Distributed Virtual Network Embedding

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Virtualization

• Virtualization provides resource abstraction

• Partition physical resources into multiple virtual resources
  (e.g. to gain energy-efficiency)

• Combine physical resources into one virtual resource
  (e.g. for scalability reasons)

Virtual machines can be *migrated*!
Network Virtualization

• Network virtualization = virtualizing network resources
  
  • Virtualization: key technology for the “Future Internet”
    aim: overcome the inflexibility of the Internet!
  
  • Decentralized
  • Various hardware devices
  • Many organizations

• Embedding is NP-complete
  
  • Bin-packing problem (nodes)
  • Unsplittable Flow problem (links)

→ Heuristics
Virtual Network Embedding:

- Map virtual resources to substrate resources
  - Substrate network *provides* resources
  - Virtual networks *consume* resources
Optimization metrics

How to evaluate?
→ VNE simulation framework: ALEVIN (http://alevin.sf.net/)

• Different ways to optimize embedding
  • Minimize cost/revenue ratio
    • Cost: Physical resources that have to be spent
    • Revenue: Virtual resources that can be mapped
  • Reduce stress of physical resources
  • Energy efficiency
  • …
Additional information

• Some additional background information:
  
  • Embedding requests arrive “randomly”
  • Embedding might be only valid for a specific time frame
  • Some virtual machines use a lot of I/O, others need a lot of bandwidth, ...
  • Some machines only have to work at certain times of day
Distributed VNE

- Centralized approaches: problems
  - Physical networks: single point of failure
  - Doesn't scale
  - Virtual networks: demands might change on-line; keeps embedding node busy!
A Distributed Algorithm

- Partition the physical network into different, coherent regions
- Independent partitions can embed virtual networks independently (like P2P)
  - Collaborate to embed parts of virtual networks
- QoS: some resilient partitions might be used by “premium” users only
Thanks!

Es soll manchen Dichter geben,
der muß dichten um zu leben.
Ist das immer so? Mitnichten,
manche leben um zu dichten.

(Heinz Erhardt)