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Service-centric networking - Architecture

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Agenda

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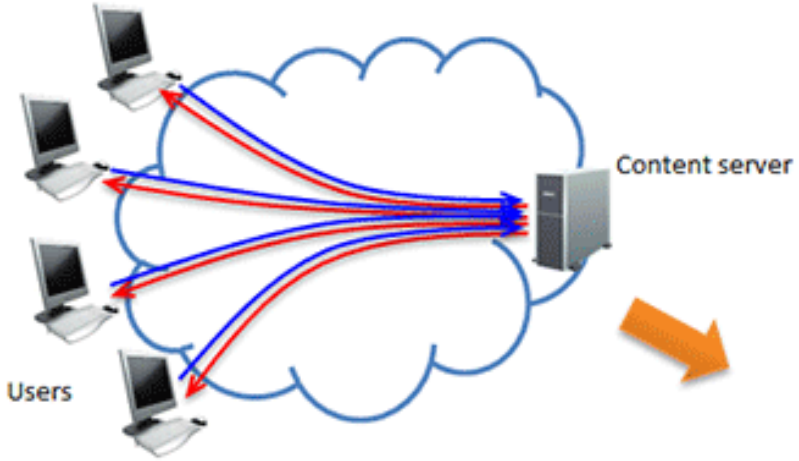
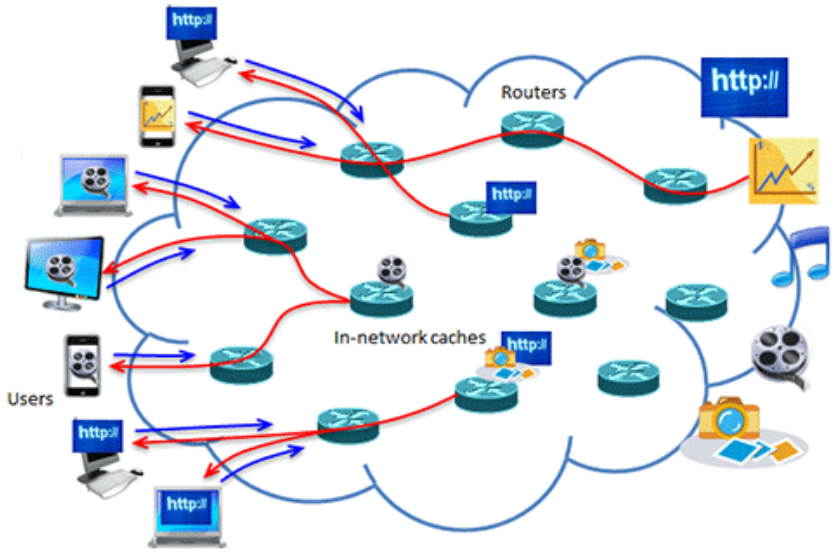
- Introduction
- Brief overview
  - CCN and SCN
    - SCN requirements
  - SoCCeR
  - NLSR
- 2-level architecture
  - Simple nodes
  - Super nodes
- Implementation
- Conclusion

Intro: Content-centric networking

- Content-centric networking (CCN) is a new approach for future Internet architecture
  - Clients ask *What* (Content) instead of *Where* (IP)



Host-centric Networking



Information-centric Networking

Content-Centric Networking (CCN)

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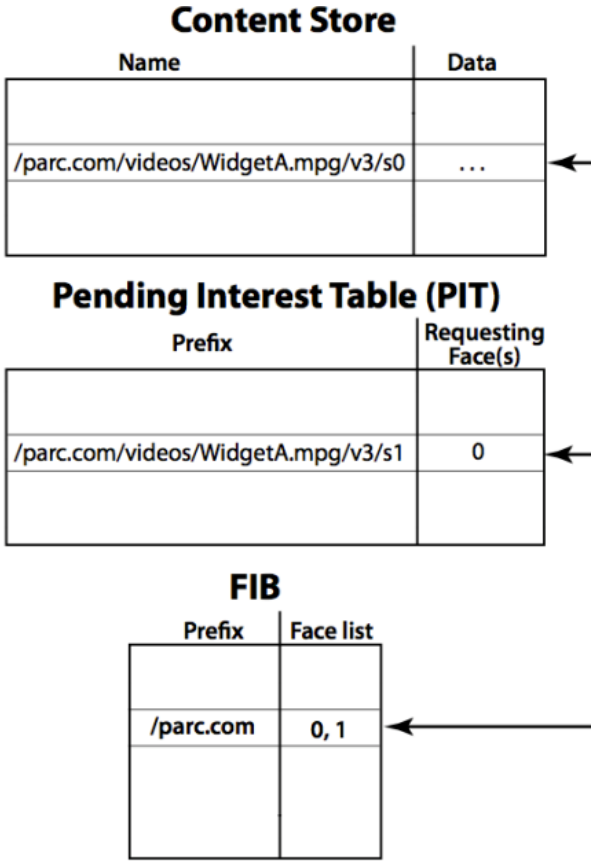
- New paradigm for internet architecture
  - Content is the core
  - Content is directly addressable
  - Routing is based on the content identifier
    - Instead of IP
- CCN has two type of messages
  - Interest
    - For example: /mywebsite.com/pictures/picture.jpg/v2/s1/
  - Content

CCN node components

- Forwarding Information Base (FIB)
  - Matches faces and prefixes for forwarding
    - Longest prefix match
  - Like an IP Routing table
- Pending Interest Table(PIT)
  - Requested contents
- Content Store (CS)
  - Caches incoming data



CCN routing

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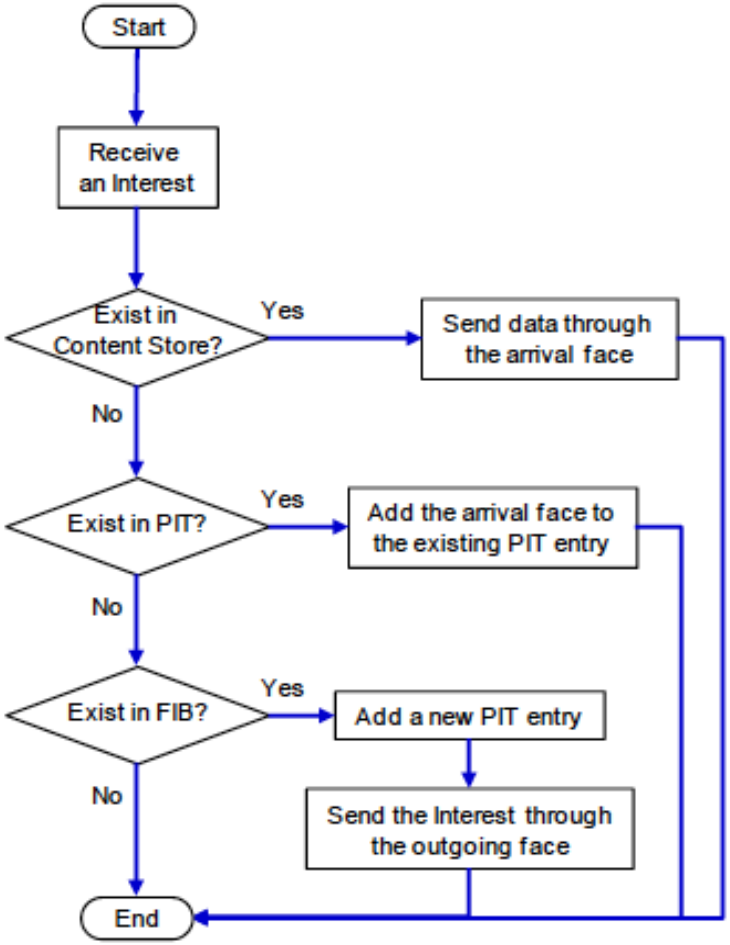
- When a CCN Client sends an Interest message (request)
  - It will send to all faces that have the longest prefix match
    - Incoming requests will be forwarded in the same way.
  - If a node possesses the content (stored/cached)
    - Then the forwarding process will stop and the data will be sent to the requester through the reverse path of the Interest Message
      - Intermediates nodes will cache the content

CCN : Interest message processing



Service-Centric Networking (SCN)

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- Service-Centric Networking is a new networking paradigm
- SCN is an extension of Content-Centric Networking (CCN)
  - To support services
- Nodes provide services
- Messages
  - Interest Messages
  - Data Messages

SCN Requirements

- Load balancing
- Discovery guarantee of services
- Scalability
- Should be easily integrated into current internet
- Security
- Services with parameter support
- Session support
- Service composition
- …

SoCCeR Architecture

- The main SCN architecture
- SoCCeR is SCN over CCN
  - CCN nodes forward a request to all faces that match the request, SoCCeR only forward to the best face
  - CCN Extended with Ant Colony Optimization (ACO)
- Routers select the best face from the list of FIB faces
  - In Service routing there is processing at the end
    - Important to forward only to one node
- To determine the best face
  - Next slide

SoCCeR : Determine the best face

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- Nodes broadcast Interest Messages for random services periodically
- When a node proposing the service receives an Interest Message
  - It sends back a Data Message containing
    - Timestamp
    - Service status information (service load, memory, etc.)
  - Intermediate nodes use information from the Data Message to classify faces

SoCCeR : Advantages and Disadvantages

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- Advantages
  - Decentralized and distributed service routing
  - No single point of failure
  - Highly reactive to changes
  - Routers select the best face for forwarding
  - Responsive to network failure
  - Scalable
- Disadvantages
  - Do not support stateful services
  - Protocol overhead (control messages)
  - Service name does not support parameters

NLSR

- Named-data Link State Routing Protocol (NLSR)
  - CCN messages are used to exchange routing messages
  - Nodes know the whole network topology
  - NLSR routers advertise local links and prefixes to the whole network
- Nodes use two type of broadcast messages to
  - Advertise local links
    - Periodically an alive message
    - When the node's neighbour status is changed
  - Advertise content availability
    - When content is created or deleted

NLSR: Advantage and Disadvantage

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- Advantage
  - NLSR nodes have a view of the network topology
    - Better load balancing and security
    - Service composition capabilities
- Disadvantage
  - Protocol overhead

Proposed SCN architecture

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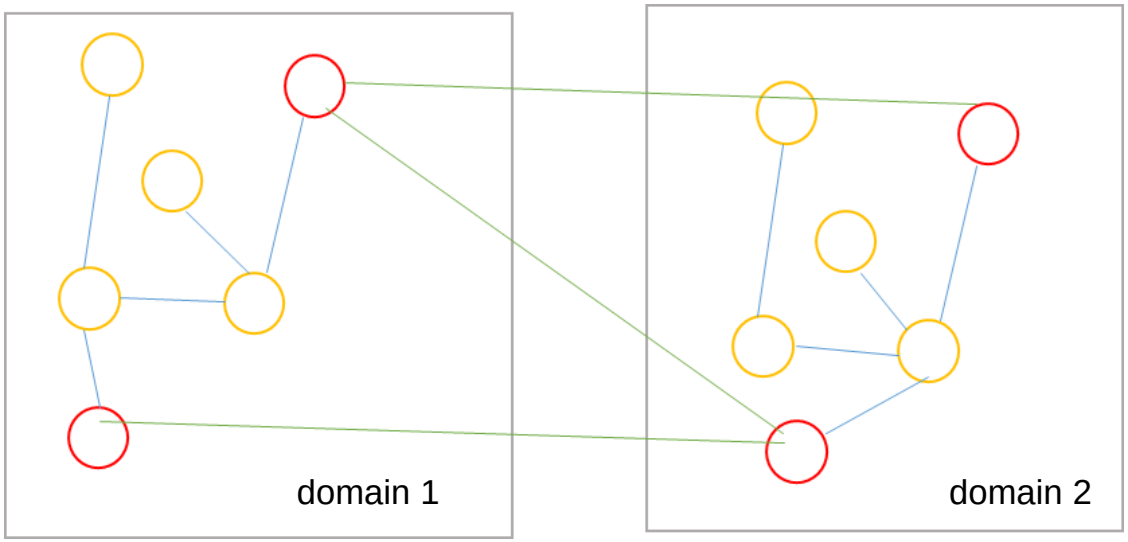
- Creating an architecture by combining SoCCeR and NLSR
- Inter and Intra domains
  - Inter-domain routing based on SoCCeR
    - Communication is done by supernodes
  - Intra-domain routing based on NLSR



2 level architecture

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- Done by simple nodes
  - Intra-domain routing
  - NLSR like
- Done by super nodes
  - Service composition
  - Service Directory storage and sharing
  - Inter-domain routing
  - SoCCeR like

Simple nodes

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- All nodes are simple nodes and some of them are also super nodes
- Simple nodes know the whole intra-domain topology and have an updated FIB table with the service availability information of the domain’s nodes
- NLSR-like

Super nodes

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- Super nodes are the nodes with the best resources
  - Nodes can decide to become super nodes
  - Nodes can be defined as super nodes
    - All nodes in a domain possess resource information about all other nodes. If a node has very high resource availability in comparison to other nodes, then it becomes a super node.
    - A domain will have at least one super node
  - A Super node is also a Simple node
    - NLSR-like on Intra-domain level
    - SoCCeR-like on Inter-domain level
  - SoCCeR is used on the inter-domain level because of its scalability
    - NLSR is less scalable

Super nodes

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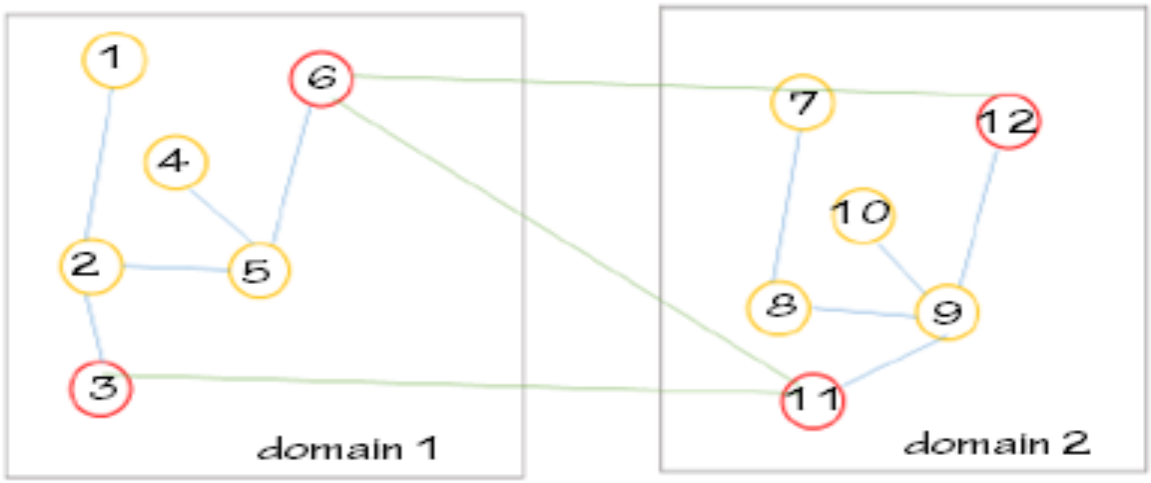
- Super nodes broadcast requests for random services periodically
- Requests go through the super nodes until it reaches a super node (domain) where the service information is available
  - Concerned super node will send a response containing the service identifier, the resource availability information and a timestamp
  - Response will be forwarded back through the reverse path by using the Pending Interest Table (PIT)
  - Intermediate nodes will update their FIB tables by using the information inside the response message
- To have up to date FIBs, super nodes will check periodically
  - The service online status and resource availability

Service Directory

- All nodes store a Service Directory that contains the following information about existing services in the network
  - Service-unique ID
  - Service Name
  - Service version
  - Service Description (Description text, parameters…)
    - In XML
- Service Directory is shared among the nodes

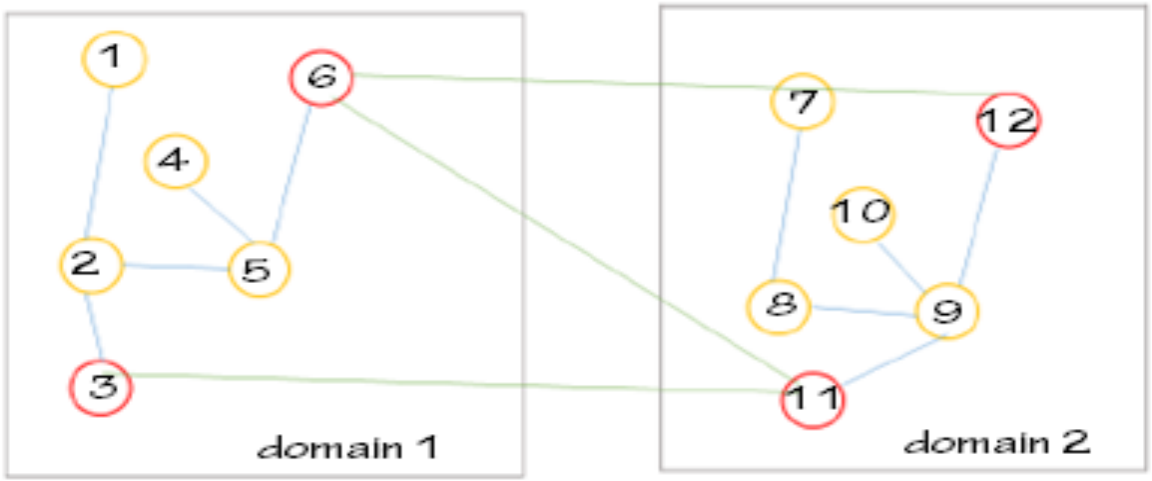
Example #1

- Node 1 requires a service proposed by node 7
  - In a domain nodes are aware of all available services in the domain, in this example the service is not available in the domain



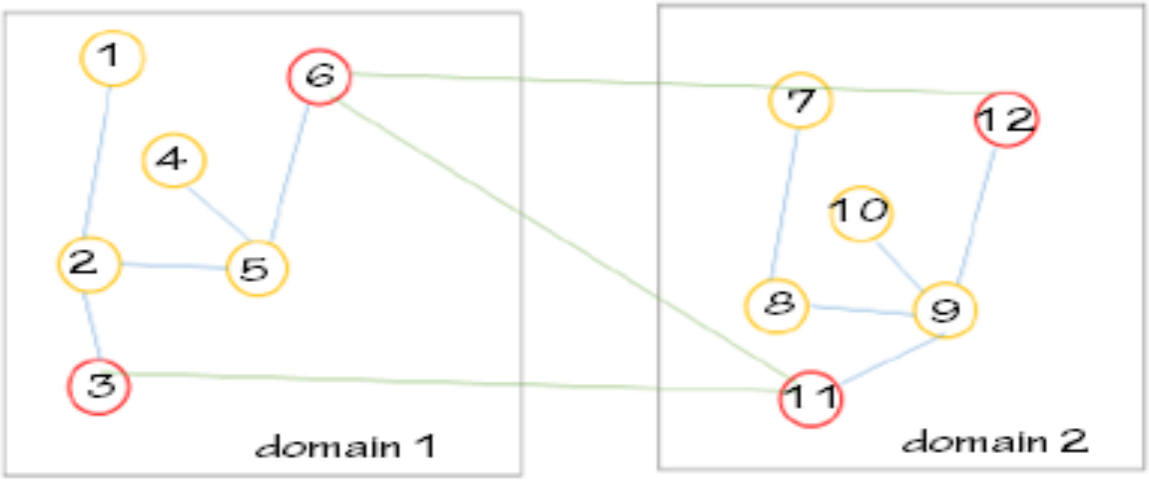
Example #2

- Node 1 will broadcast a message to find the required service
  - The request will reach the super nodes
    - Super nodes will reply if they have in their FIB the forwarding information for the required service
    - Super nodes will broadcast the message to the inter-domain level
      - In this example super nodes (node 11 and 12) from domain 2 will reply with a timestamp and the status information of the node 7



Example #3

- Response message will be forwarded through the reverse path
  - Node 1 will receive the status information
  - The supernodes of domain 1 will update their FIBs with the forwarding information
- The Service Consumer (node 1) can now start sending its service request

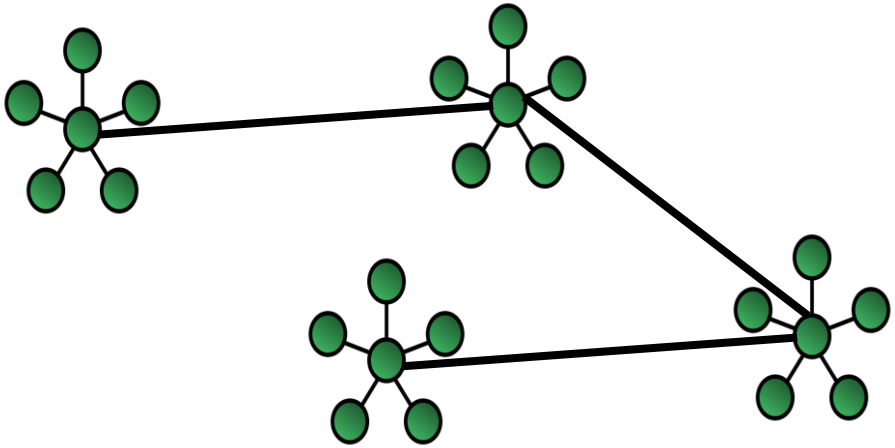


Implementation

- Implementation is done in the ndnSIM simulator
- SoCCeR for ndnSIM
  - In development
  - First version should be ready in a couple of weeks
    - To have first results
- NLSR for ndnSIM
  - Is currently being implemented by Cisco

Conclusion

- First testing will use only SoCCeR approach
  - With a star network topology
- Interesting to assess other routing protocol composition
  - e.g. SoCCeR on both levels



Questions