Internet Indirection Infrastructure

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Contrasting LNA, HIP, and *i3*

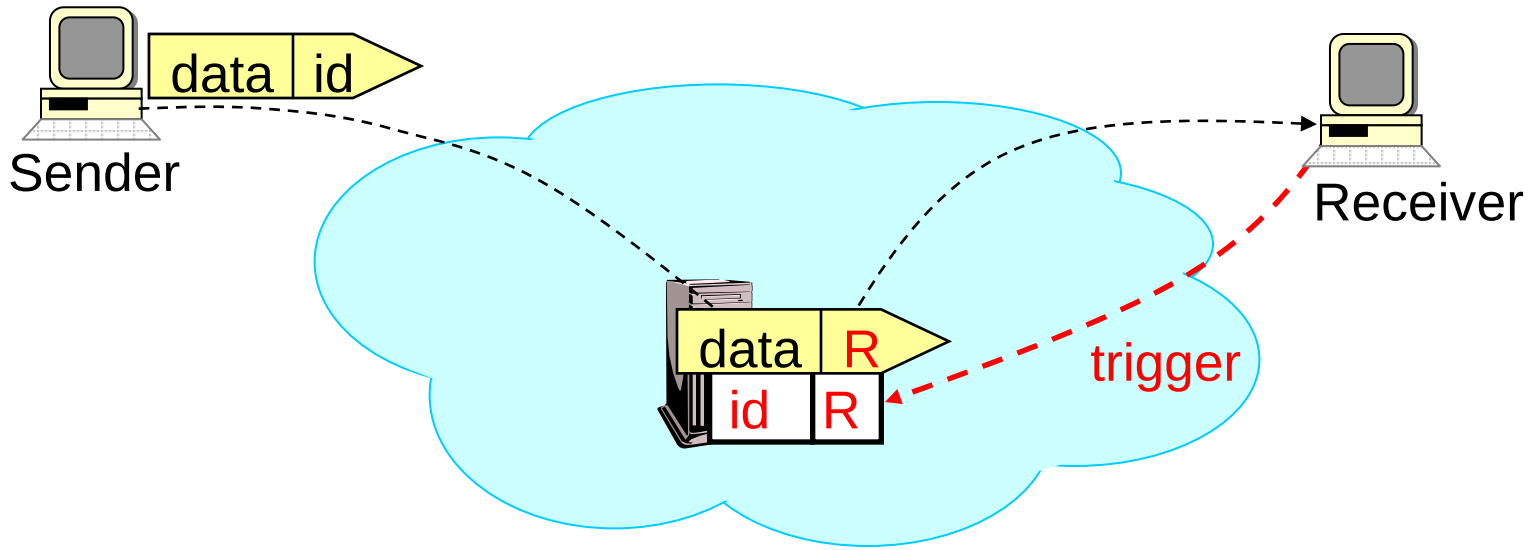
- LNA = “Layered Naming Architecture”
- LNA, HIP, i3:
  - All network architecture proposals
  - Separate location and identity
- What are the differences?

i3 Overview

- (Overlay) Forwarding Infrastructure that allows users to control routing and naming
- Routing:
  - Senders, receivers can control routing in the network
  - Set up the routing entries in the infrastructure
- Naming:
  - Fixed size IDs chosen by users/applications
  - ID typically identifies a service; can also identify end-hosts, etc.

i3 Overview

- Basic primitive is indirection
- Each packet is associated an identifier ***id***
- To receive a packet with identifier ***id***, receiver R maintains a trigger (***id***, R) into the overlay network



Mapping IDs

- *i3* is implemented on top of Chord
  - But can easily use CAN, Pastry, Tapestry, etc
- Each trigger ***t = (id, R)*** **or** ***(id,id')*** is stored on the node responsible for ***id***
- Use Chord recursive routing to find best matching trigger for packet ***p* = (*id, data*)**

What *i3* supports

- Communication abstractions
  - Mobility, Multicast, Anycast
- Service interposition
  - Receiver-driven, Sender-driven
- Can combine primitives powerfully
  - Receiver-driven heterogenous multicast
  - Service composition with server selection (using anycast)
- Enables many applications
  - NAT traversal, Secure VPN access
  - Protection against DoS attacks
  - IDS: route all packets through an intrusion detection box (e.g., Bro)

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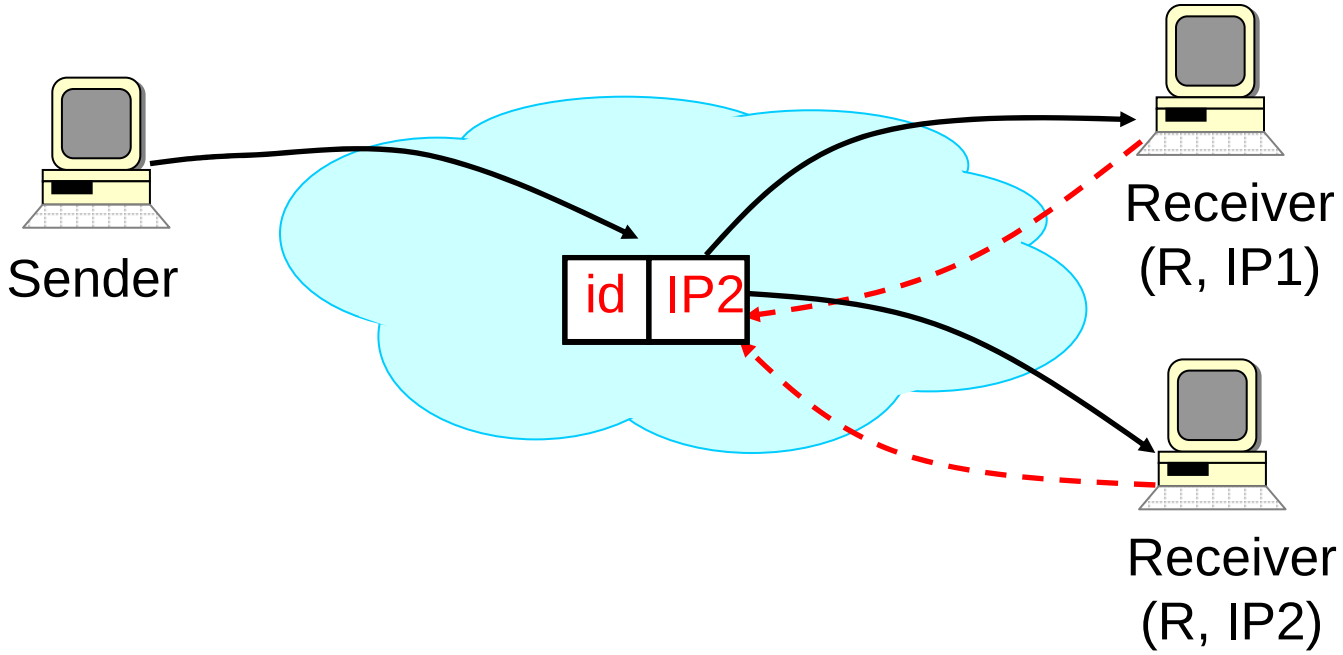
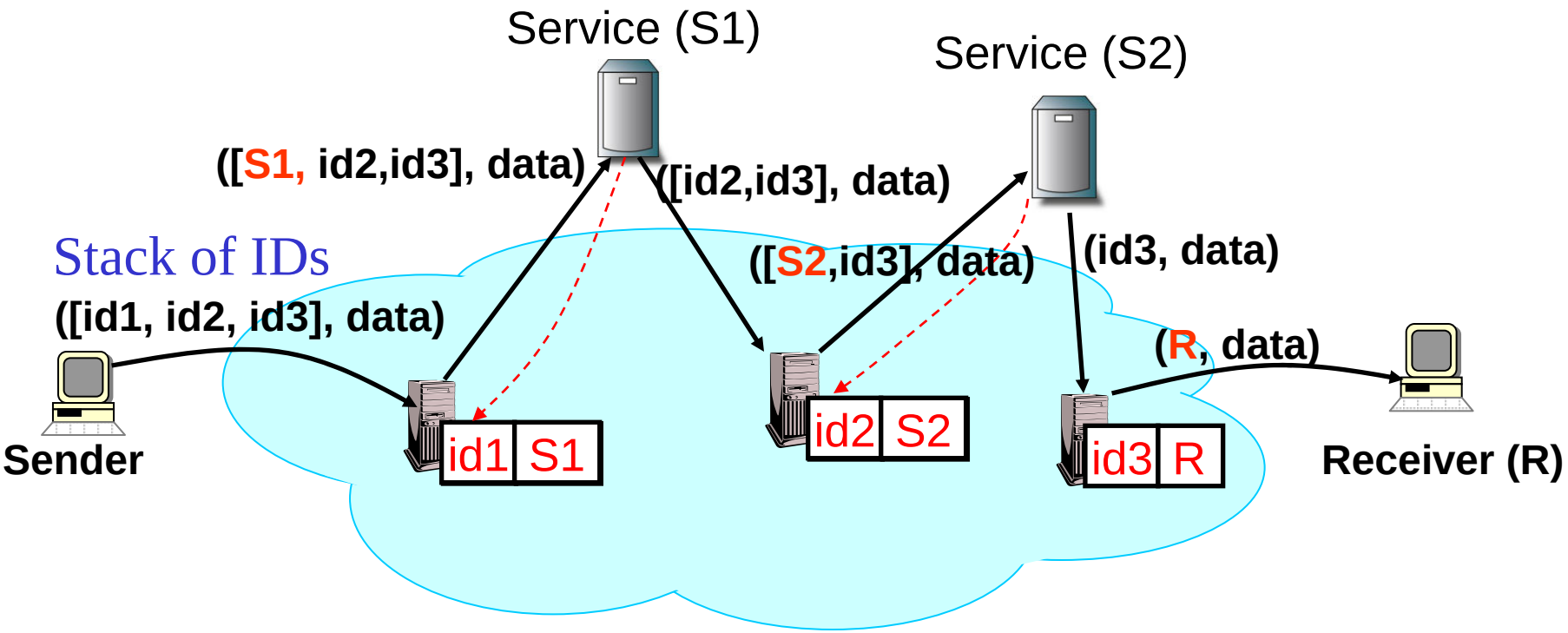
Mobility

- Host just needs to update its trigger as it moves from one subnet to another



Sender-driven Service Composition

Use stack of identifiers in packets



Receiver is unaware of transformations

Heterogeneous Receiver-driven

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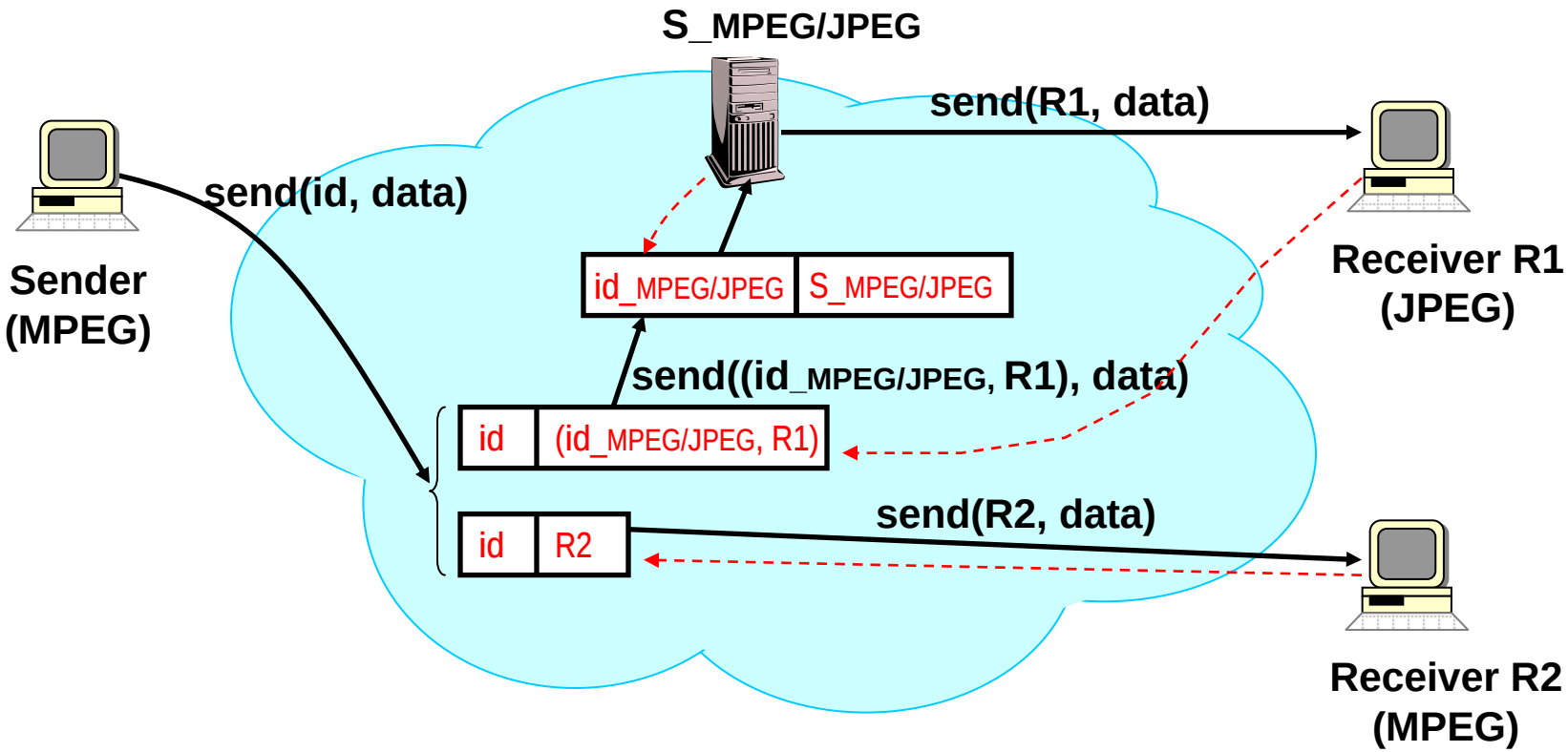

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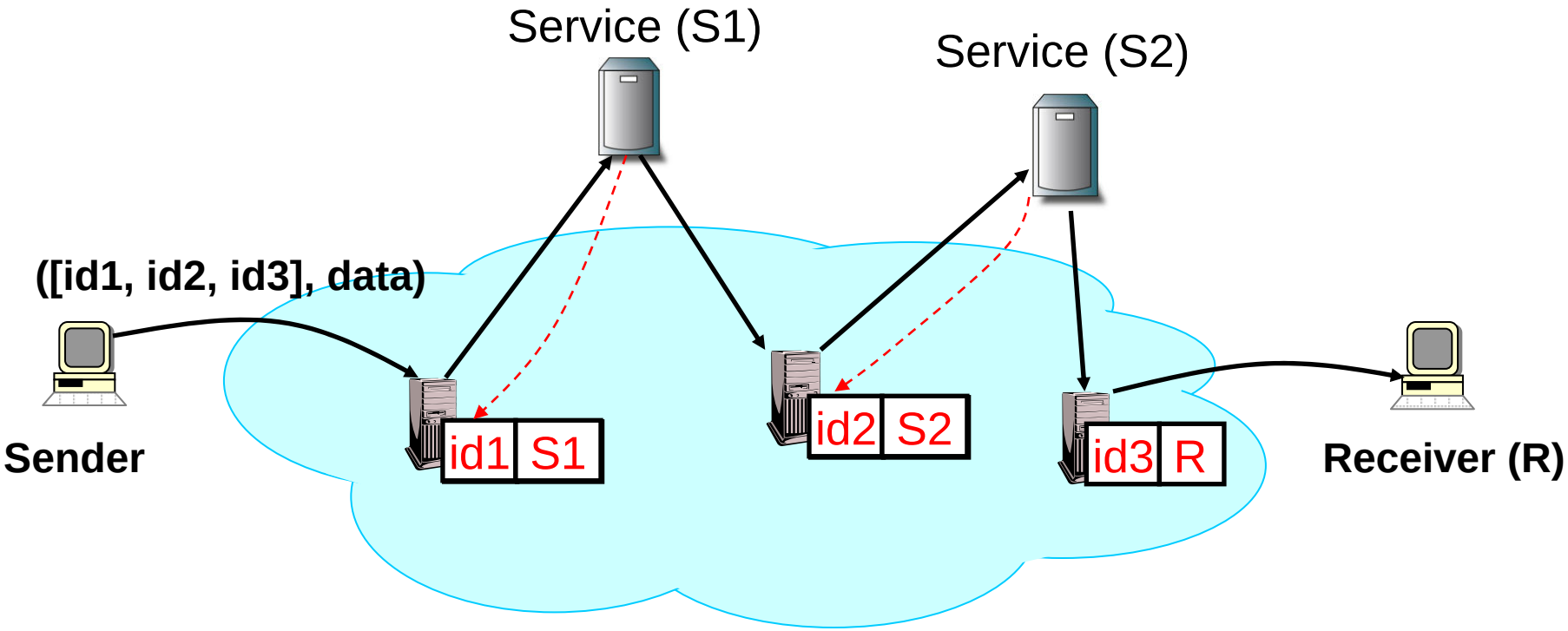
Using *i3* as a Lookup Infrastructure

- *i3* employs *short-cuts* if both sender and recipient allow it
- *i3* is only used as a lookup infrastructure



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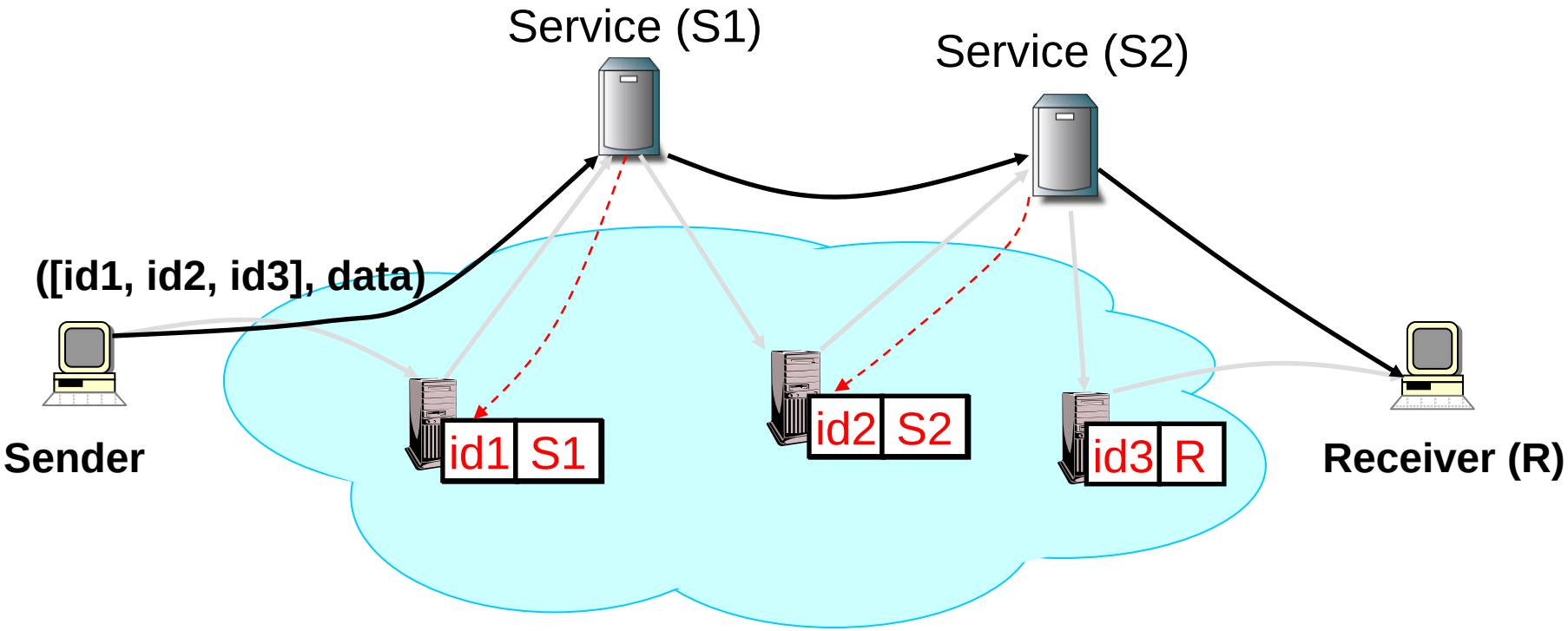
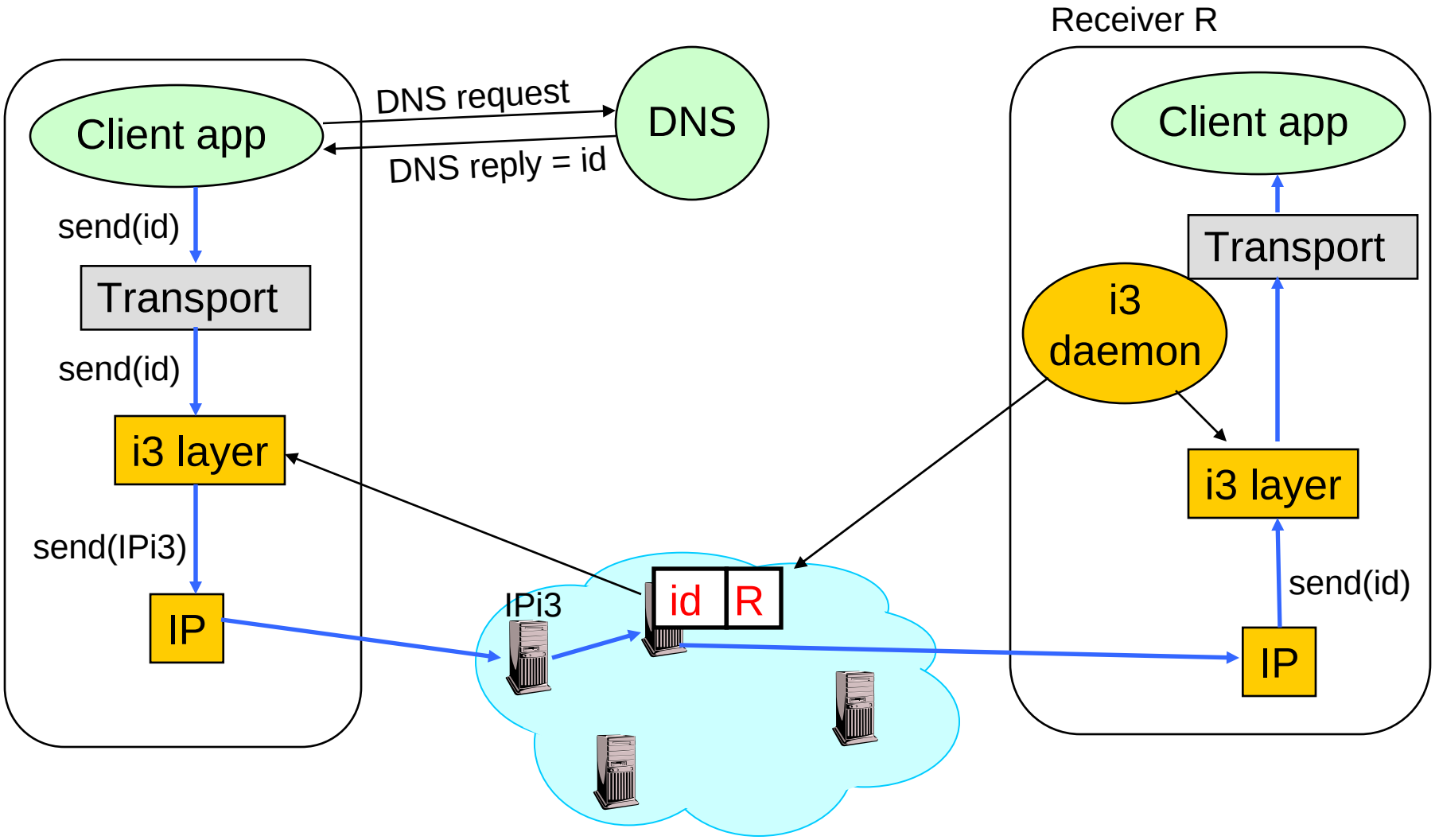


Protocol Stack (Native Apps)



Status of *i3*

- Code publicly available: http://i3.cs.berkeley.edu
- Supports Linux & Windows XP/2000 legacy applications
- Several groups build applications on top of i3
  - U. of Waterloo: delay tolerant networks
  - UIUC: service composition
  - U. of Tübingen (Germany): mobility, security

Contrasting HIP, *i3* and LNA

- Infrastructure:
  - HIP: rendezvous server
  - *i3*: integrated forwarding infrastructure; can be used for lookup also
  - LNA: uses an external lookup infrastructure
- Semantics of IDs:
  - HIP: IDs identify hosts
  - *i3:* IDs identify services; could also identify hosts
  - LNA: EIDs identify machines and SIDs services
- Security:
  - HIP: authentication, integrity, transport anonymity/DoS resistance
  - *i3*: IP anonymity, DoS defense at IP, rest through middleboxes
  - LNA: everything can be done through middleboxes