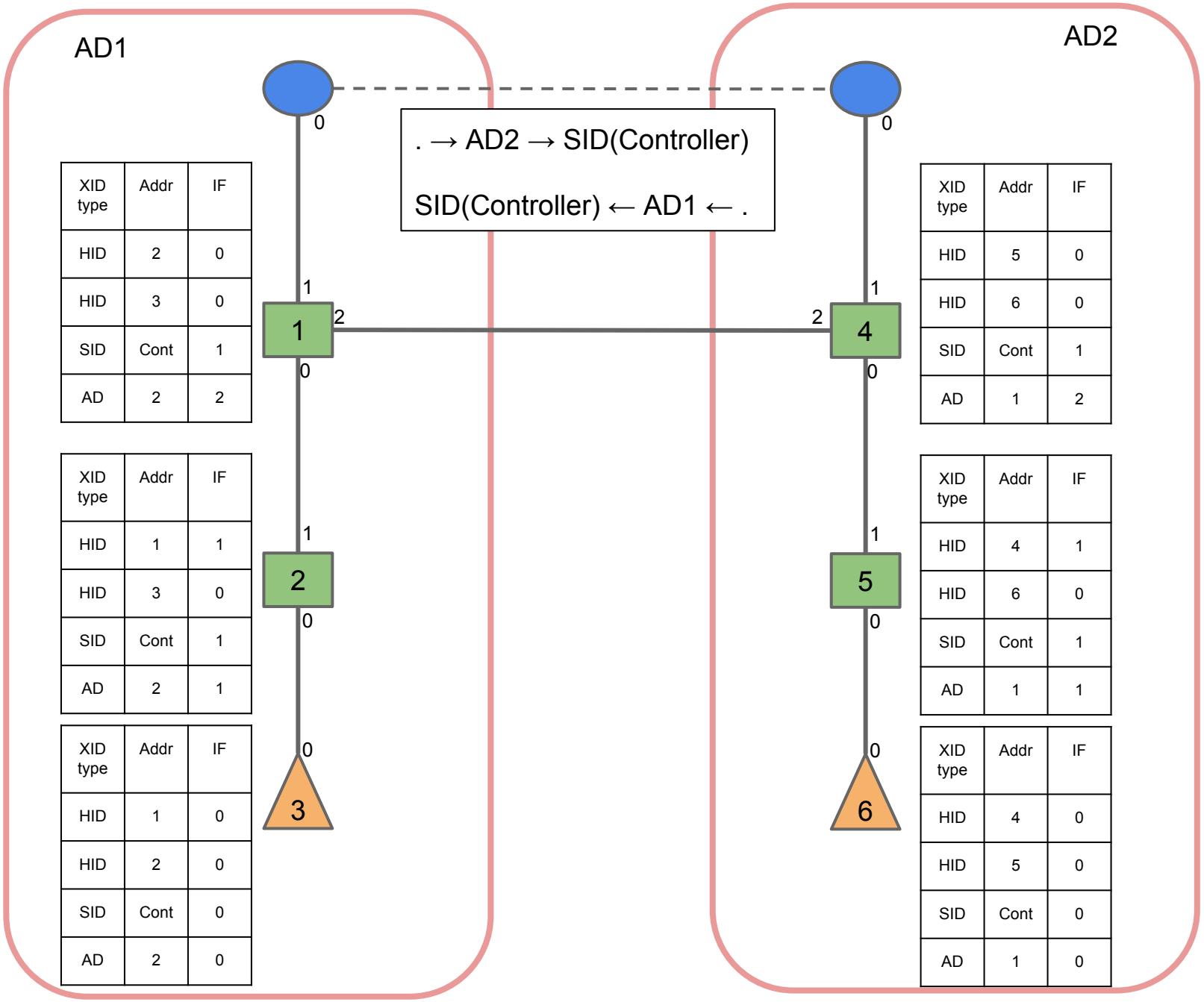
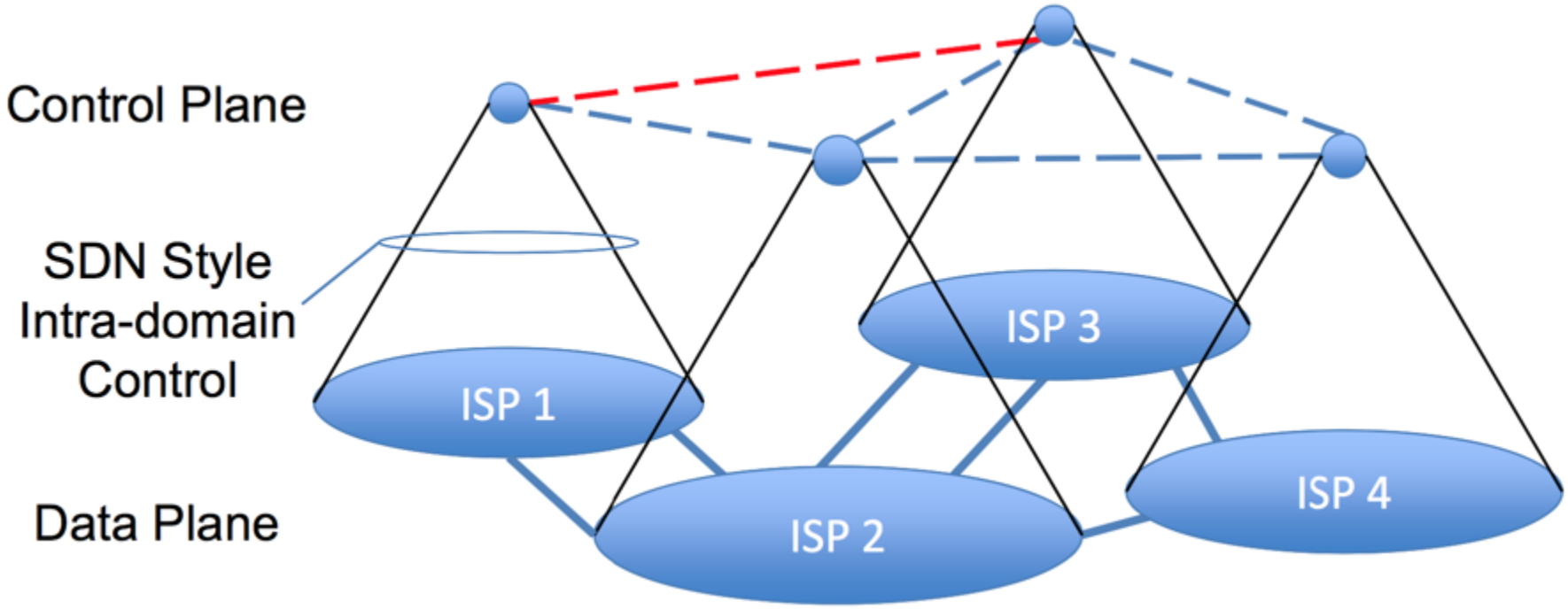
Intradomain routing

1. Hello messages establish neighboring routers and ADs
   a. Boundary routers can self-identify
   b. Intrinsic security prevents AD spoofing
2. Flood LSA within the same AD
3. Eventually, controller collects all the link information and calculates routes
4. Distributes routing info to internal hosts/routers


AD1
AD2
. → AD2 → SID(Controller)
SID(Controller) ← AD1 ← .
0
1
2
1
4
2
5
3
6
XID type
Addr
IF
HID 2 0
HID 3 0
SID Cont 1
AD 2 2
HID 1 1
HID 3 0
SID Cont 1
AD 2 1
HID 1 0
HID 2 0
SID Cont 0
AD 2 0
HID 5 0
HID 6 0
SID Cont 1
AD 1 2
HID 4 1
HID 6 0
SID Cont 1
AD 1 1
HID 4 0
HID 5 0
SID Cont 0
AD 1 0


Control Plane
SDN Style
Intra-domain
Control
Data Plane
ISP 1
ISP 2
ISP 3
ISP 4

Interdomain routing

1. After intradomain routes are set up, controllers from neighboring ADs can communicate with each other through logical connections
   a. DAG: .→ AD → SID(controller)
2. Run an interdomain routing protocol over these logical connections
   a. Link-state (adapt current code)
   b. BGP lite (BGP with simpler decision process)
   c. SCION
3. Distribute AD routing info to internal hosts/routers

Questions

- Since XIDs are unique and hash of public key, there is no longer an intrinsic form of hierarchy in the addressing. Forwarding table could be exhausted by recording specific XIDs. How do we tackle this?
- Examples:
  a. HID: Should inter-domain routing directly to hosts be supported?
     i. . → HID
     ii. (in addition to) . → AD → HID
  b. CID: will not have a pattern/hierarchy in addressing. Potentially huge number of CIDs.
- Potential solution: some scoping principal for each XID type
  a. ADs for HIDs
  b. Content type principal (e.g. video, music, doc) for CIDs

Design questions: Route calculation

- Current Internet
  - Distributed for both intra and inter domain
    - Individual routers exchange info then calculate routes using same algorithm
- XIA
  - Centralized within an AD
    - Controller gathers info, calculates routes, then distributes routes within AD

Design questions: Routing tables

- Current Internet
  - (dst IP, netmask) → (gateway, interface)
  - Other info for path selection, e.g. cost
- XIA
  - (dst XID type, dst XID) → (gateway, interface)
  - How to do flow-based routing?
    - e.g. (src IP, dst IP) → (gateway, interface)
  - Note on XION
    - After processing SCION header, routing is done by (AD, egress AD ID)
    - Maybe after initial processing, can cache entry
      - (XION, dst XION ID) → (gateway, interface)
    - Maybe even allow references in case routes change
      - (XION, dst XION ID) → (AD, egress AD ID)

Design questions: HID routing

- Current Internet
  - Routing to specific end-host IP addresses is supported due to CIDR
- XIA
  - HIDs are globally unique, so it is impossible to keep routing information for all of them at each router
  - To address some HID in a remote AD, it must be scoped by the AD in the routing DAG
    - HIDs without AD scoping are assumed to be in the local AD
    - Larger ADs may have several sub-ADs
      - Will this present security problems, since internal topology

Design questions: Boundary routers

- Current Internet
  - Boundary routers are statically configured
    - BGP set up as TCP sessions across point-to-point links
  - Even so, it is not secure: prefix hijacking, man-in-the-middle attacks
    - http://www.nanog.org/meetings/nanog49/presentations/Tuesday/HowSecure_NANOG_print.pdf
- XIA
  - Intrinsic security prevents spoofing
  - Boundary routers can be dynamically discovered

Design questions: BGP

- Current Internet
  - eBGP between boundary routers
  - iBGP required to distribute routes internally
    - usually fully meshed; special rules/configuration to avoid looping
- XIA
  - Routing handled by controller
    - xBGP between controllers instead of routers
      - Done over logical links: . → AD(neighbor) → SID(controller)
    - No need for iBGP
      - Controller distributes routes within AD
  - Only exchange AS reachability info (not HIDs)