Systems Engineering for Software-Defined Network Virtualisation

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Agenda

Motivation

Case Studies

Opportunities and Challenges

Questions

SESA/INCOSE Telecommunications Working Group

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Motivation
Enablers

**Software-Defined Networking (SDN)** decouples data plane and control plane

**Network Function Virtualisation (NFV)** decouples service functions and infrastructure


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SDN/NFV Benefits

1. Higher Asset Utilisation
   Across whole of Network
   - Today - Dedicated Hardware for each network function.
   - With Virtualised Network Functions
   - Effective Aggregate Capacity
   - Infrastructure Saving

2. Lower Equipment Costs
   Greater competition due to “whiteboxes” & open source SW
   - Initial SDN development (professional services)
   - Small saving beyond year 1
   - Note: Long term difference could be marginal due traditional vendors responding to competitive threat

3. Fewer Physical Ports
   with service chaining
   - 18 Ports
   - 6 Ports
   - Virtual Ports
   - Physical Interfaces

4. Lower Deployment Costs
   Fewer truck rolls. New functions deployed as Software

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SDN/NFV Architecture

Network Functions self-optimise: expand / contract and change location “autonomously”

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Case Studies
1. Disaster Recovery

Cyclone Debbie

If all primary links fail, the SDN Application ensures Critical Interstate Traffic has priority.

During Cyclone Debbie, 1 link failed due to loss of power

Primary High Capacity redundant Interstate Links

2 x Temporary physical links established (as backup)

Protecting critical communications over lower bandwidth emergency links.

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2. National Analytics Backbone

- Access Network
- Fixed Broadband Control Server
- Existing single Collector: With traffic sent over the core network. An Overlay
- Core network
- National Analytics Backbone

Provides redundancy for collection of network monitoring data

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2. National Analytics Backbone

**Benefit**

Traditional Overlay Model  Native SDN Model

Network Traffic

Device Port or TAP

Overlay

Network Packet Broker Appliance

Underlay

Layer 3 Networks

Layer 2 Networks

Optical Transport Network

Shifts functionality from the “underlay” hardware to software and Virtual Machines

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3. Provider Edge Routing

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3. Provider Edge Routing

Initial footprint

NFVi: Network Function Virtualisation Infrastructure

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3. Provider Edge Routing

**NFVi Architecture**

- **Networks**
  - IP Core Network
  - Telephony Applications Network
  - Management Network

- **Over Cloud**
  - NFVi Network
  - OpenStack Controller
  - OpenStack Storage
  - OpenStack Compute
  - Virtual Provider Edge

- **Under Cloud**
  - Director

**Management Functions**
- Orchestration
- Configuration
- Alarms and Logs
- Authentication, Authorization, and Accounting (AAA)
- Backup & Restore
- Domain Name System (DNS)
- Reporting

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Challenges and Opportunities
Technical Challenges

Management and Orchestration
Traffic and function monitoring; Interoperability; Programmability; Self-management e.g., alarm processing

Energy Efficiency
Deployment studies; Energy-efficient hardware; Energy-aware function placement

NFV Performance
Selected hardware acceleration; Performance-flexibility trade-off

Resource Allocation
Placement, migration and scheduling of virtualised network functions; Resilience; Scaling up and down

Security, Privacy and Trust
Network performance isolation; Multi-administrator isolation

Modelling of Resources, Functions and Services
Runtime management; Federated services; Easier modelling/deployment design


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Ecosystem Challenges

The industry is still maturing

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# Systems Engineering Opportunities

<table>
<thead>
<tr>
<th>Sys Eng Process</th>
<th>Opportunities to influence typical SDN/NFV practices</th>
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<tr>
<td>Business analysis</td>
<td>Improve discipline of assessment of opportunities to a) cull capital and operational expenditure and b) provide new customer services. <em>Value engineering</em>.</td>
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<tr>
<td>Architecture definition</td>
<td>Achieve automation, flexibility and interoperability by improving fidelity of models of system resources, functions, services and interfaces. <em>Model-based systems engineering. Reliability engineering.</em></td>
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<td>Verification</td>
<td>Improve continuity and automation of integration testing, for solutions that will contain a mix of traditional and virtualised network elements for some time.</td>
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<td>Transition</td>
<td>Improve automation and frequency of deployment to production environment, while maintaining system availability.</td>
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<td>Lifecycle model management</td>
<td>Improve use of evolving, concurrent define-develop-operate models, controlled by evidence and risk-based decision processes. <em>Agile systems engineering.</em></td>
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Questions
SESA/INCOSE
Telecommunications
Industry Working Group
The purpose of this working group is to improve telecommunications services by developing a body of knowledge that advances Systems Engineering of telecommunications solutions.
Working Group Feasibility Criteria

1. Eight contributors prepared to invest 30 minutes for a weekly call and an average of one hour per week for the next year in developing working group material.
2. Three engineering executive sponsors of telecommunications solutions, with at least one from a leading US telecommunications service provider.
3. Alignment and cooperation with INCOSE working groups for model-based systems engineering, security systems engineering, agile systems engineering, systems of systems, reliability and critical infrastructure.
4. Plan of work aligned with at least one leading telecommunications industry standards body.
5. Shepherding by SESA and INCOSE technical directors.
Working Group Discussion Items

Roundtable discussion – 15 minutes
What two telecommunications systems engineering opportunities interest you?
Who could you engage to champion or shepherd the group?
What actions could you take to improve working group outcomes?

Roundtable reports – 15 minutes
Report back

Next steps
Register your interest and contact details today with John Risson,
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Thankyou