Different Faces of Information Centric Networking

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AGENDA

- Current Internet
  - Features & Issues
- Information Centric Networking (ICN)
  - Common Characteristics
- Different ICN Approaches
  - DONA, CCN, PURSUIT / PSIRP
- From IOT Perspective
- Transition from IP to Contents
- Comments & Questions

POINT TO PONDER

IS CURRENT INTERNET FRAMEWORK THE WAY TO GO FOR FUTURE DEVELOPMENT

IP BASED INTERNET

- **ISSUES & CHALLENGES**
  - Used out of Context
    - Resource sharing, used for content sharing
  - Trust Assumption
    - Every one was trust worthy
  - Works on Sender's Terms
    - Anyone can send data EVEN if not wanted
  - “Where” vs “What”
  - Security as an Add on feature
    - No effective mechanism to counter DDOS still
    - Privacy and Confidentiality
  - Scalable and Cost Efficient Content Distribution

IP BASED INTERNET

- **ISSUES**
  - Lack of Persistent and Unique Name Space
  - The current protocols have ossified
  - Monopoly of Tier 1 Operators
  - Source of Revenue
- **CHALLENGES**
  - Massive demand for replicated content

INFORMATION CENTRIC NETWORKING

- **Everything is Information**
  - Why not route on information
  - Replace WHERE with WHAT ?
- **System Level Security (in built)**
  - Will provide solutions for problems like DDOS
- **Receiver Driven Model**
  - No unsolicited traffic (unsubscribed data to be received)

INFORMATION CENTRIC NETWORKING

- **Projects**
  - EUROPE :
    - PSIRP, 4WARD, PURSUIT and SAIL
  - USA
    - CCN , DONA and NDN

INFORMATION CENTRIC NETWORKING

- **Characteristics**
  - Routing on Information content
    - What rather than where
  - Caching
    - Can be at the network edge and in-network caching

DATA ORIENTED NETWORK ARCHITECTURE (DONA)

- **Guiding principles**
  - Most of the problem lie in how internet names are structured and resolved
  - Names handle persistence and authenticity
  - Name resolution handles availability
  - Replaces the hierarchical DNS name space
    - Cryptographic
    - Self-certifying
    - Pseudo flat

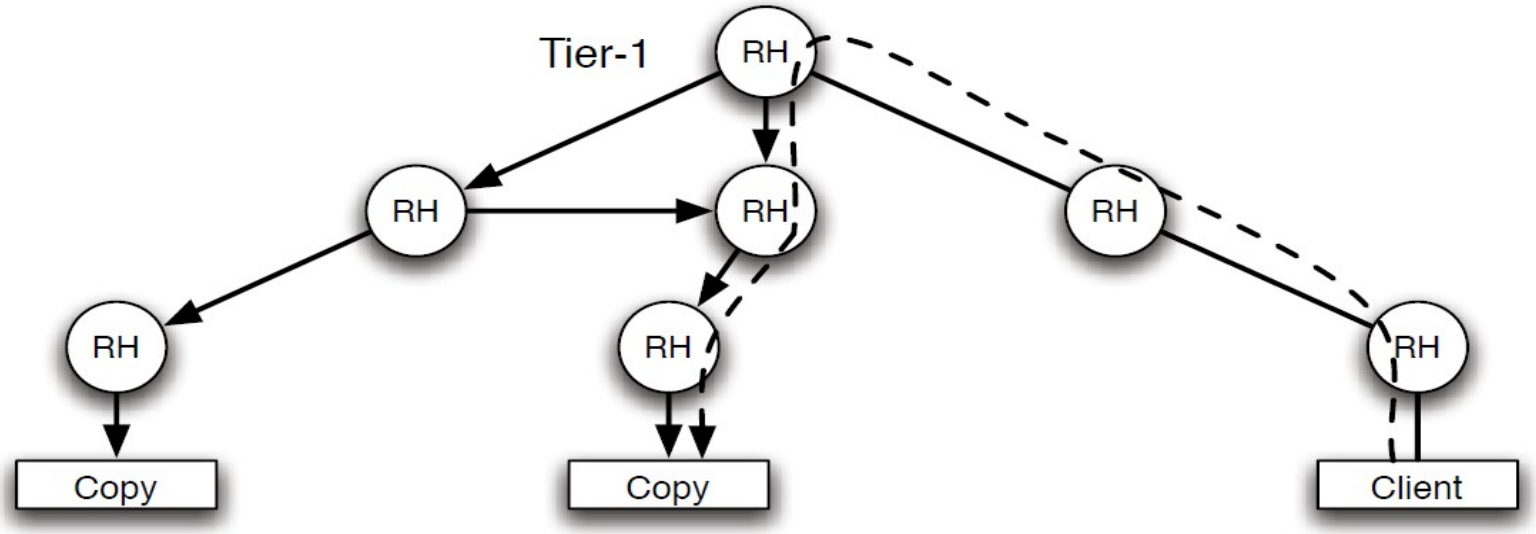
DATA ORIENTED NETWORK ARCHITECTURE (DONA)

- **Features**
  - Names organized around principles
    - P(cryptographic hash function of principals public key):L (label chosen by principal)
    - Two tier approach makes it scalable
  - Each principal associated with public private key pair
  - Packets / Messages
    - Find (P:L) & Register(P:L)
  - Names do not refer to location, data can be hosted anywhere : satisfies **persistence**
    - How users will learn flat, long names
    - Using services

DATA ORIENTED NETWORK ARCHITECTURE (DONA)

- **Features**
  - Name discovery and routing using “Anycast”
  - Does not support caching originally (but can be extended to do so) : needed for **availability**
  - Self certifying names : satisfies **authentication**
  - Name Resolution
    - Instead of DNS, use Resolution Handlers(RH)
    - Find and Register packets
    - Each client knows local RH through some local mechanism

DATA ORIENTED NETWORK ARCHITECTURE (DONA)



COMMUNICATION SCENARIO

CONTENT CENTRIC NETWORKING

- **Guiding Principles**
  - Routing should be done based on content rather than location
  - Decouple location from identity, security and access

CONTENT CENTRIC NETWORKING

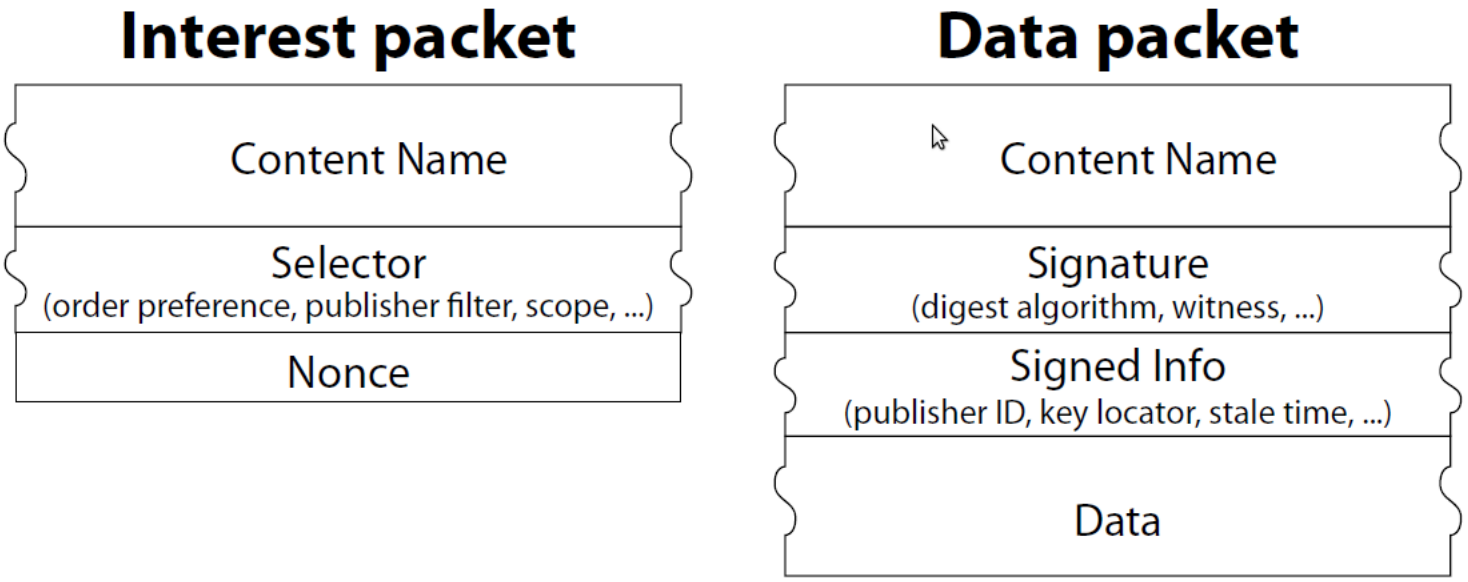
- **Features**
  - Communication is driven by “consumers of data”
  - Packets
    - Packets : Interest and Data
  - Consumer Broadcasts interest
    - Data is transmitted only in response to interest and consumes that interest
  - Data matches if
    - Interest <contentName> PREFIX data <contentName>
  - Forwarding engine with 3 data structures:
    - Forwarding Information Base (FIB)
    - Content Store (buffer memory)
    - Pending Interest Table (PIT)

CONTENT CENTRIC NETWORKING

- **Features**
  - Data packets follow the same path as Interest packets (in reverse order)
    - Each PIT entry is a “bread crumb” marking

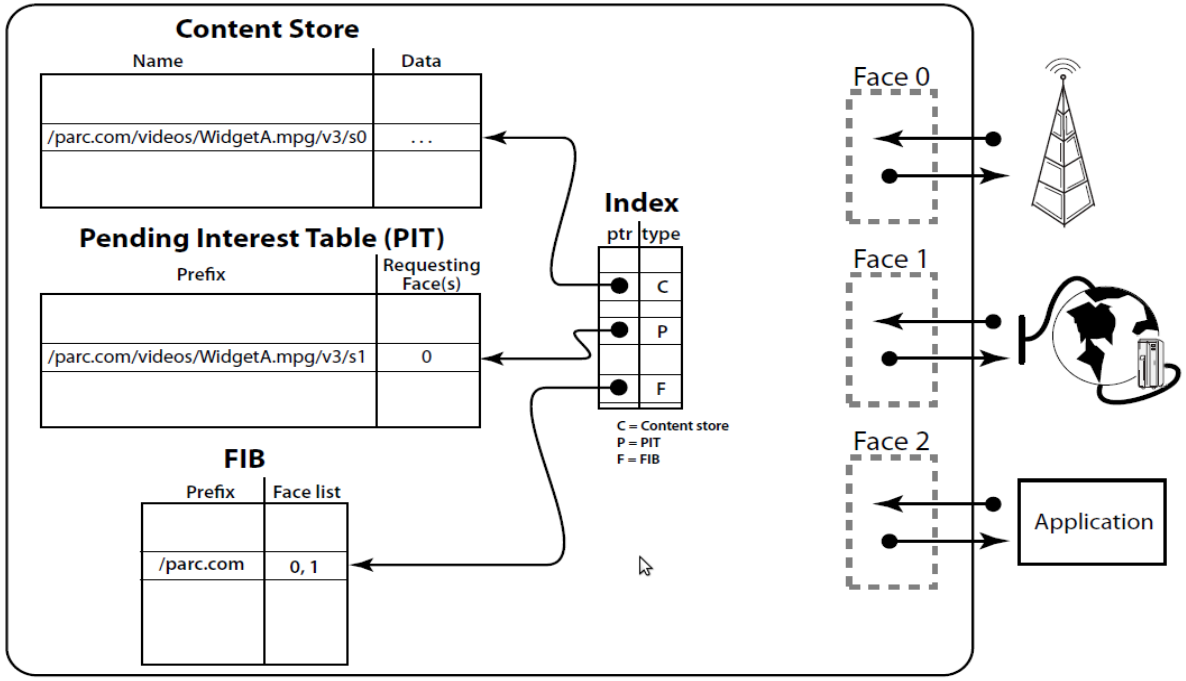
    Content-based Security
    - Security and trust is a property of content rather than the location on which is travels
  - All content authenticated with signatures, private content encrypted
    - Enhances usability since the names are not complicated hashes
    - Needs more time to verify content ?
  - Packet contains information about public key

CONTENT CENTRIC NETWORKING



CCN PACKETS

CONTENT CENTRIC NETWORKING



CCN FORWARDING ENGINE

CONTENT CENTRIC NETWORKING

- **Merits**
  - Very simple and understandable scheme
  - **Shown to work** with streamed media
  - Easy to implement based on current routing software
  - Easy to deploy on existing routing protocols and IP networks
  - Easy, human-readable naming scheme

CONTENT CENTRIC NETWORKING

- **Possible Concerns**
  - The simple hierarchical (URI-like) naming scheme is built deep into the design
  - Will it scale to hundreds of billions of nodes?
    - Flooding (send out through all available faces)
    - Flow balance – an Interest for every Data
    - How large can the FIB grow (soft state)?
    - Data takes the same (possibly non-optimal)
  - Security architecture looks very conventional

PURSUIT / PSIRP

- **Design Principles**
  - Internet based on Pub / Sub paradigm
  - Routing based on Bloom Filter
  - Security based on Packet Level Authentication

PURSUIT / PSIRP

- **Core Functionalities**
  - Rendezvous
  - Forwarding
  - Topology Management
- **User usage API**
  - Generic Pub / Sub functions
- **Use of Scoping**
  - Information targeted to solve a particular problem

PURSUIT / PSIRP

- **Rendezvous**
  - Link Local
    - Pubs subs on the same node
  - Intra Domain
    - Scenarios like IPTV, multicast services
    - Network access through forwarders
    - Rendezvous node broadcasts to forwarders
    - Forwarders send publications / subscriptions to RN

PURSUIT / PSIRP

- **Rendezvous**
  - Inter Domain
    - Local RN's join to form larger Rendezvous Networks
    - Larger RNs joined into a Rendezvous Interconnect that uses Chord DHT as a distribution strategy
    - Rendezvous Core provides Anycast routing strategy

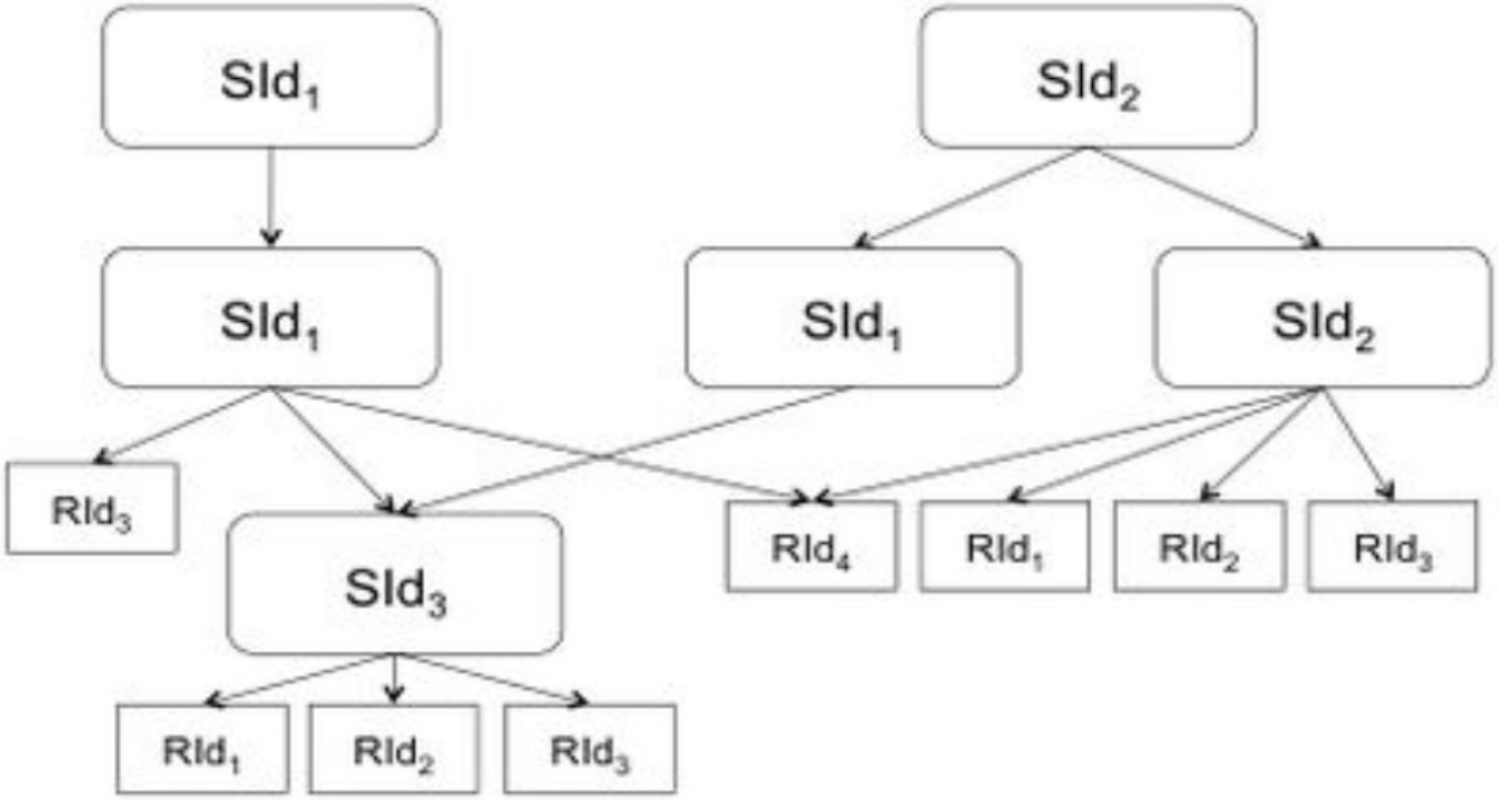
PURSUIT / PSIRP

- **Topology Management**
  - To find optimal forwarding paths from subscribers to publishers
- **Forwarding**
  - Based on Bloom Filter
  - Path information encoded into packet header
  - Lends itself to multicast

PURSUIT / PSIRP

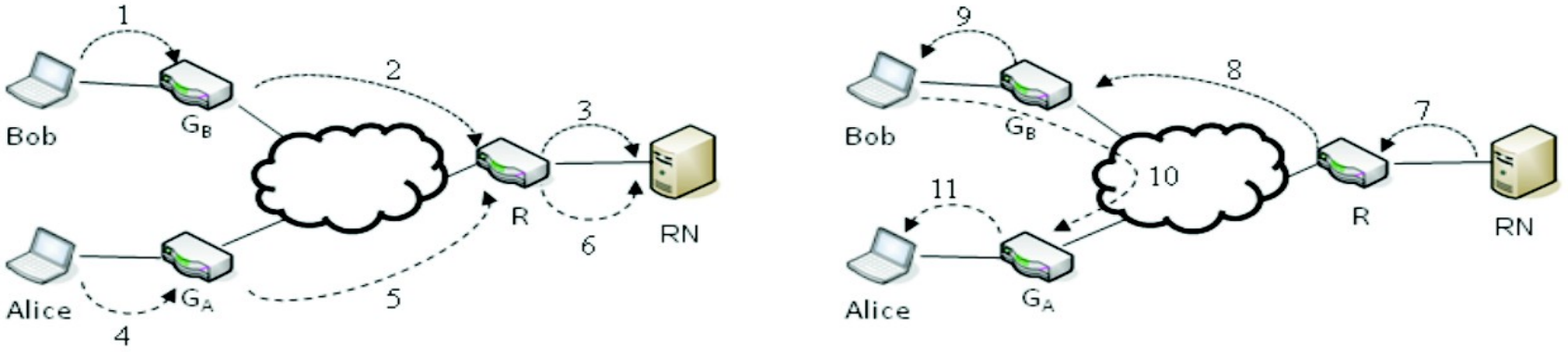
- **Security**
  - Packet Level Authentication
    - Analogy to paper currency
    - Allows any node to verify packet authenticity and validity
    - Sender adds header on top of network layer containing cryptographic identity, certificate from third party, signature over packet

PURSUIT / PSIRP



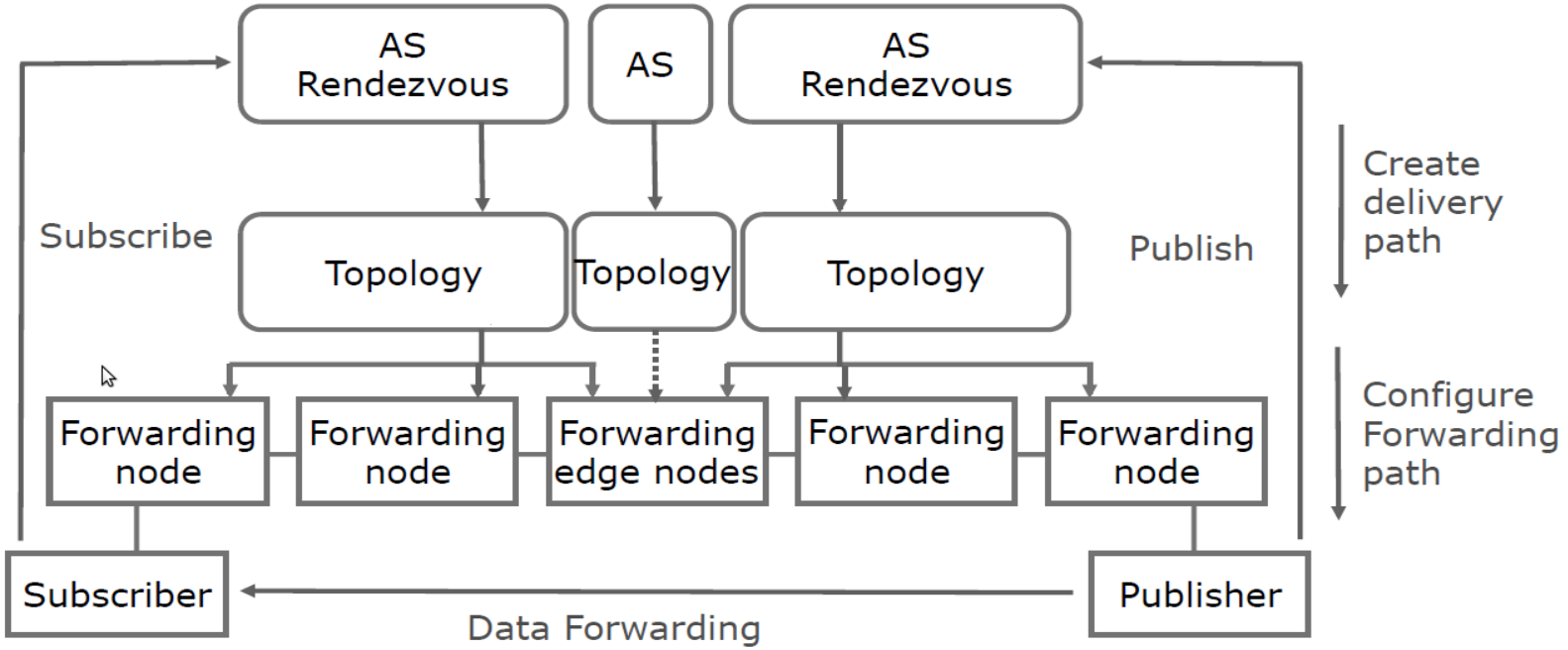
USE OF SCOPING

PURSUIT / PSIRP



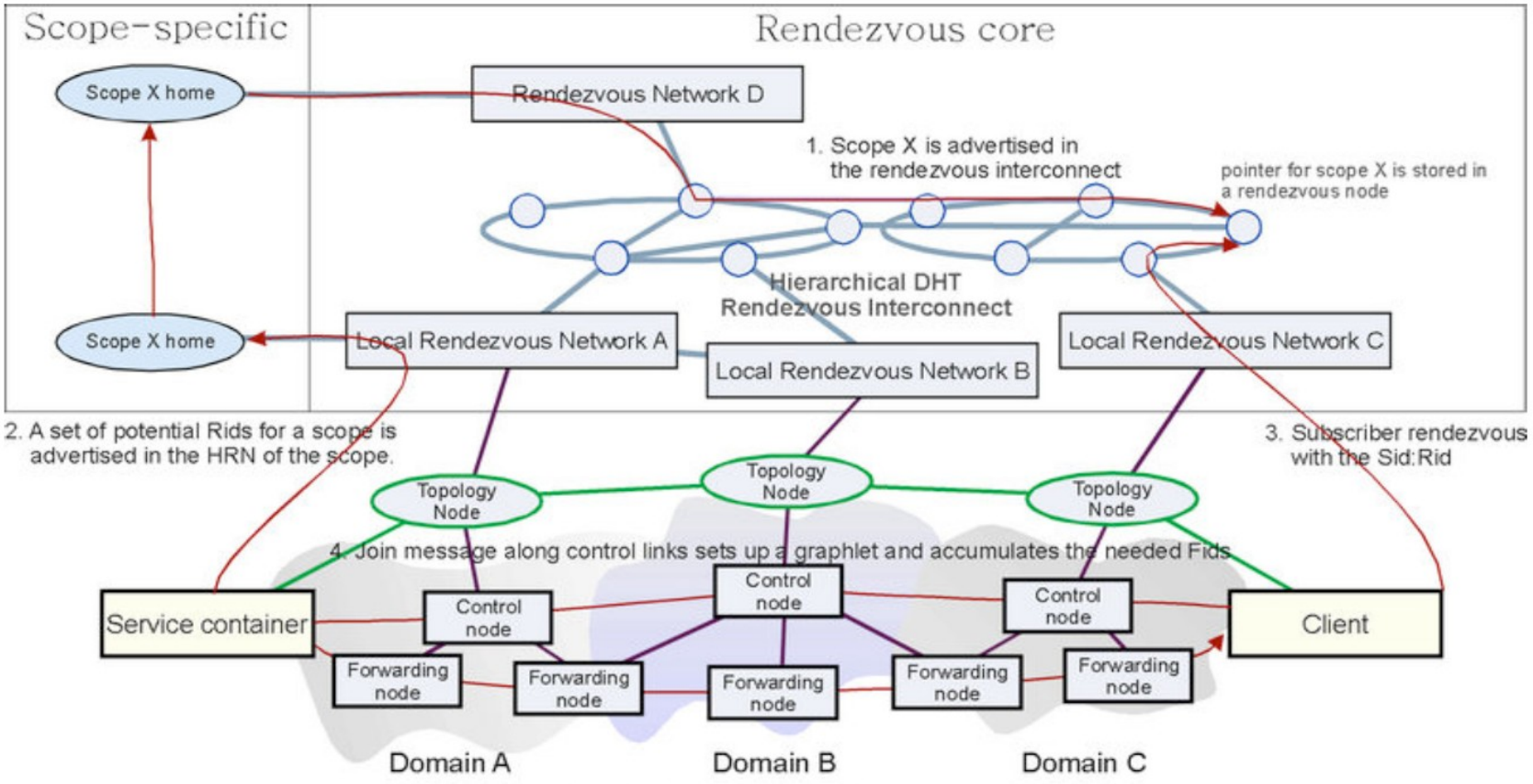
Communication in Intra Domain Scenario

PURSUIT / PSIRP



FRAMEWORK ARCHITECTURE

PURSUIT / PSIRP



Large Scale Deployment

COMPARISON

	DONA	CCN	PURSUIT
Clean Slate Approach	For naming & name resolution		Yes
Messaging	Find / Register	Interest / Data	Publish / Subscribe
Compatibility With current IP	Active	Active	Passive
Security	Self Certifying	PKI like	Self certifying+ trust
Mobility & Multihoming	yes	yes	yes
Scalability	Pseudo flat	Hierarchical	flat
Feasibility Demonstration	Simulation Level / Modeling	Secure Voice	Simulation Level / Modeling

IOT and ICN

- **ISSUES & CONSIDERATIONS**
  - Receiver Driven Architecture
  - Simple communication paradigm
    - Get / Put
    - Energy Efficient ?
  - Network built security
  - Performance compared to current WSN Communications

MISCELLANEOUS CHALLENGES

- **Implementation**
  - Overlay on top of current IP
- **How to trigger a change**
  - Strong push by established giants (Facebook vs Google+)
  - Some large scale DDOS attack ?
- **Energy Issues**
- **Monopoly of Tier 1 operators**

- QUESTIONS
- COMMENTS

THANKS !

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