Towards a Global IP Anycast Service
(Ballani et al)

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IP Anycast

- Different IP layer addressing technologies:
  - IP unicast: one-to-one
  - IP multicast: one-to-many
  - IP anycast: one-to-any

- Anycast: IP packet is delivered to a node in a group of nodes identified by the IP anycast address

- Useful for e.g. (transparent) service discovery
  - Anycast supports the complete service for connectionless query/reply type of service (e.g. DNS)
Problems with Network Layer
Anycast

- Part of IPv6
- Very hard to deploy globally
  - Requires large address blocks to be advertised using BGP
- Scales poorly by the number of anycast groups
  - One route per IP anycast group
- Does not support load-balancing
  - because IP routing is used as the target host selection mechanism
Application Layer Anycast

- Maps a name (e.g. DNS name) into one host in a group of hosts
  - Informs the client of the IP address e.g. using DNS or some kind of redirect mechanism
- Benefits
  - Easier to deploy globally
  - Supports load-balancing
Problems with Application Layer Anycast

- Unusable and non-transparent for low-level protocols running on top of IP (like DNS)
- May not discover nearby resources without complex discovery mechanisms
- Packets are not delivered directly to the target
  - Redirection causes one extra round trip
Proxy IP Anycast Service (PIAS)

- Collects the benefits of network and application layer anycast but avoid the drawbacks
- Accomplishes this using proxies and tunneling
- Goals: backwards compatibility, scale by group size, efficient packet transfer, robustness, fast failover, ease of joining/leaving, scale by the number of groups/dynamics, target selection criteria
Generalized Proxy Architecture

- **AP**: Anycast Proxy
- **Unicast (Tunnel/NAT)**
- **Native IP Anycast**

Diagram shows the architecture with Anycast Proxy (AP) nodes connected by arrows indicating data flow.
## Architecture Components

- **AC = Anycast Client**
  - The source of the anycast packet
- **AT = Anycast Target**
  - The destination of the anycast packet
- **IAP = Ingress Anycast Proxy**
  - Proxy for the client (provides overlay tunneling service)
- **JAP = Join Anycast Proxy**
  - Proxy for the target (monitors target health, legacy support)
- **RAP = Rendezvous Anycast Proxy**
  - Provides a JAP look-up service (and ensures proximity)
Initial Packet Path

- **IP Tunnel**
- **Reverse Path**
- **Anycast**
- **Unicast**

Diagram:
- AT
- JAP
- RAP
- IAP
- AC

Steps:
1. JAP address (Cached)
2.
3.
4.
5.
6.
Subsequent Packet Path
Discussion

- Native IP affinity is quite good but not guaranteed
- Native IP anycast: bad proximity
- PIAS vs. i3
  - PIAS requires a deployment of 20 000 proxies
  - PIAS does not require any changes to protocol stack
  - i3 does not require anycast
  - IAP and JAP correspond to i3 private and public triggers?
- How does PIAS work in a mobile environment?