XIA + SCION Design

Introduction

Intra-domain routing
- Always use centralized SDN protocol (XSDN) as defined in previous documents

Inter-domain routing
- Can switch between:
    - BGP-style protocol (XBGP) as defined in previous documents
    - SCION protocol (XION)
- Protocol must be chosen before or when an end-host's packet reaches its gateway router, so that it can be forwarded to the proper domain egress if SCION is chosen
- **Possibilities for who chooses the inter-domain routing protocol:**
    - End-host can choose SCION:
        - On a per-packet basis but does not choose the SCION path
        - On a per-packet basis and chooses the SCION path
    - Transparent to end-host, domain controller can choose SCION:
        - On a per-packet basis
        - On a per-host basis
        - On a domain-wide basis
- This question is a policy decision and could be decided based on input from the greater XIA core group
    - SCION currently allows both options

Bootstrapping

1. Each domain's controller populates intra-domain forwarding entries
    a. This includes entries for SCION Certificate, Beacon, and Path Server SIDs
2. Each domain's controller uses XBGP to setup forwarding entries for reaching other ADs
    a. This step may not be necessary since SCION propagates PCBs only to adjacent ADs (see next step)
3. As defined by SCION, TD Core Beacon Server generates PCBs and all downstream Beacon Servers propagate PCBs to further downstream ADs
    a. Note: this process never stops; not just for bootstrapping
4. When a border router receives a PCB, it forwards it to the domain's Beacon Server
    a. The routes to the Beacon Server were setup in step 1
5. As defined by SCION, receiving Beacon Servers use PCBs to construct and register paths with Path Servers

Usage

We introduce a new principle type called XION for packets that should use SCION for inter-domain routing. XION packets will make use of XIA's Extension Header feature.

What are the limitations of the XIA Extension Header for storing SCION Headers?

Option 1: End-host will choose SCION but not the SCION path

1. When sending a packet on a socket, end-host will specify a destination DAG of the form "XION: 123, HID: 456" rather than one of the form "AD: 123, HID: 456"
2. When a gateway router receives a packet with a XION destination domain, it will query the Path Server--which will recursively query upstream AD Path Servers if necessary--and construct a SCION path to that domain
3. This path will then be added to the packet header as part of the XIA Extension Header
4. The gateway router and all subsequent routers in the domain forward packet to the first egress router
5. Egress router sends it to the next domain's ingress router
6. Repeat this until packet eventually reaches the final destination AD's ingress router
7. Routers within the final destination AD then forward packet to the final destination HID/SID

Option 2: Controller will transparently choose SCION for the whole domaibxfn

1. When sending a packet on a socket, end-host will specify a normal destination DAG of the form "AD: 123, HID: 456"
2. When a gateway router receives a packet, it will replace the destination DAG with one of the form "XION: 123, HID: 456" to identify it as requiring SCION for routing
3. It will also query the Path Servers and construct a SCION path to that domain
4. This path will then be added to the packet header as part of the XIA Extension Header
5. The gateway router and all subsequent routers in the domain forward packet to the first egress router
6. Egress router sends it to the next domain's ingress router
7. Repeat this until packet eventually reaches the final destination AD's ingress router
8. Routers within the final destination AD then forward packet to the final destination HID/SID

Plan
Steps

1. Update controller to add router forwarding table entries for SCION Certificate, Beacon, and Path Server SIDs
2. Bootstrap SCION by using existing SDN and XBGP routes to propagate PCBs, then construct and register resulting SCION paths
3. Update Click/routers to handle XION principle type
4. Update routers to query Path Servers and construct SCION paths
5. Update routers to insert SCION paths in XIA Extension Headers
6. Update routers to forward based on encapsulated SCION path egresses/ingresses

Components
- Controller Daemon (xcontrold)
  - Must include entries for SCION Certificate, Beacon, and Path Server SIDs in disseminated routing tables
- Routing Daemon (xrouted)
  - When a border router receives a PCB, it forwards it to the domain's Beacon Server
  - Must be able to route SCION PCBs to adjacent domains

- - Add support for XION principle type
    - Update routers to insert SCION paths in XIA Extension Headers
    - Update routers to forward based on encapsulated SCION path egresses/ingresses
  - Click
    - Add support for XION principle type
    - Ensure XIA Extension Headers have capacity to hold SCION paths