A Routing Infrastructure for XIA

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Outline

• Goals and principles
• High level design
• Implementation status
• Broader context
XIA 101:

- **Client-server access using simple DAG**
- **Naming, routing, and forwarding interact**
  - All impact execution of communication operation
  - Case study: incremental deployment of “new network architectures” [Conext 2013]
- **Today: how routing sets up forwarding**
  - Impact on fault handling, performance, ... later

Goals and Design Principles

- **High level goals**
  - Clean separation of inter and intra domain control
  - Evolvability
  - Interfaces for “tussle”
- **Design principles**
  - Intra-domain
    - Logically centralized control, e.g., 4D, SDN (not required)
    - Maximize component reuse across XID types
  - Inter-domain
    - Allow for rich transit policies (e.g., non-neighbor agreements)
    - Facilitate inter-domain protocol evolution
    - Diversity, e.g., across XID types
    - Incremental deployment
Control Plane
The 10K Mile View

- Domains present a single point of control at inter-domain level
- Matches logically centralized intra-domain control
  - But actual implementation can be anything

Routing
The 100 Mile View

- Inter and intra domain routing protocols driven by different concerns and metrics
  - True today – likely to remain
- Need to define interface between the two protocols
### XIA Packet Processing Pipeline

- Principal-independent processing defines how to interpret the DAG
  - Core architecture
- Principal-dependent processing realizes forwarding semantics for each XID type
  - Logically: one forwarding table per XID type
  - Reality: anything goes, e.g., no forwarding table
- Control plane sets up forwarding for each principal type

![XIA Packet Processing Pipeline Diagram](image)

### Routing in XIA

#### The 1 Mile View

- Logically different “routing” protocols for XIDs
  - May not look like OSPF or BGP
  - Multiple protocols may co-exist for a given XID (e.g., BGP, MIRO)
- Some routing protocols may be shared
  - Inter- or Inter-domain

![Routing in XIA Diagram](image)
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Goals of Implementation

• Goals are to support research in ...
  – Routing protocols for different XID types, e.g., considering business policies, etc.
  – Diversity in forwarding and routing
  – Evolution, broadly defined
• Design principles for the prototype
  – “Framework” – shared infrastructure + examples
  – Diversity from day 1
  – Focus on APIs – can evolve as research progresses
Components of Implementation

- SDN-style intra-domain for HIDs and SIDs
  - Bootstrapping the network
  - Provide all-all communication; also CIDs
- Simple “node = AD” inter-domain routing protocol
  - Naïve routing for NID-based forwarding; policy next
  - Support for Scion path selection and forwarding
- Coordinating inter and intra domain routing

Intra-domain Routing Architecture

- Routing done by centralized routing applications
  - Controller applications are services with SIDs (of course)
- Use flooding as control channel
  - Easy and robust; can optimize later
- Different applications for different XID types
  - Currently share the same “protocol”
• Centralized routing applications for each domain
• Initial focus on NIDs, Scion and services
  – NIDs offer “traditional” all-all connectivity
  – Scion supports path-based forwarding
  – Services support anycast, use different policies from ADs
Scion over XIA Data Plane

- Store paths generated by Scion into a new type of XID
  - Sequence of per-AD forwarding states (cryptographic)
  - Can be combined with other principal types in DAG

- Scion always used centralized per-AD controller
  - Beacon controller controls paths, i.e., “routing”

- XIA network supports both path and destination-based forwarding

Status of Implementation

- Basic infrastructure is working
  - Inter domain - NIDs; intra domain - HIDs and SIDs
  - Additional principal types in progress

- Securely bootstrapping the network is hard problem
  - Using the Scion bootstrapping infrastructure

- Provides interesting insights in XIA
  - Impact of different XID types, use of DAGs for control traffic, ...
Mobility

- XIA naturally separates identifiers and locators: XIDs versus DAGs
- Hand-off of sessions: based on coordination between mobile and fixed device
  - DAG change can be signed using cryptographic XID
  - Basic implementation already in our release
- Initial contact with mobile host based on rendezvous service
  - Can be linked into the DAG (different approaches)
  - Can also be used for simultaneous mobility

Finding Mobile Devices

- Must map identifier into an up-to-date locator
  - Challenges include scalability, security, deployment complexity, latency, overheads, ...
  - Lots of previous work
- Exploring solution based on locator services
  - Keeps track of user’s current location
  - User can choose service
Examples Uses of Interfaces

- Many choices: DAG, XID type, SID/CID routing, Scion vs NID, path selection, services, ..
- Examples: fault management, optimizing video distribution

The End