spontaneous virtual networks SpoVNet

Considering Network Heterogeneity in Global Application Layer Multicast Provision

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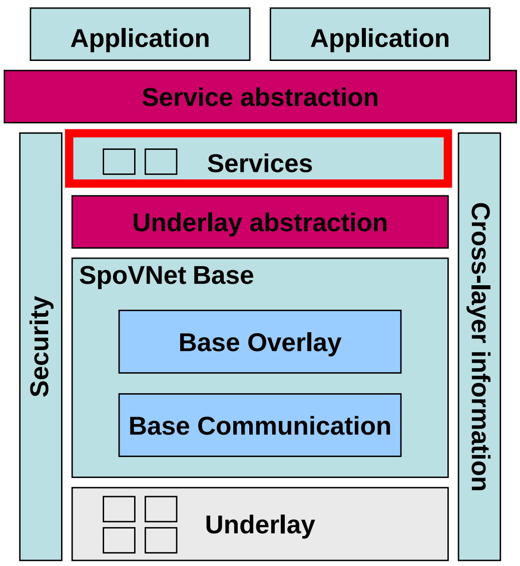
8th Würzburg Workshop on IP: Joint EuroNF, ITC, and ITG Workshop on
“Visions of Future Generation Networks” (EuroView2008)
July 21st - July 22nd 2008, Würzburg/Germany

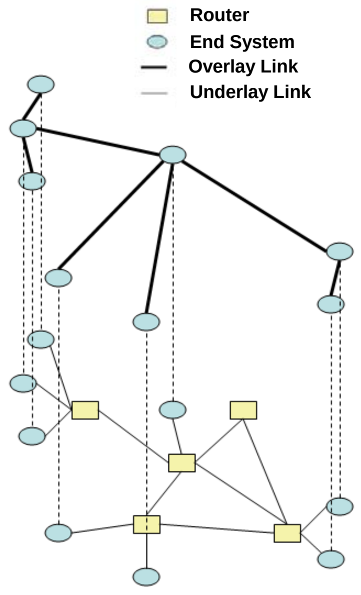
Getting higher in the SpoVNet stack…

- Services in SpoVNet
  - Reside above Underlay Abstraction
- Offer interface to applications
- Several services as part of the architecture
  - MCP-O (Data Dissemination)
  - ES (Event Service)
  - Security Service
- Focus here: MCP-O



Goal: Efficient Data Dissemination

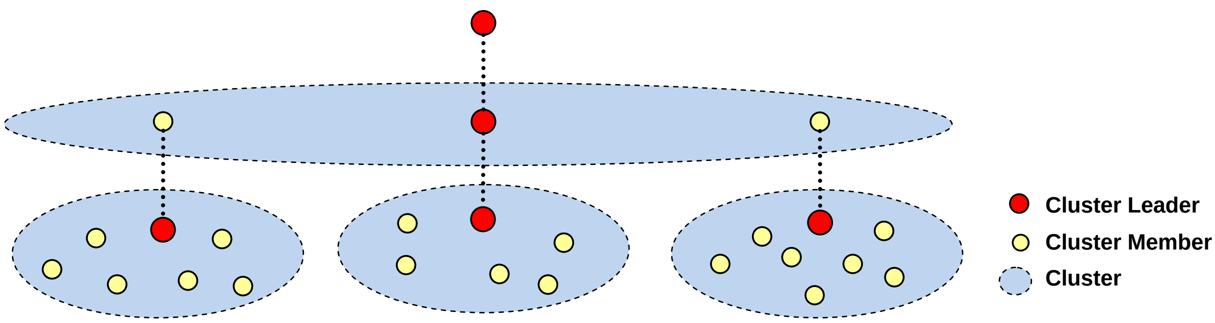
- Group Communication in SpoVNet instances
  - Solution: Application Layer Multicast (ALM)
- Several existing approaches
  - Narada, NICE, Yoid, Nemo, …
  - Each with different target applications
- Drawbacks
  - Considering homogeneous (UDP-)underlays
  - Measure link property themselves
    - Mostly latency
- **SpoVNet Vision**
  - Global service provision
    - Heterogeneity of nodes and network!
  - Different application demands



Application Layer Multicast (ALM)

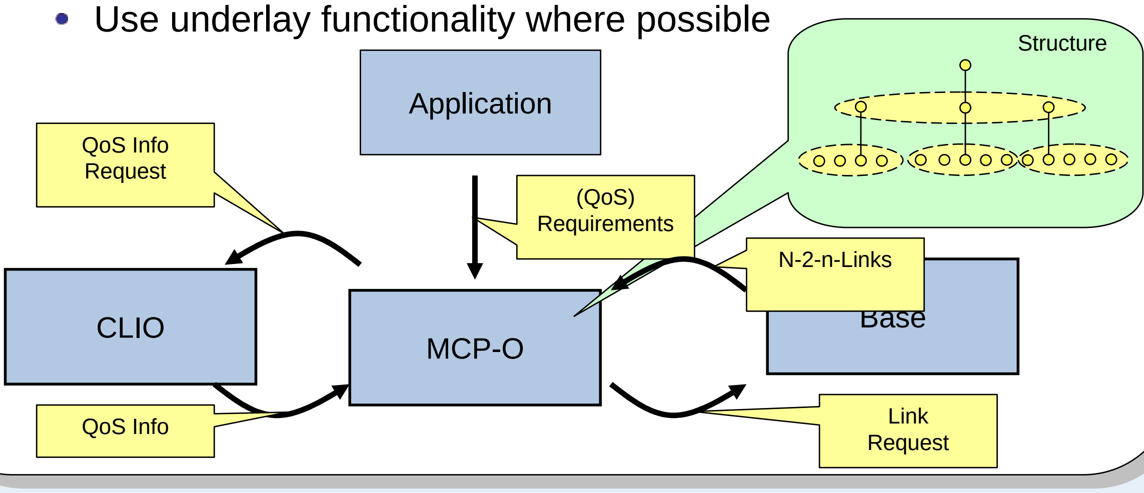
NICE

- Achieve scalability through hierarchical clustering
  - Limit protocol overhead
- Consider node distances (n-2-n latencies)
- Logical structure determines date dissemination



MCP-O Protocol Design

- Basic idea (enhance NICE approach to…)
  - Evaluate application demands for structural design decisions
  - Consider Cross-Layer-Information (provided by CLIO comp.)
  - Built efficient dissemination topologies for every use case
  - Use underlay functionality where possible

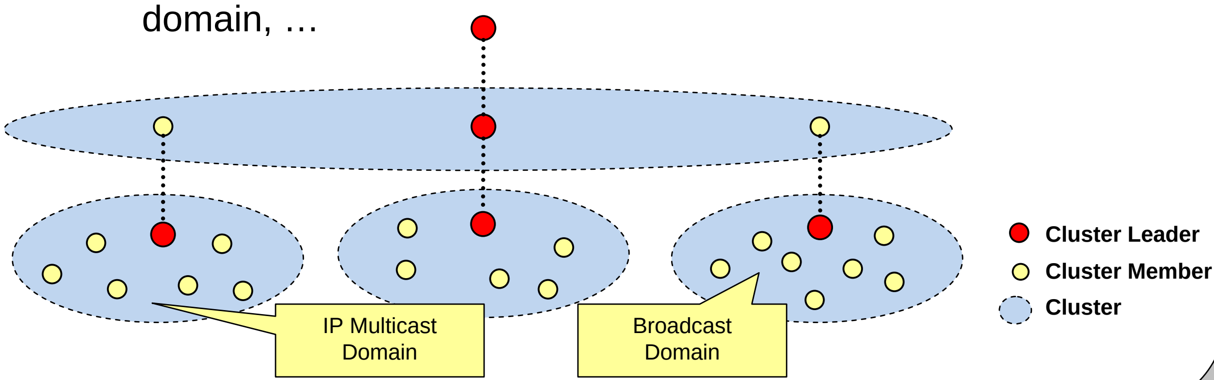


Service Demands Adaption

- Use Service Metric to affect building of structure

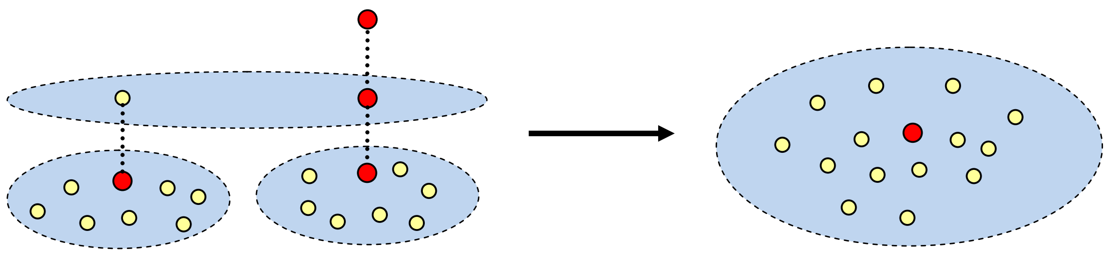
$$d : K \times K \rightarrow \mathbb{R}_{\geq 0}$$
$$d : (x,y) \mapsto \sum_i a_i f_i(x,y)$$

  - Weights a_i determined through application requirements
  - $f_i(x,y)$ e.g. latency, same WiFi domain, same IP Multicast domain, …



Service Demands Adaption

- But: Hierarchical approach not always the best choice
  - Good scalability, but cutting back e.g. latencies ☹
- Example: Latency-sensitive app with < 16 Members
- Adapt cluster size K
  - K = (lowest current upstream) / (data stream)
  - Unicast brings best achievable latency, protocol decides reasonable overhead in bounds

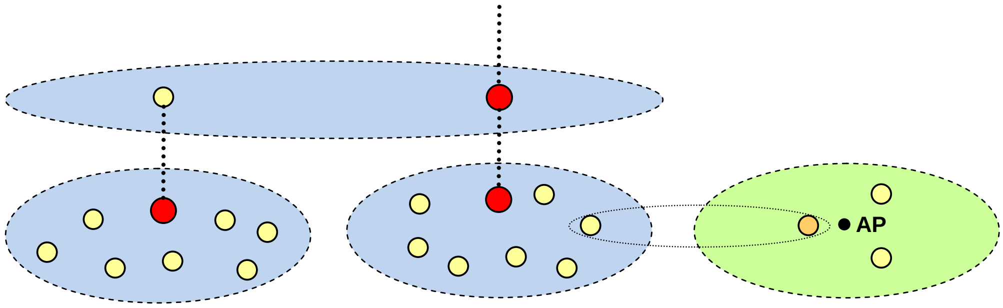


Examples for Protocol Behavior

- Single Source Videostreaming application
  - Locate High-Bandwidth nodes near source
  - Make them cluster leader, upstream determines cluster size
    → Flat tree to bound latency and jitter
- Realtime Game
  - Latency critical factor
  - Use unicast where feasible

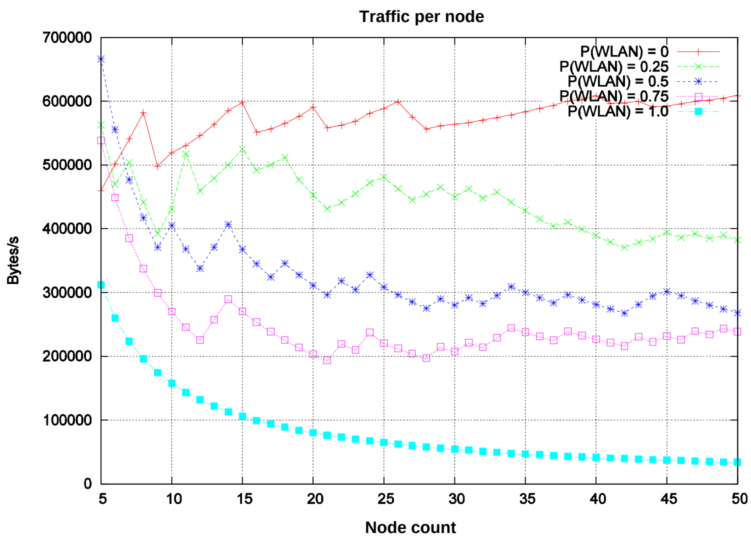
WiFi Integration

- First Steps: Wireless Integration
- Save transmission overhead through broadcast
  → NICE-WLI
- Introduce Gateway-Nodes for mediation
  - WiFi domain not part of structure, but connected through Gateway
  - Prevent Gateways from becoming cluster leaders (save overhead)



WiFi Integration

- Approach saves data transmission overhead
  - Figure: P(WLAN) denotes probability of WiFi node



Summary & Outlook

- Efficient data transmission for SpoVNet applications through
  - Considering node and network heterogeneity
  - Use appropriate dissemination strategies
    - IP Multicast, broadcast, QoS reservations,…
- WiFi support already integrated
- Further Work
  - Multiple group support per instance
  - Usage of underlay features