Enabling SCI-FI: Service-oriented Context-aware and Intelligent Future Internet

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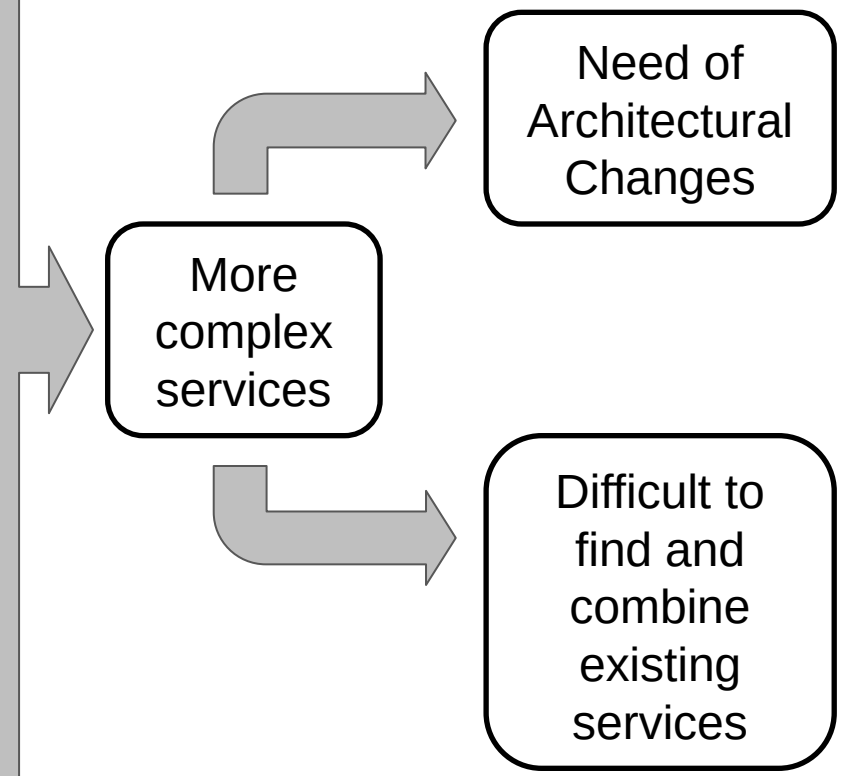
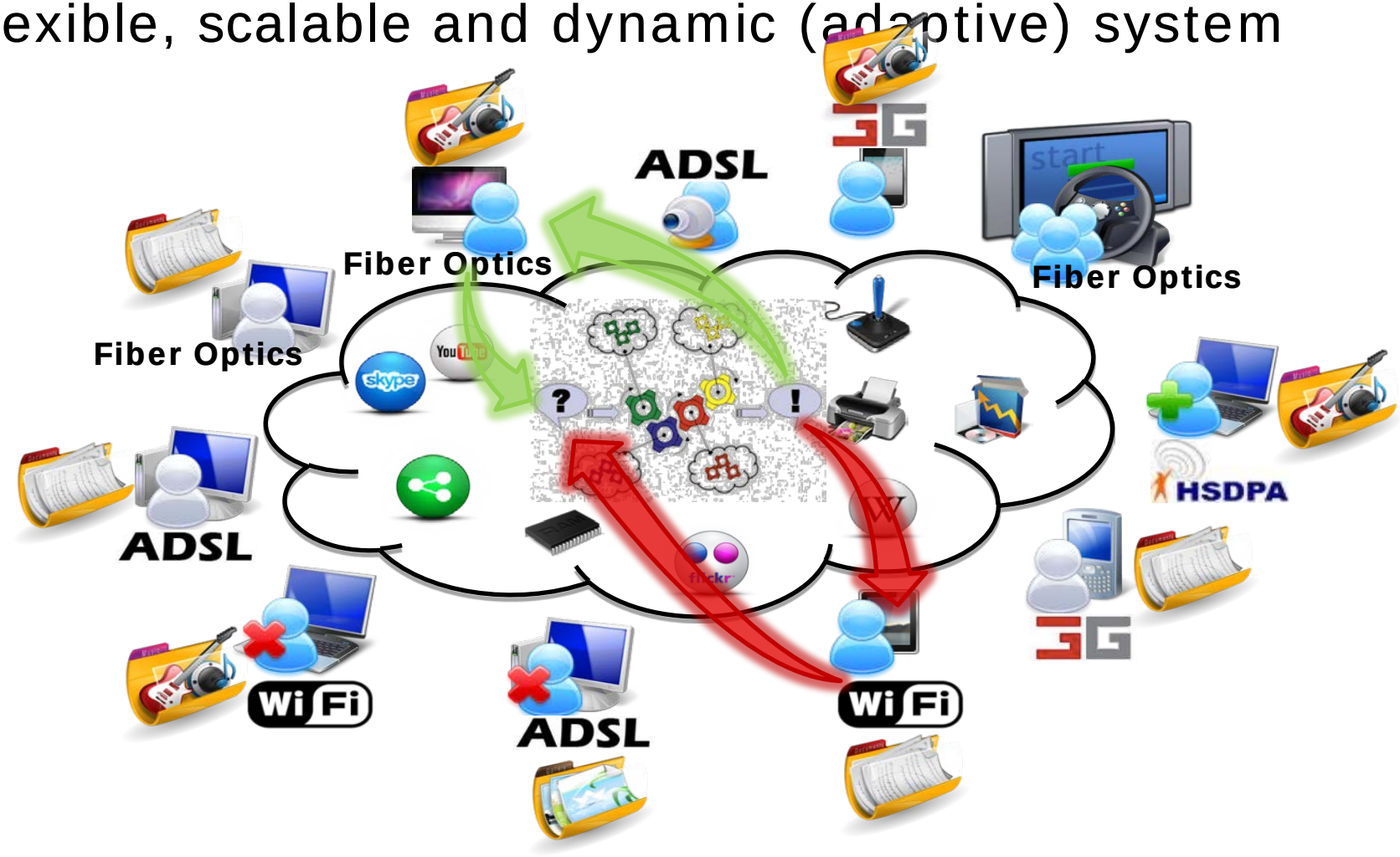
Problem Statement

- **Bandwidth** growth (video, IoT)
- New **applications** and **services**
  - New requirements: security, mobility, …
  - New computing paradigms:
    - Pervasive/ubiquitous computing
    - Internet of Services (IoS)
    - Ineternet of things (IoT)
    - Heterogeneity and dynamicity
- Restricted **layer** structure (TCP/IP)
  - Cross-layer solutions
  - Sub-layers arising
  - Middle-boxes (NAT, FW,…)



Motivation

- Establish more efficient and reliable communications (QoS, QoE)
- Flexible, scalable and dynamic (adaptive) system

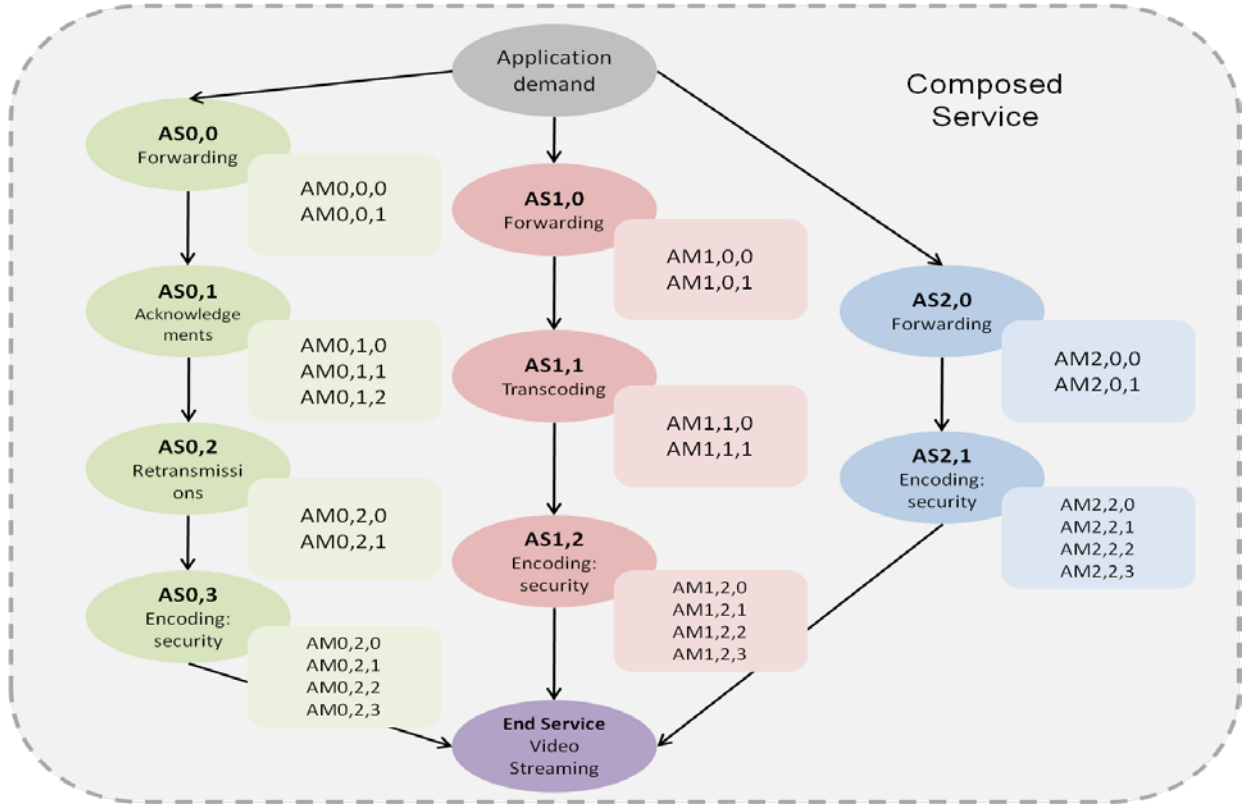


Motivation

- How?
  - **Role Based Architecture (RBA)**
    - **Decomposition** of fundamental functions (services)
  - **Service Oriented Architectures (SOA)**
    - Assembly of **necessary functions (services) dynamically** according to:
      - **Requirements (QoS, QoE, etc.)**
      - **Context**
        - Network conditions: topology, bandwidth available, etc.
        - User: preferences, constraints
        - Device: characteristics, interfaces
        - Service: Cost, content/service restrictions, etc.
        - Other: Geographic location, etc.

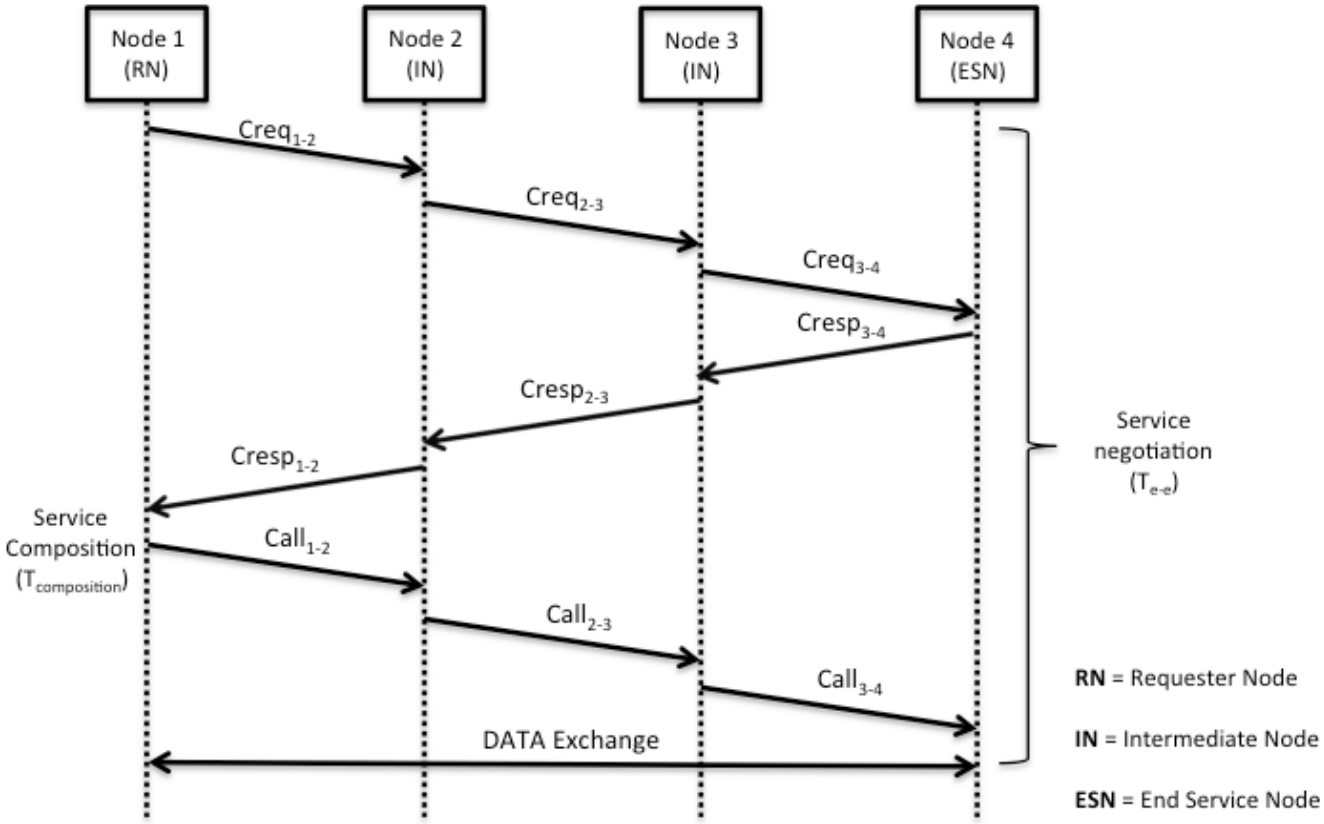
SCI-FI Overview

- **Main elements, pieces:**
  - **Atomic Services** (AS): fundamental blocks that offer non-divisible, self-contained functions (e.g. acknowledgement, forwarding)
  - **Atomic Mechanisms** (AM): specific implementation of an AS
  - **Composed Services** (CS): services built by assembling different ASs
  - **Work Flow** (WF): concatenation of ASs to be executed into a node



SCI-FI Oveview

- **Service Discovery Process**

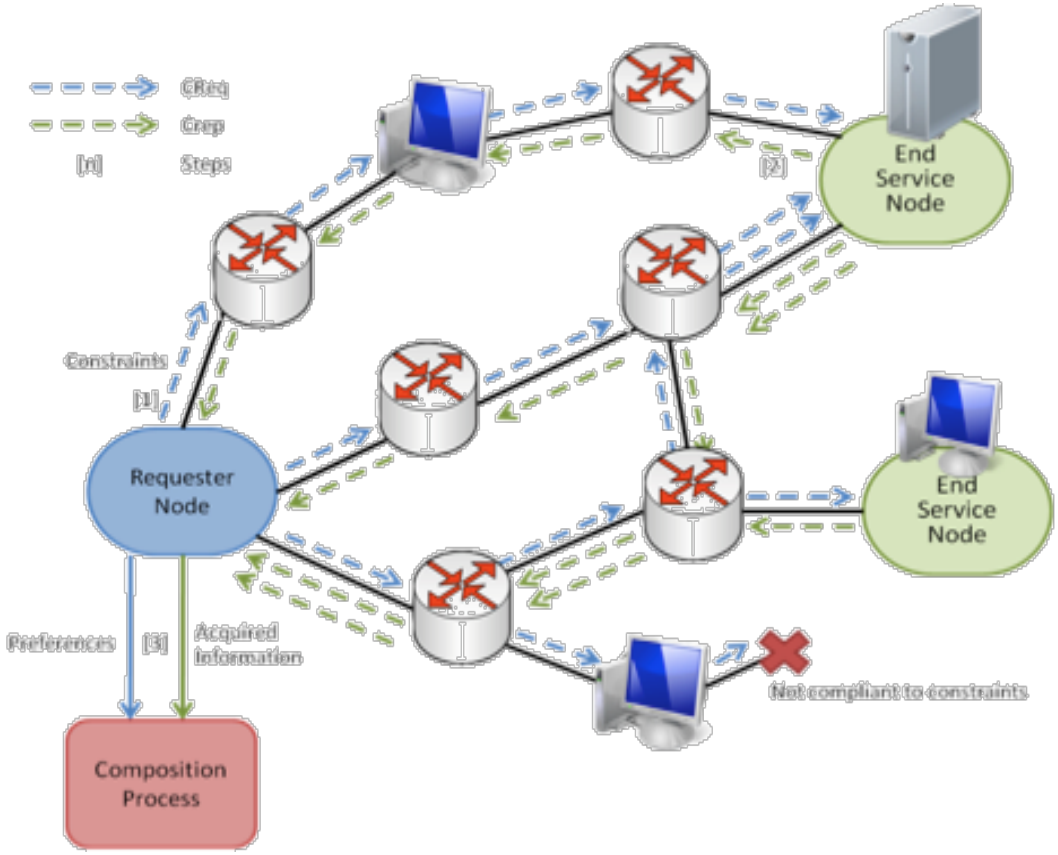


- Identify the set of nodes (path) that can provide the desired end service
- Identify the ASs that may be required in:
  - o INs
  - o ESN
- Gather information of the nodes:
  - o ASs
  - o other constraints
  - o links (between RN and ESN)

SCI-FI Oveview

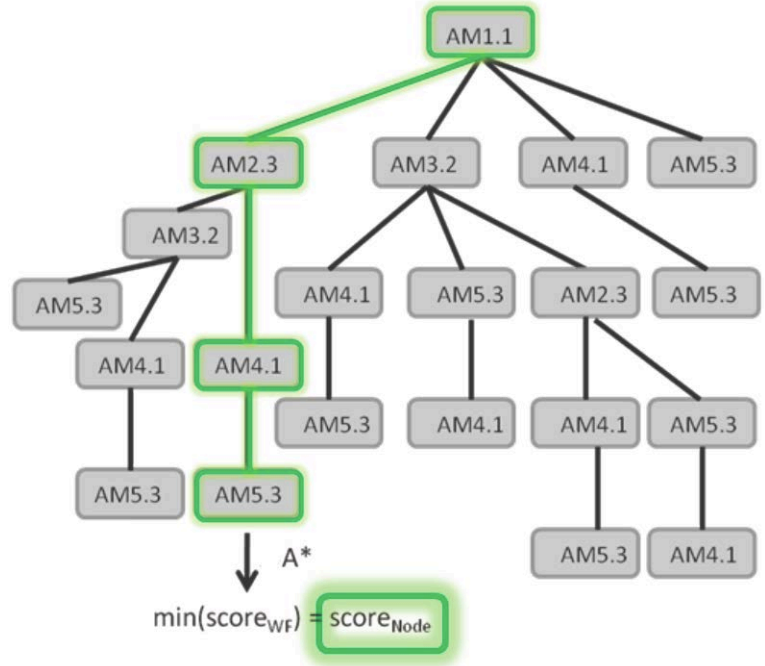
- **Service Discovery Process**

  - 3 Steps:
    - Requirements are mapped to a service request (CReq)
    - Receiver nodes evaluate if they can provide or not the service
    - Nodes response which services and which characteristics they can provide and it is checked to guarantee service provisioning



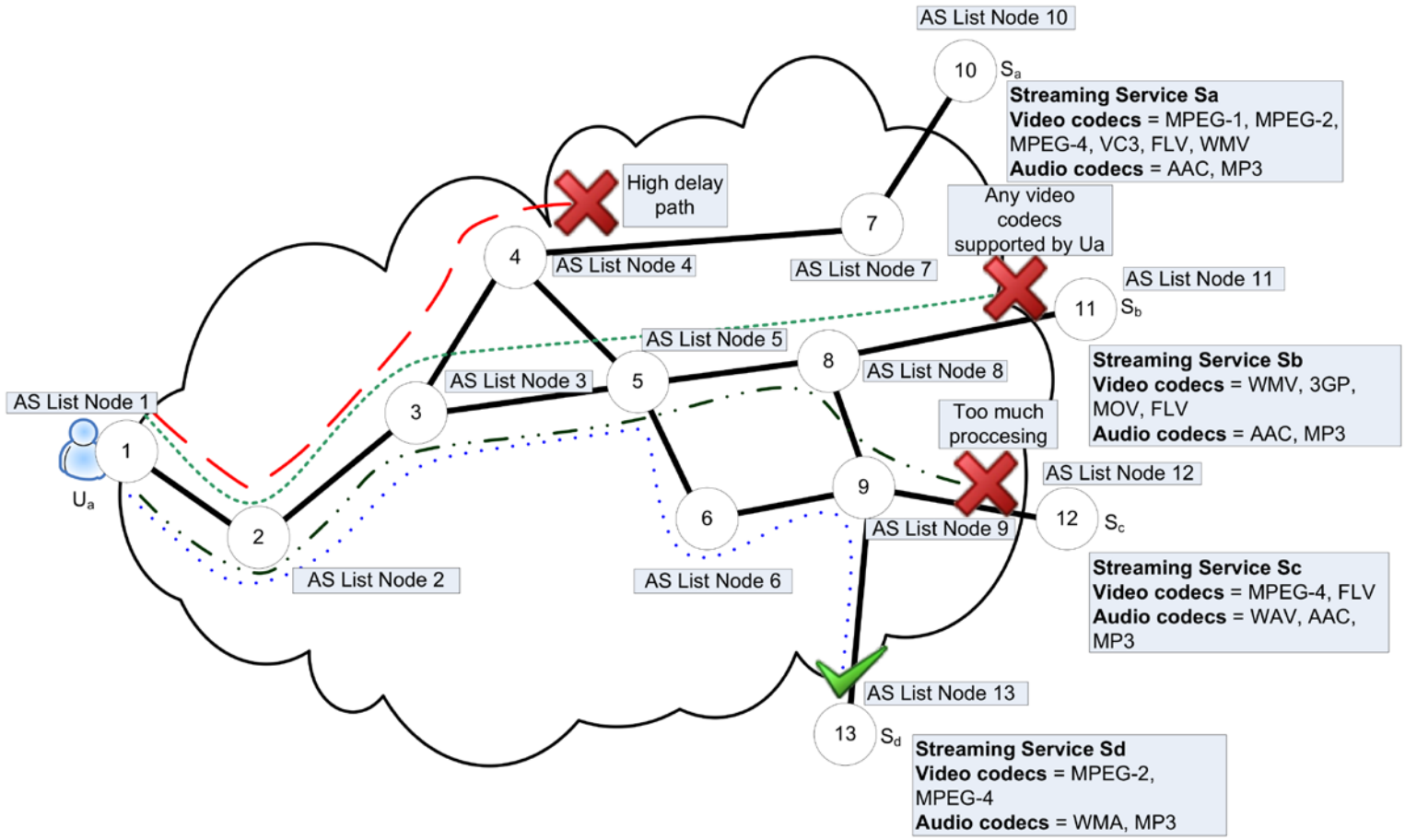
SCI-FI Oveview

- **Service Composition**
  - Prioritized selection and combination of the end service and intermediate ASs among all the candidates found during the service discovery phase
  - Service selection must take into account domain policies and effects that the usage of a service produces over the network (e.g. delay, congestion, cost, etc.)
  - 3 Phases:
    - AM scoring
      - AM that implements each AS is selected
    - AS composition
      - AS that will offer the desired effect are selected
    - Path selection
      - Selection of nodes implementing the required ASs



Use Case

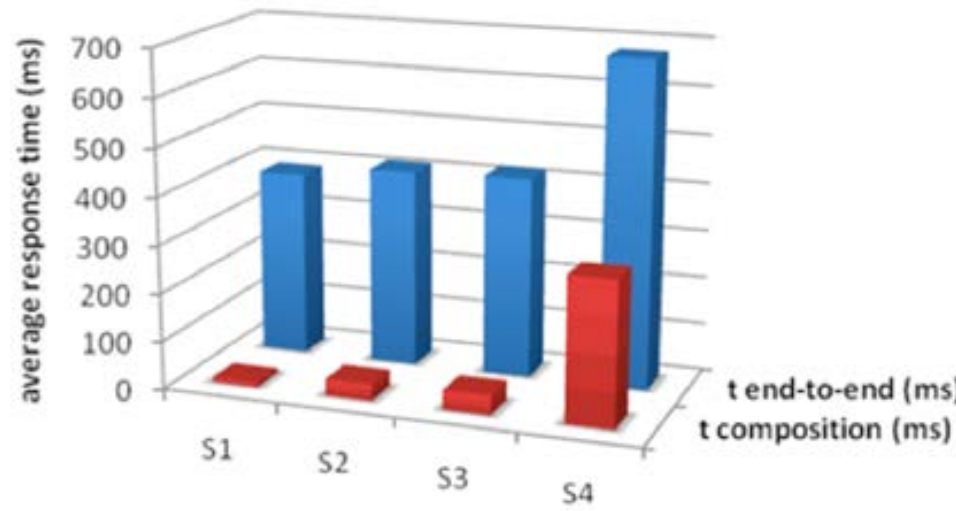
SCI-FI goal:
enable FI communications that permit to meet QoS/QoE requirements whilst satisfying user expectations



Evaluation

- **Evaluation**
  - **2 developments**
    - System-on-Chip CC2430 from Texas Instruments platform
    - PC Linux-based

Node Type	CPU	RAM
Requester Node (RN)	13%	340KB
Intermediate Node (IN)	5%	180KB
End Service Node (ESN)	9%	250KB



*Results for PC Linux-based C-based development:

- Pentium 4 540@320GHz
- 1MB L2 Cache
- FSB 800MHz
- 512 MB RAM
- Ubuntu 11.04 (32 bits)
- 8 nodes : 1xRN, 3xESN, 4xIN)

Conclusions

- **Internet has evolved** a lot and keeps growing very fast
  - Heterogeneous and dynamic growth
  - Bandwidth demand is increasing
  - New services, new applications
- Apply **SOA paradigm** as the basis of a **new FI architecture**
  - **Avoid rigid layering**
  - **Flexible** and **scalable**
- **Service-Oriented Architecture and Role-based Architecutre:**
  - **Requester discovers, selects and composes communications** according to its requirements and context conditions (cost, location, availability, etc.)
- **Use Case**
  - A first proof-of-concept that establishing the grounds of the proposed architecture
  - Results obtained demonstrate that it is feasible at least at small-mid scale networks

Future Work

- **From RN to decentralized approach**
  - **Distribute** the composition **cost among nodes**
  - More intelligence to the network
- **Analyze** other composition methods
  - **Different composition in each case**
  - Comparisons and benchmarks of composition algorithms
- Consider applying **IA Planning methods** as future optimization of the proposed generic composition

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Thanks!
Q & A?