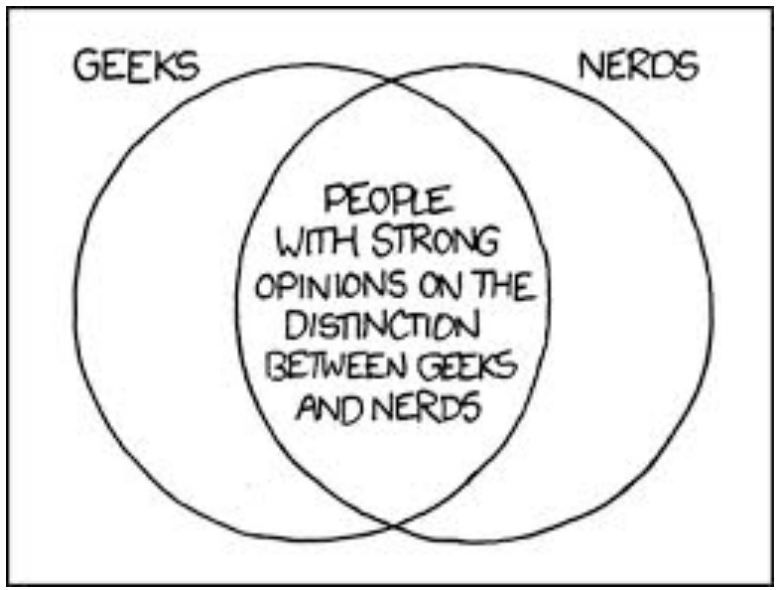
- The bad news
  - 82% of the Facebook users believe that *spam* is one of the largest Internet problems today
  - 49% consider *newsfeed* as spam.
  - 29% are afraid that someone may steal their ID
  - 30% of the Internet users spent some time everyday due to spam
  - In August 2010 the average daily number of spam was 326 Billions

Source: SurveyGizmo Oct-Nov. 2010, on behalf to F-Secure

What is FIARch Group

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





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Target Audience

- European ICT industry and decision makers
  (including but not limited to)
  - Telecom Operators
  - ISPs
  - Networking Equipment manufacturers
  - Software Vendors
  - Providers of Value-Added networking services

- Research and Academic community

What is FI?

- ***The Future Internet (FI) is expected to be a holistic communication and information exchange ecosystem…***
- ***which will interface, interconnect, integrate and expand today's Internet, public and private intranets and networks of any type and scale***
- ***in order to provide efficiently, transparently, timely and securely services (including essential and critical services) to humans and systems…***
- ***while still allowing for tussles among the various stakeholders without restricting considerably their choices.***

Where the document resides

- http://ec.europa.eu/information_society/activities/foi/research/fiarch/index_en.htm

Definitions

- ***"data"*** to refer to any organized group of bits a.k.a. data packets, data traffic, information, content (audio, video, multimedia), etc

- "***service***" to refer to any action performed on data or other services and the related API.(The definition of service does not include the services offered by humans using the Internet as a medium)

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.

Processing and Handling Limitations

- ***The Internet does not allow hosts to diagnose potential problems and the network offers little feedback for hosts to perform root cause discovery and analysis*.**
- ***Pure malice or selfish interests are detrimental to the cooperation between Internet users and providers.***
- ***Lack of data identity* is damaging the utility of the communication system.**
  - Data traverses the communication infrastructure multiple times, limiting its scaling,
  - Lack of content 'property rights' (author and usage rights) leads to the absence of a fair charging model.

Processing and Handling Limitations

- ***Lack of*** ***sing and handling*** **essential services** ealthcare, transport

  - ***Real-tim***

    - The limit ations.
    - Many ap ne Internet processi

Storage Limitations

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

Storage Limitations

- ***Lack of context/content aware storage management:*** Data are not inherently associated with knowledge of their context. So, it is not feasible to make efficient storage decisions that guarantee fast storage management, fast data mining and retrieval, refreshing and removal.
- ***Lack of inherited user and data privacy:*** In case we include data protection/ encryption methods, data can't be efficiently stored. On the other hand, lack of encryption, violates the user and data privacy.
- ***Lack of efficient caching & mirroring:*** There is no inherited method for on-path caching and mirroring of data/content (compared to off-path caching) that could deal with issues like flash crowding.
- ***Lack of data integration and federated storage solutions:*** There is an increasing need for access to federated distributed storage resources, particularly in view of collaborative activities and ad-hoc service compositions or sensor data aggregation.

Transmission Limitations

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

Transmission Limitations

- **Lack of efficient transmission of content-oriented traffic:** Transmission from centralized locations creates unnecessary overheads and non-optimal transmission when massive amounts of data are consumed.
- **Lack of integration of devices with limited resources to the Internet as autonomous addressable entities.** Environments such as sensor networks (or even nano-networks/smart dust) and machine-to-machine (M2M) environments operate with such limited capacity that partially operate the necessary protocols in order to be integrated at the Internet as autonomous addressable entities.
- **Security requirements of the transmission links:** Communications privacy is not only protecting/encrypting the exchanged data but even not disclosing that communication took place.

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.

Control Limitations

- ***Lack of flexibility and adaptive control***. IP (and more generally communication) control components are driven exclusively by cost/ performance ratio considerations leaving very limited (functional) flexibility.
- ***Segmentation of data and control.*** The current Internet model segments (horizontally) data and control, whereas from its inception control has a transversal component i.e. IP control component applies across layers even those not associated with IP forwarding.
- ***Lack of unified architecture of the IP control plane***. The IP data plane is itself simple but its associated control components are numerous and thus their interactions more and more complex.
- ***Lack of efficient congestion control.*** Congestion control cannot be realized as a pure end-to-end function: congestion is an inherent network phenomenon that can only be resolved efficiently by some cooperation of end-systems

Cross area + operational Limitations

Cross area + operational Limitations

- ***Traffic growth vs heterogeneity in capacity distribution:*** There are serious limitations in the transmission capacity mainly due to the great heterogeneity (especially the traffic exchange points). However, the telecom operators hesitate to further invest in network infrastructure as there is no clear business plan for return on investment.
- ***The current inter-domain routing system is reaching fundamental limits*** in terms of routing table scalability but also adaptation to topology and policy dynamics that in turn impact its convergence, and stability properties.
- ***Scaling to deal with flash crowding.*** The huge number of (mobile) terminals combined with a sudden peak in demand for a particular piece of data may result in phenomena which can't be handled.
- The amount of foreseen data requires significant ***processing power / storage / bandwidth for indexing / crawling and (distributed) querying*** and also solutions for large *scale / real-time data mining / social network analysis*

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 and by means of various/heterogeneous wireless/radio and wired 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)

Design Objectives

- Low Level Objectives:
  - **Reliability** (capacity to perform what it is expected with a growing number of users with increasing heterogeneity).
  - **Robustness/stability**, resiliency, and survivability
  - **Security**
  - **Flexibility** (capacity to adapt/react in a timely and cost-effective manner when internal or external events occur that affect its value delivery) and **Evolutivity** (of time variant components)
  - **Simplicity and cost-effectiveness**
  - Ability to offer **information-aware transmission and distribution**. .

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.***

Thank you

SEVENTH FRAMEWORK PROGRAMME

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http://ec.europa.eu/information_society/activities/foi/research/fiarch/index_en.htm

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