

The Role of Virtualization

Future Internet - Management and Service-aware networking

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Overview

- > Future Internet Vision
- > Virtual Networks
- > Virtualisation and Resilience
- > Virtualisation and Energy Efficiency
- > Conclusion



Future Internet Challenges

- > Architectural flexibility needed for envisioned multitude of services
- > Network resilience has to be maintained and strengthened
- > Energy consumption has to be minimized

Virtualisation Solutions

- > Virtual networks provide self-managing virtual resource overlay, service-aware network resources
- > Virtual services experience increased resilience through independence of hardware
- > Service consolidation: shut down unused hardware



Virtual Networks

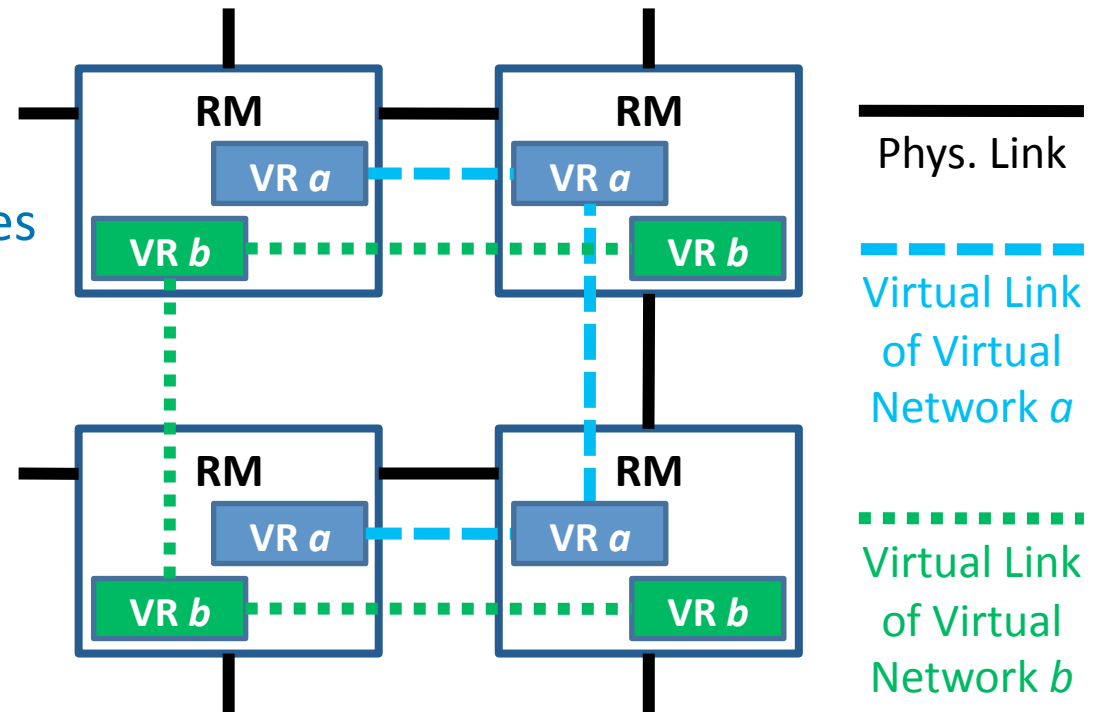
> Virtual Networks are: Virtual Routers + Virtual Links

> Virtual Routers:

- Support different network technologies (e.g. IPv4 & IPv6)

> Virtual Links:

- Connect VRs
- May span multiple physical links
- Can be modified dynamically (e.g. bandwidth)



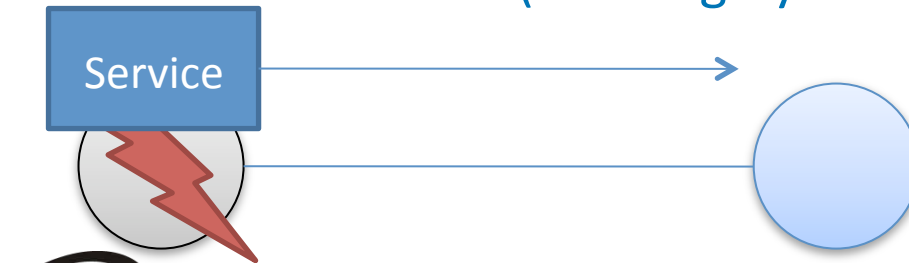
Virtual Network Management Issues

- > Evaluate scalability of virtualization approaches
 - Determine upper limits on VM creation
 - Determine VMM overhead
 - How much virtualization state do we need and can we afford?
- > Investigate identifier/locator problem
 - How to do routing in virtual networks?
- > Do assumptions hold true on specialized router hardware?
 - Verify applicability on specialized router hardware
 - What can be virtualized? What can't?



Virtualization and Resilience

- > Migrate services that are about to fail
 - Warning needed in advance of event
 - Depending on service constraints and event conditions either live or cold migration
- > Possible scenarios
 - Hard disk failure (warning by SMART tools)
 - Power loss (warning by UPS)
 - Large scale natural disaster (warning by weather forecast)



Virtualization and Energy Efficiency

- > Virtualization is key technology for energy efficient ICT
- > Virtualization of servers
 - Resource sharing in / across data centers (Cloud Computing)
- > Virtualization of networks
 - Current networks are designed for peak loads
 - Moving virtual network components (VROOM)
 - Consolidation (Shutting down unused equipment)
 - Usage of energy efficient hardware in times with less load



Virtualization and Energy Efficiency

- > New organization-wide policies are possible
 - Energy efficiency policies
 - Energy sharing between data centers
 - Reduction of CO₂ emission
 - Minimizing energy consumption per company
 - not only per data center
 - Redundancy only for resilience and security
 - Specialization of data centers



Virtualization and Energy Efficiency

- > Virtualization requests for a self-organizing management of virtual resources
- > Dynamic self-migration of load / **heat** to reduce cooling efforts
 - across different time zones
 - day/night
 - summer/winter
 - Move heat to cold places
- > Switching off unused hardware



The Impact of Virtualisation on the Future Internet

- > Virtualization is not new element in the network stack
 - It is there already: hardware support by Intel, AMD, Cisco, ...
 - We should not neglect it: integrate into future network designs
- > Virtualization provides new common interface
 - Common interface is needed to communicate across hybrid platforms
 - Previously: IP (hourglass model) – now: VMM
 - Closer to hardware: allows for more innovation all the way up
- > Utilize virtualization in Future Internet context
 - Identify future Internet specific requirements
 - Remain technology-agnostic: allow for innovation to flourish



Conclusions

- > Future Internet vision poses some challenges
 - Virtualization may provide solution for some of them
 - Prerequisite: maintaining flexibility (simplicity) of Internet
 - We need self-management EuroNF + Autol: STREP 7th FP 1st call
 - We need resilience ResumeNet: STREP 7th FP 2nd call
 - We need energy efficiency
 - COST Action IC0804: kick off, Brussels, 5th May 09
 - 1st Int`l Conf. on Energy Efficient Comp. and Networking: eEnergy
 - Passau, April 11-13, 2010
 - Chairs: Randy Katz, UC Berkeley, USA, David Hutchison, Lancaster Univ, U.K. and Hermann de Meer, Passau Univ., Germany

