



Management and Service-aware Networking Architectures for Future Internet (MANA)

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Presented by

Alex Galis

University College London

a.galis@ee.ucl.ac.uk

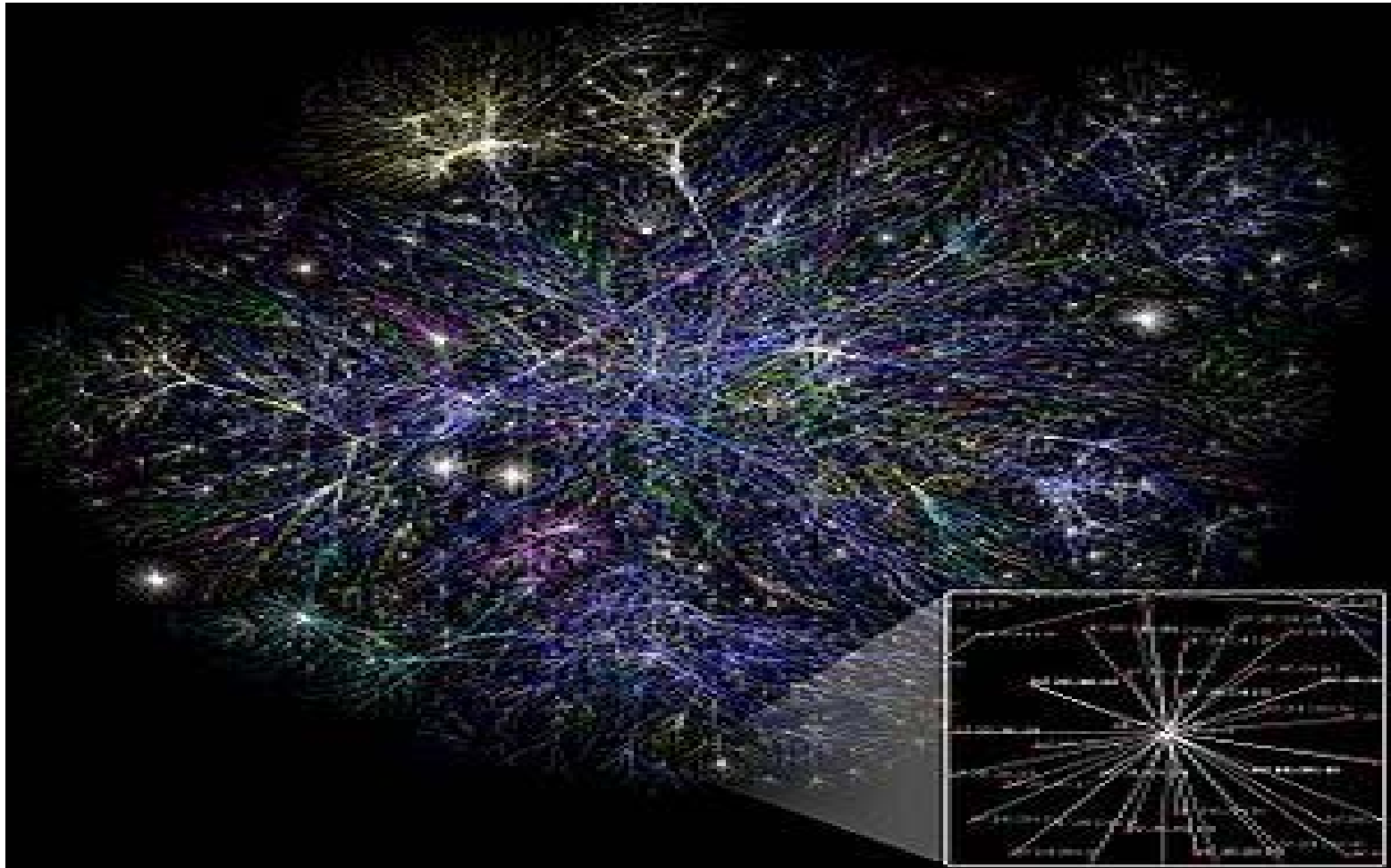
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Content

- Internet Evolution : Way/How to change Internet
- An architectural model for Future Internet
- Research Roadmap
- Conclusions

Internet 2009



Why to change

Current Internet = Network of Interconnected uncoordinated networks

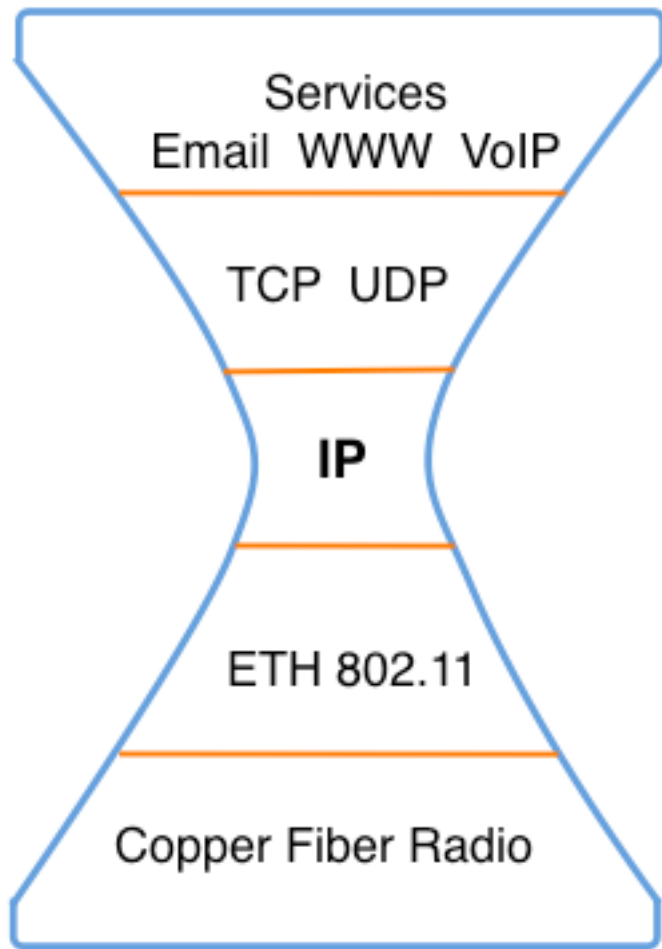
- **Size & Costs:**
 - **$N \times 10^9$ connectivity points - status: reaching maturity and maybe some limits**
 - **$N \times 10^5$ services /applications - status: fast growing**
 - **$N \times 10^3$ exabytes content- status: fast growing**
 - **Cost structure: 80% (\rightarrow 90%) of lifecycle costs are operational and management costs - status: reaching crisis level**
- **Internet is not centric \rightarrow Polymorphic Internet: communication-centric systems, information-centric systems, context-centric systems, resource-centric systems, content-centric systems, service/computation-centric systems, device-centric systems, object-centric systems, things-centric systems and management-centric systems**
- **Change Capability - status: ossification reaching crisis level; a lot of missing and interrelated features; missing enablers for integration of Nets, Services, Content, Storage, ...**

How to change

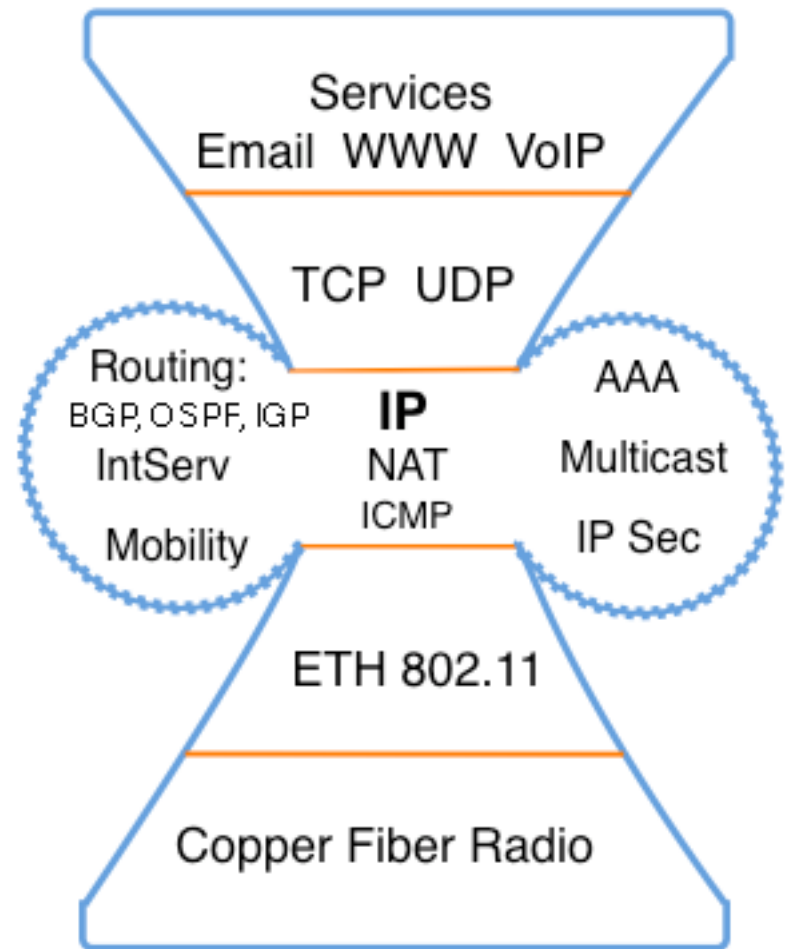
Approach:

- Parallel Internets; Progressive changes; “Cleaner” slate and evolutionary
- Network of networks → system of coordinated service networks
- Virtualization of resources (Networks, Services, Content, Storage)
- Programmability
- Increased self-manageability as the means of controlling the complexity and the lifecycle costs

Architectural Model

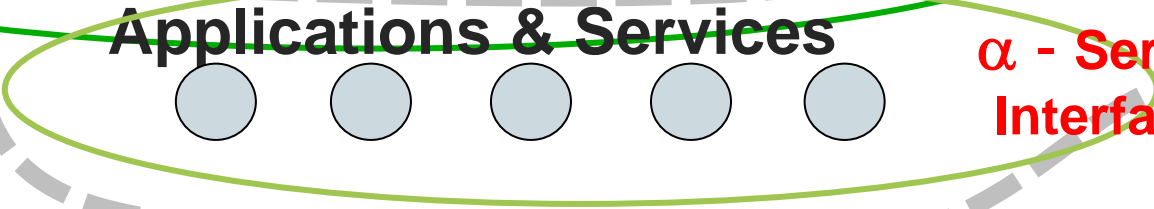
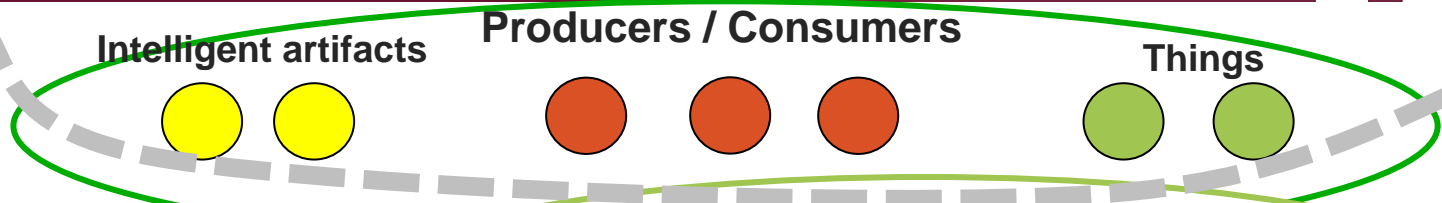


Data Plane



Control Plane

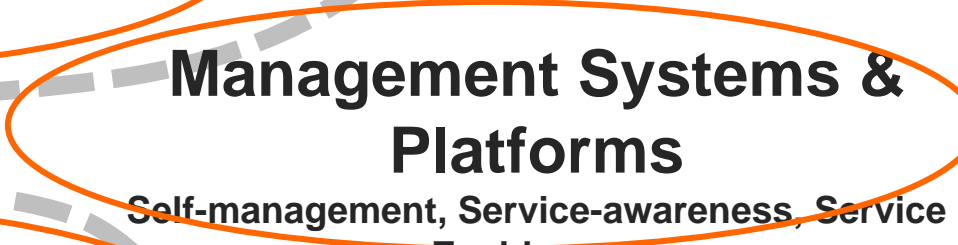
**Producer/
consumer
facing
services**



α - Service Interfaces

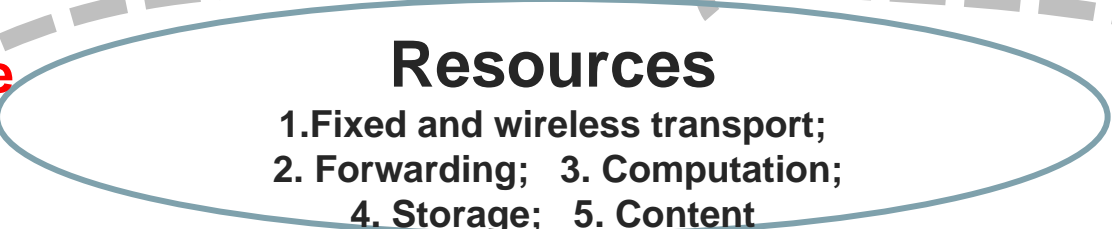


β - Service Interfaces

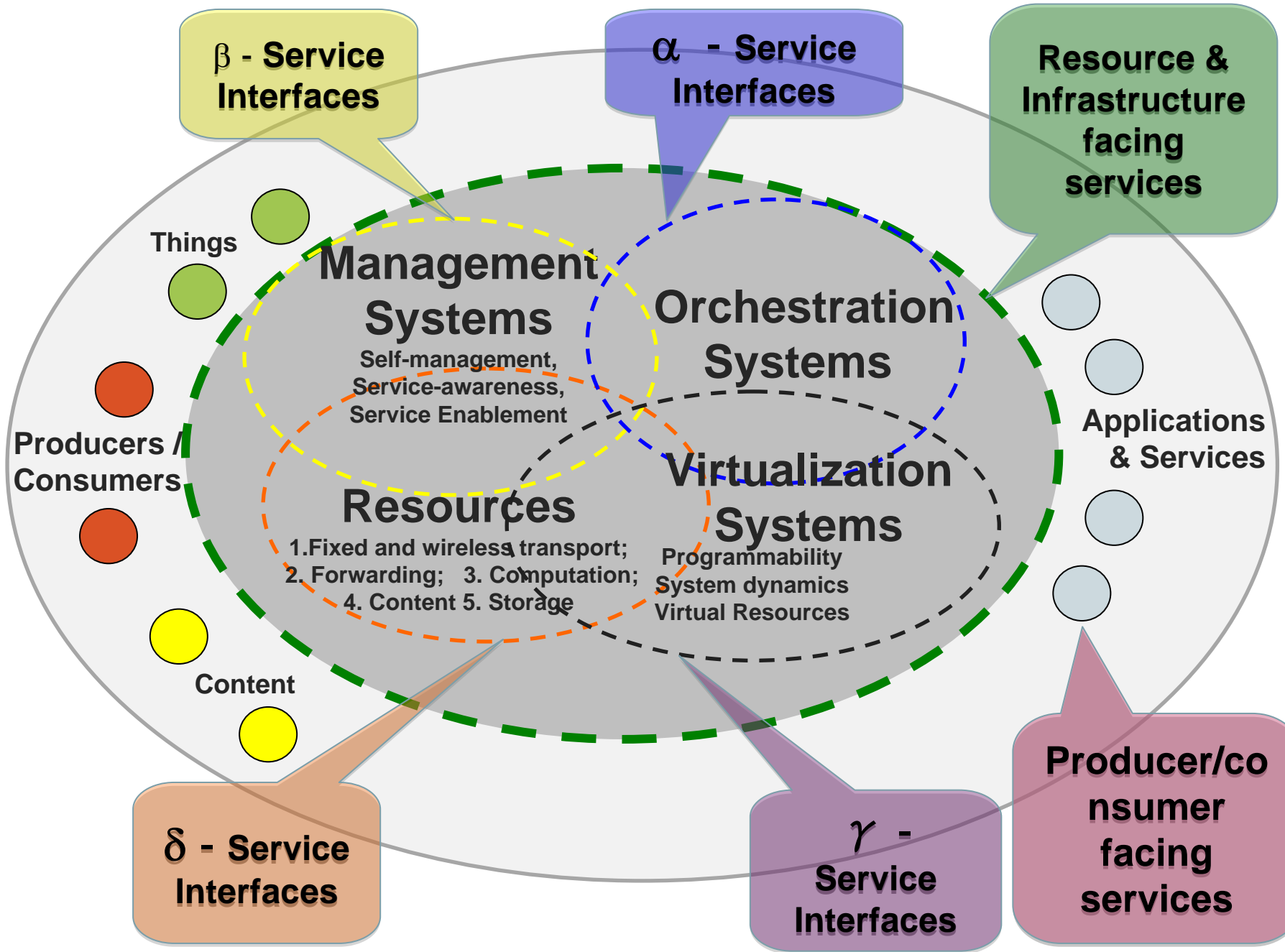


γ - Service Interfaces

δ - Service Interfaces



**Resource
facing
services**



Key Research Milestones: Roadmap

- Hourglass model / layering** works well in creating a data plane without the management mechanisms for different prosumers to influence or control what is inside the networks and how to deploy services ; it has fade away and it needs to be berried; it would be replaced with resources centric services and prosumers centric services
- **Prosumers' control / responsibility** on route selection & sent /receive packets;
 - **Virtualisation of system facilities** resulting in ease of deployment and isolation of different Internets; programmability as software defined / triggered / managed networking systems
 - **Identifiers** (resources, virtual resources, users, services entities, network entities, machines, things) instead of addressing; Decoupling of identity from trust and identity from addressing; Identity Management as a Global Service
 - **In-Systems Autonomous capabilities** as the norm

Key Research Milestones: Roadmap

- **Composable Resources** as resource centric services: user's triggered, semantically defined, autonomously managed; Composable fine grain service elements based on ontology of functions and interfaces; programmability and adaptability of composable resources
- **System Oriented Cloud Infrastructures**: rethink and redesign networking, computing, storage, resource and content as planetary scale infrastructures : Convergence of Internet
- **Exposure to systems' interactions** : minimal new APIs for interoperability and orchestration
- **Metrics for evolution** – comparison of alternative architectures

Conclusion

- Future Internet Objectives, Requirements and Research Challenges documents available (i.e. <http://www.future-internet.eu>)
- Approach for open and flexible architectures
- Research Roadmap



Thank you