

Future Internet Assembly in Stockholm

Session II.1

“Orchestration Across Networks, Services, Things and Content”

System of Systems viewpoints

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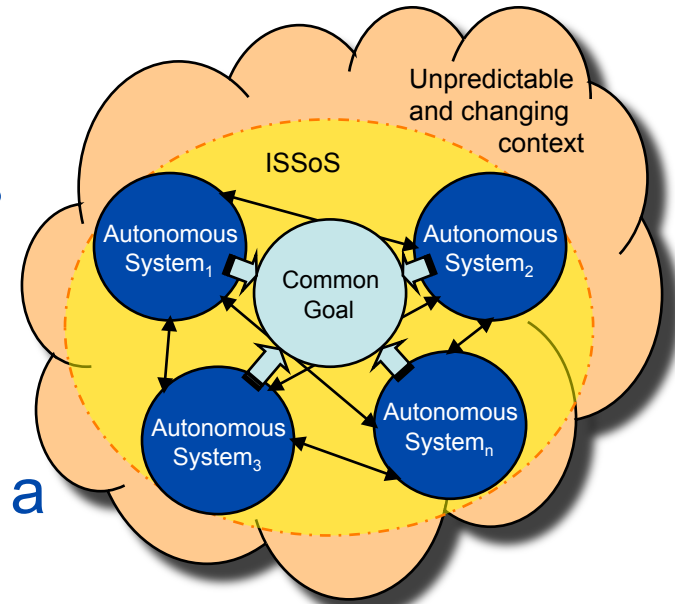
Agenda

- SoS / ISSoS Background
 - What are we talking about
 - Key characteristics
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 - Scenarios
 - Projects
- ISSoS General Requirements
 - Interoperability
 - Engineering / Deployment
 - Governance
- ISSoS Specific Orchestration Requirements
 - Derived from ISSoS General Requirements

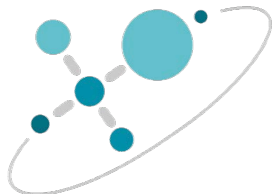
What are we talking about

- Internet Scale Systems of Systems (ISSoS) is a paradigm that describes systems which are assembled of many autonomous systems that collaborate by means of Internet in order to attain a common goal within a changing and unpredictable context.

As defined in NASSE Workshop at ServiceWave'08 organized by NESSI



- ISSoS subsystems where not necessarily designed to meet the requirements of the final system.



ISSoS
Internet Scale Systems of Systems

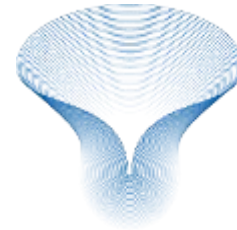
Key Characteristics

- Unanticipated emerging behaviours
- Lack of a universal view of the whole system
- Lack of synchronization between processes
- Latent incompatibilities
- Ad-hoc interoperability
- No a-priori requirements
- De-centralized governance




History

- **ISSoS** initiative was triggered in the NASSE workshop at



ServiceWave 2008
December 10th - 13th 2008, Madrid, Spain
<http://www.servicewave.eu/>

- ISSoS has a working group within the Spanish Future Internet platform: 
(www.idi.aetic.es/esInternet)
- ISSoS is about evolving SoS towards Future Internet requirements
- ISSoS fundamentals are in SoS. Major references:
 - European Software Institute –TECNALIA
(<http://www.esi.es/issos>)
 - Software Engineering Institute
(www.sei.cmu.edu/isis/)
 - Systems of Systems Engineering Center of Excellence (www.sosece.org)

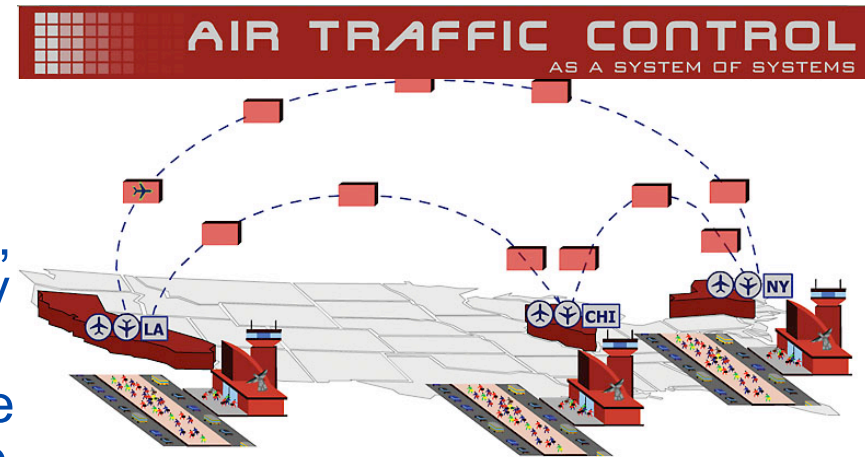
History

- Scenarios

- **Crisis management** where different organisms are involved (Red Cross, firemen, police, 112, hospitals,...) to solve emergency situations
- **Transport and logistics** e.g. the integration of European airspace.
- **Energy Grid**: integration of different power generation and consumption networks
- **Enterprise systems** (ERP, CRM, plant level devices, provisioning,...)

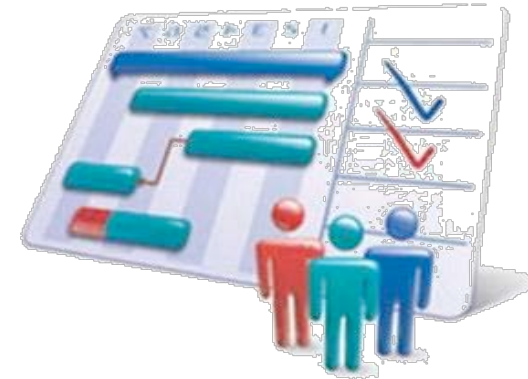
- (Proposed) Projects

- POMPEII - Emergency Management (real scenario)
- PERSIMMONS – Simulation (concept and framework)
- EMUS – Experimental facility (experimenting with predictability and governance on real physical infrastructure)



ISSoS Interoperability Requirements

- Process
 - Design/Definition of Common Collaborative Process(es)
- Service
 - Modelling, Composition, Semantics
- Data
 - Modelling, Structure, Semantics
- Heterogeneous devices (IoT)

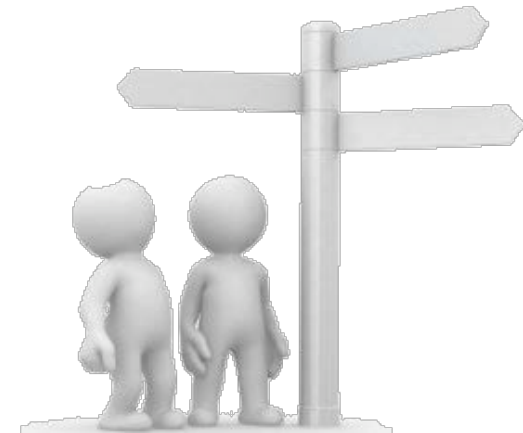


ISSoS Engineering / Deployment Requirements

- Collaborative Business Process Modelling
 - Process synchronization
 - SoS workflow
- Virtualization
 - Distributed systems requiring virtualization on different layers
- Evolvability [ability to produce enough advantageous variation to allow adaptive evolution to occur – Wikipedia]
 - Dynamic adaptation capabilities
- Predictability
 - Scoping variability in the design phase
- Support for critical applications
 - Determinism & Safety Integrity Level (SIL) 4
- Engineering against POET priorities (vs. TOEP)
 - Political > Operational > Economic > Technical

ISSoS Governance Requirements

- SLA management / enforcement
- QoS management / enforcement
- Federated governance models
 - Negotiation
 - “tussle” (conflicting interests/policies)
- Self Orchestration
 - Adaptability to changing context
- Self-configuration & Self-awareness
 - Two key means to enable self-governance
- How to handle emerging behaviour?



IsSoS Specific Orchestration Requirements

- Interoperability
 - Mediating interoperability layers
 - *Mechanisms and capabilities for allowing heterogeneous systems to interwork*
 - Loose interaction paradigms
 - *publish/push/subscribe mechanisms and capabilities for dissemination of knowledge regarding the OP*
 - *Mechanisms and capabilities for FI federation*
- Engineering
 - Cross organizational / domain workflow management
 - Mechanisms and capabilities for controlling workflow
 - Dynamic context-specific adaptation and resource allocation
 - *Mechanisms for dynamically optimising, organising, re-configuring and adapting other systems under supervision*
 - *Mechanisms for supervision of resource allocation in several virtual systems*

IsSoS Specific Orchestration Requirements

- **Governance**

- *Mechanisms for distributed governance*
- *Mechanisms for negotiation and conflict resolution*
- *Mechanisms for allowing conflicting interests / policies*
- *Mechanisms for cognitive control*
- *Mechanisms and capabilities for controlling the sequence and conditions in which one system component invokes other system components*

- **Lifecycle system supervision**

- *Mechanisms and capabilities for allowing nesting of different control loops*
- *Mechanisms for creating a holistic network view*