Making practical use of IPv6 anycasting: Mobile IPv6 based approach

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Contents

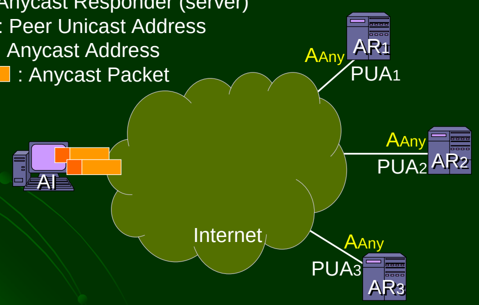
IPv6 Anycast

- Defined in IPv6 specification
- Supports service-oriented address assignment
  - Anycast address is assigned to multiple nodes which provide same service
  - Anycast packet is delivered to an appropriate node
    - Appropriateness depends on the routing protocol
- Shares address space with unicast
  - Existing unicast services can be switched to anycast services with the same address

	Unicast	Multicast	Anycast
Object of address assignment	A node	A group of nodes	**A service**
Candidate for receiver	Single	Multiple	**Multiple**
Communication form	Point to Point	Point to Multipoint	**Point to Point**
Address space	Unicast address	Multicast address	**Unicast address**

Anycast Communication

AI: Anycast Initiator (client)
AR: Anycast Responder (server)
PUA: Peer Unicast Address
A_{Any}: Anycast Address
: Anycast Packet



Advantages of Anycast

- Provides a fixed address for a service
  - Client only has to know the anycast address to get the service
- Enables client nodes to connect to appropriate server without care
  - The appropriate server is selected by the routing mechanism
- Provides robust availability of the services
  - When a server breaks down, anycast packets are delivered to another working server

Current Usages of Anycast

- Only a few services use global anycast
  - Current global anycast services are achieved via service-specific methods
  - Current anycasting cannot provide stateful communication (e.g. TCP)

Objectives

- to achieve service-independent global anycast service
- to provide stateful communication in anycasting

Difficulty of Anycast Routing

- Anycast addresses are location-independent
  - Locations of anycast responders cannot be identified from anycast addresses
  - Need to associate the locations of anycast responders with anycast addresses
- Mobile IPv6 (MIPv6) resolves the same difficulty
  - We utilized MIPv6 for proposed architecture

Analogies between MIPv6 and Global Anycast

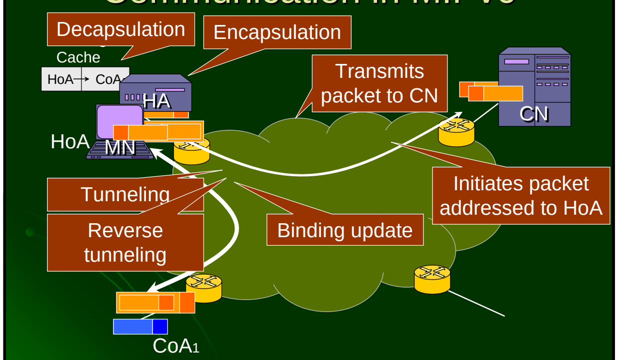
MIPv6	Global Anycast
Mobile Node (MN) has a location-independent address Home Address (HoA) and a location-dependent address Care-of Address (CoA)	ARs have a location-independent address A_{Any} and a location-dependent address PUA
MN uses HoA to communicate with Correspondent Node (CN) regardless of the network where MN exists	ARs use A_{Any} to communicate with AI regardless of the network where ARs exist

- Proposed architecture utilizes these analogies

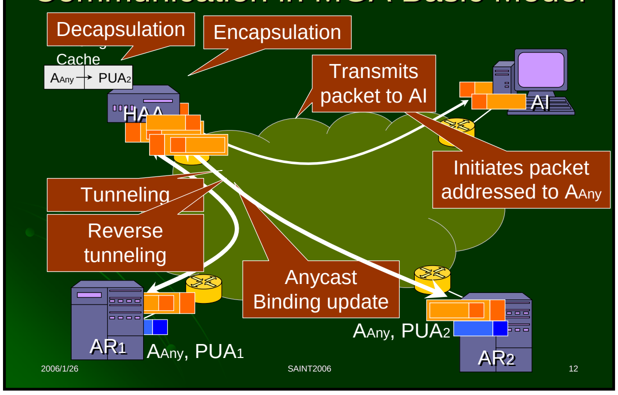
Proposed Architecture

- Mobile IPv6-based IPv6 Global Anycast (MGA)
- Two models
  - Basic model
    - Utilizes MIPv6 architecture as is
  - Advanced model
    - Extends MIPv6 architecture to resolve the differences between MIPv6 and global anycast

Communication in MIPv6



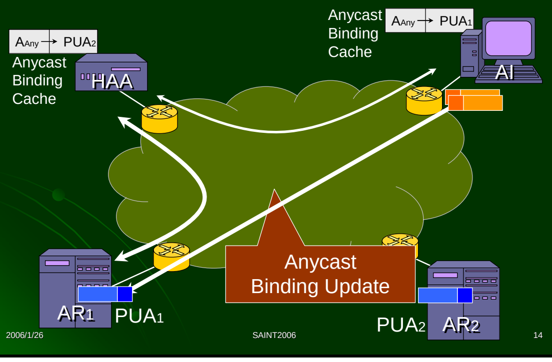
Communication in MGA Basic Model



Keeping a Stateful Communication

- Various anycast responders update binding caches in home anycast agent
  - Change corresponding anycast responder
  - May destroy stateful sessions
- We utilized Route Optimization procedure defined in MIPv6
  - Switch communication paths not through HAA

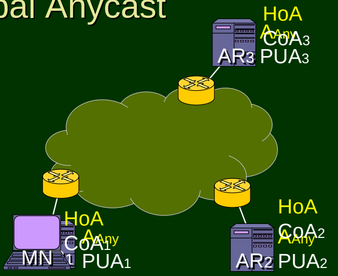
Stateful Communication in MGA Basic Model



Difference between MIPv6 and Global Anycast

MIPv6
Home Address is possessed by a single Mobile Node

Global Anycast
Anycast Address is shared by multiple Anycast Responders



- The difference causes some limitations in MGA basic model

Limitations in MGA Basic Model

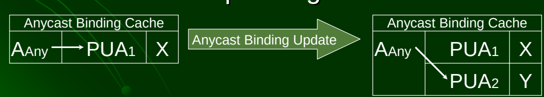
- Cannot distribute anycast packets to multiple ARs at one time
  - Only a single PUA can be bound with a single A_{Any}
- Stateful communication may be destroyed
  - When AI cannot execute route optimization
- Traffics are centralized in a HAA
  - More typically than the case in MIPv6

MGA Advanced Model

- Multiple binding cache entries for a single anycast address
  - Distribute anycast packets to multiple ARs
- Stateful communication provided by HAA
  - Achieve stateful communication without route optimization
- Distributed deployment of multiple anycast agents
  - Balance the anycast traffics

Multiple Binding Cache Entries for Single Anycast Address

- We extend binding cache to maintain multiple entries and metrics
- We extend binding update message to transmit some metrics
  - Metric: hop count, server resource, etc.
- HAA refers metric in anycast binding cache to select a corresponding AR



Stateful Communication Provided by HAA

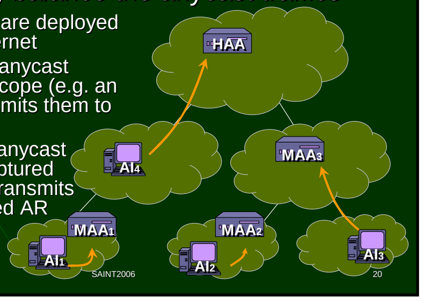
- HAA maintains correspondence information between AI and AR for a certain period
- HAA forwards anycast packets according to correspondence information table

Example of correspondence information table

Source	Corresponding PUA	Exp. Time
A_{AI1}	PUA_2	t_1
A_{AI2}	PUA_3	t_2
A_{AI3}	PUA_2	t_3
A_{AI4}	PUA_1	t_4

Distributed Deployment of Multiple Anycast Agent

- Multiple nodes (named Midway Anycast Agent: MAA) balance the anycast traffics
  - Multiple MAAs are deployed around the Internet
  - MAAs capture anycast packets in its scope (e.g. an ISP), and transmits them to selected AR
  - HAA captures anycast packets not captured by MAAs and transmits them to selected AR



Conclusions and Future Topics

- Conclusions
  - Anycast routing architecture based on MIPv6
    - Can provide service-independent anycasting
    - Can keep stateful communication
- Future topics
  - Implementation and evaluation of MGA advanced model

Thank you.