Host Anycasting Service

Presented by: Will Johnson

Outline

- **Introduction**
  - Background
  - What is an RFC?
- Anycast
- How do we do it?
- Anycast vs Multicast
- Discussion
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Background

- Written by Craig Partridge, Trevor Mendez, and Walter Milliken
- Written in 1993
- RFC 1546
- Primary Purpose: To establish semantics of anycasting services within an IP internet

What is an RFC?

- Request for Comments come from the technology community
- These come in memos from groups like:
  - Internet Engineering Task Force (IETF)
  - Internet Research Task Force (IRTF)
  - **Network Working Group (NWG)**
- In this context, used to convey new ideas about the internet
  - Proposals for standards
  - Peer review
  - Sometime even humor

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- Introduction
- **Anycast**
    - What is it?
    - Why do we need it?
    - Related Work
    - Example
- How do we do it?
- Anycast vs Multicast
- Discussion

What is it?

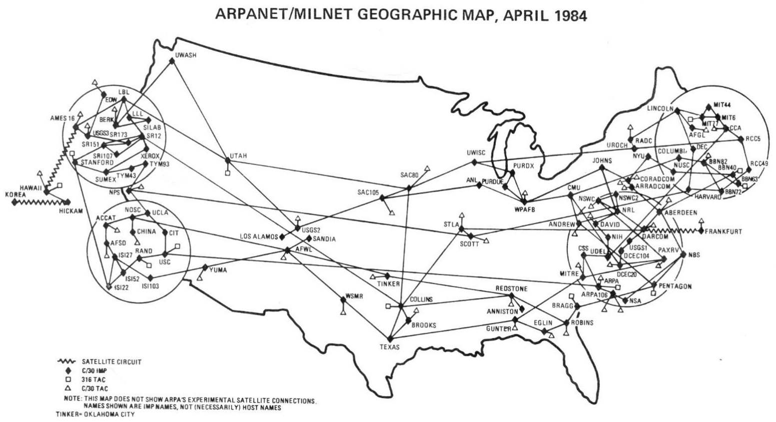
- Anycast - A service that allows users to specify a type of server
  - “I don’t care which one it goes to, I just need this type.”
- Internetwork should provide best effort deliver to at least one of these servers.
  - Providing to more than one is allowable, but not preferable.

Why Do We Need It?

- Considerably simplifies the task of finding a type of server
- Anycast to mirrored servers
- Anycast to a DNS server to resolve addresses
- Anycast finds the *nearest server*

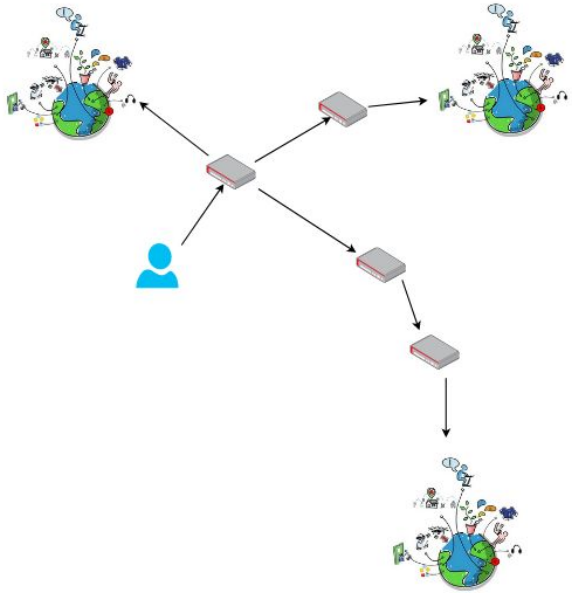
Related Work

- To this point, ARPANet supported logical addressing
  - ARPANET Host Access Protocol (AHAP) described in RFC 878
  - Supporting technology for Anycast
- No other attempt to outline Anycast



Example

1. User Makes Request to https://tntech-ngin.github.io/csc7970/
2. The Network decides which mirror to send the request to
3. It provides best effort delivery to at least one of these mirrors.
4. Best case scenario, only one receives it



Outline

- Introduction
- Anycast
- **How do we do it?**
    - IP
    - Anycast Addresses
    - Transmission and Reception
    - UDP and TCP
    - Applications
- Anycast vs Multicast
- Discussion

IP

- How can an Anycast Address act as a single Virtual Host?
- IP allows for misrouting and duplicating datagrams, so Anycast in IP should allow for:
    - Best effort delivery to one of the anycast address
    - Possible (not Preferable) delivery to more than one anycast address
- Multiple packets should be sent to the same anycast address
    - But IP is stateless, so how can it keep up?
    - Stateful protocols will have to make up the difference

Anycast Addresses

- How can we mark an address as an Anycast Address?
- Use the existing address space?
- Use a seperate class of addresses?
- Make a portion of the existing address space into an anycast addresses?

Anycast Addresses: Part of Existing Addresses

Pros

- May make routing easier (a portion of each network could be Anycast
- Host routes can be folded into net routes (hosts have to advertise anyway)

Cons

- Stateful protocols like TCP can't easily tell if an address is an anycast address
- How can we support internet wide anycasting?

Anycast Addresses: Separate Class of Addresses

Pros

- Easy to tell what is an Anycast Address
- Well-known anycast addresses are easier to support

Cons

- Routing becomes harder
  - Routers might have to keep track of more than one route.

Anycast Addresses: Part of Current Address Space

Pros

- Anycast routes look like network routes
  - Easier for routers to deal with

Cons

- Less efficient use of the address space
  - Severely limits the number of anycast addresses possible

Transmission and Reception of Datagrams

- On a shared media network, it should be possible to anycast to a server without a router.
  - A single network may not have a router.
- To achieve this, there are two approaches:
  - ARP
  - Transmit Anycast over a link-level multicast

Transmission and Reception: ARP

- Anycast servers respond to ARP requests for anycast servers
- Router simply sends to the first APR response that it gets
- To keep information up to date, ARP caches must time out
  - Timeout must be small (around 1 minute)
  - Lots of ARP traffic needed to Anycast

Transmission and Reception: Link Level Multicast

- Anycast servers listen for a multi-cast on the link-level multicast address
- Removes the need fo a router
- Generates less ARP traffic
- All multicast servers can still respond, even if one goes down
- All servers get all datagrams
- Routers should take care not to forward an Anycast datagram if another router might do the same
- Anycast servers should advertise that they are joining the Anycast group

UDP

- UDP and Anycast are both stateless services
    - UDP can treat Anycast as though it were a regular IP address
    - UDP datagram to an Anycast address - looks like Unicast
    - UDP datagram from an Anycast address - looks like Unicast
    - Datagram from Anycast to Anycast - looks like Unicast to UDP.

TCP

- TCP is stateful
  - A method must be devised to allow anycast over TCP
- Anycast Address must be treated as remote addresses of a TCP SYN segment
  - ACK bit must not be set
- When a SYN-ACK is returned, the Anycast Address must be replaced with the address of the returning host
  - We're treating the Anycast Address as a wildcard address!
  - This ensures that TCP is only connecting to one host after an Anycast datagram!

Applications

- In general, applications can treat Anycast as IP.
- It gets hairy when:
  - Applications try to maintain stateful connections over UDP
  - Applications try to maintain state across several TCP connections
  - Anycast cannot guarantee that an application is communicating with the same host every time.
- Solution: Anycast to get a server, and then get that server’s unicast address
  - This allows for stateful connections!

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- **Anycast vs Multicast**
  - Benefits and Tradeoffs
- Discussion

Benefits and Tradeoffs

Benefits

- Don't need to worry about Time To Live (TTL) of IP datagrams
- Anycast over TCP works better than Multicast over TCP
- Requires less routing support
- Less datagrams need to be sent for resource location

Tradeoffs

- Anycast may be slightly less fault tolerant
  - If an anycast server fails, datagrams may still be sent to it for some time afterward
  - In Multicasting, other servers would receive these datagrams

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  - Route Fragmentation
  - Security Considerations
  - Experimental Analysis

Route Fragmentation

- If many servers across the world are anycast:
- One may fail while packets are in transit, causing packets to be re-routed
- If these global Anycast servers are sparse, this could cause large latency

Security Considerations

- The Authors point out 2 security concerns without addressing them
- Attackers could volunteer as anycast hosts to take control of routing
  - Denial of Service
  - Eavesdropping
- Any member of a network can respond to anycast requests
  - False information

Experimental Analysis

- No experimental data is given to corroborate the claims of the authors.
- All work is theoretical
- Very few sources cited

Questions?