DNS Anycast Operation of .JP

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JPRS

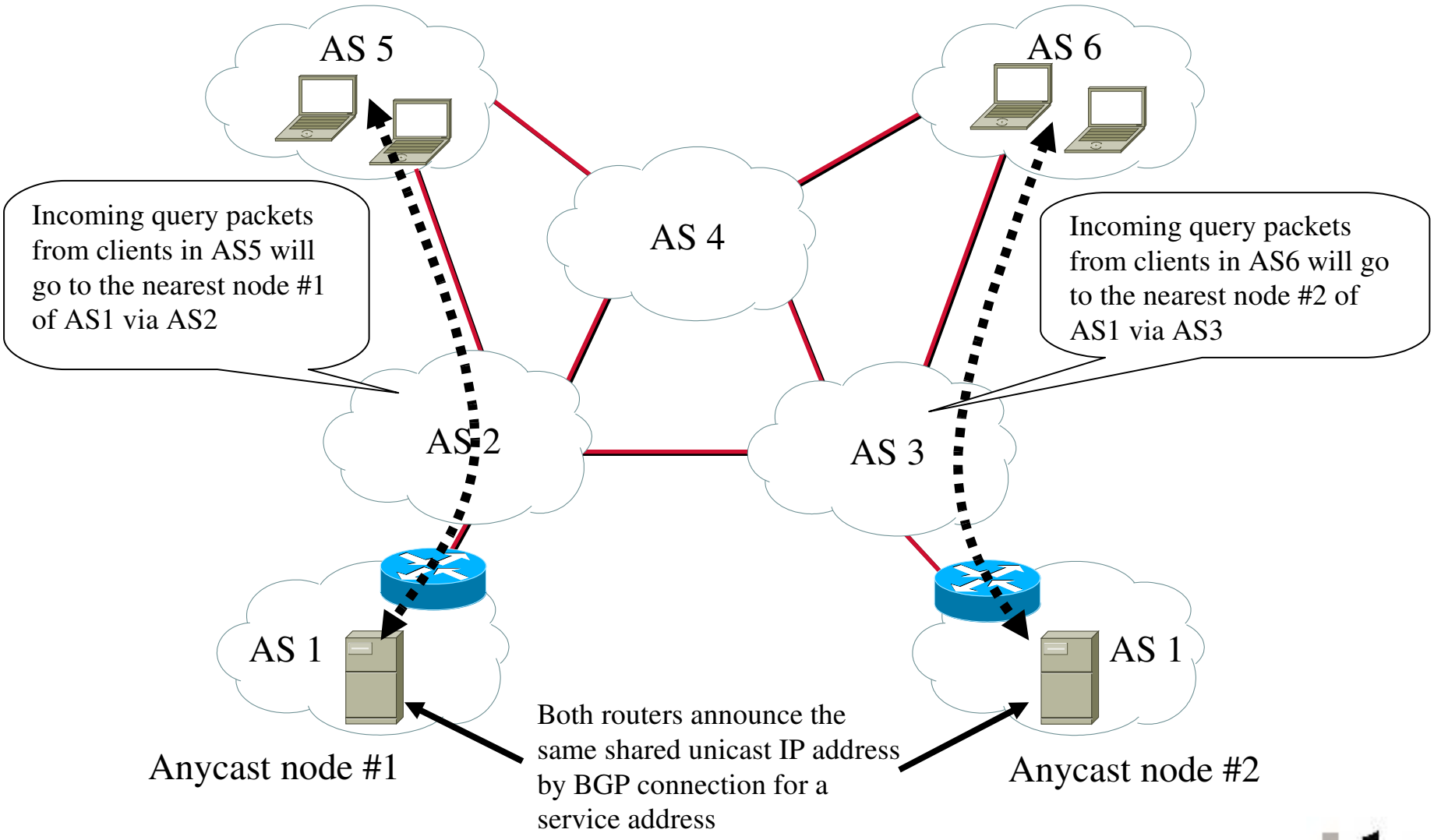
Agenda

- Background
- Motivations
- .JP Anycast Overview
- Anycast management

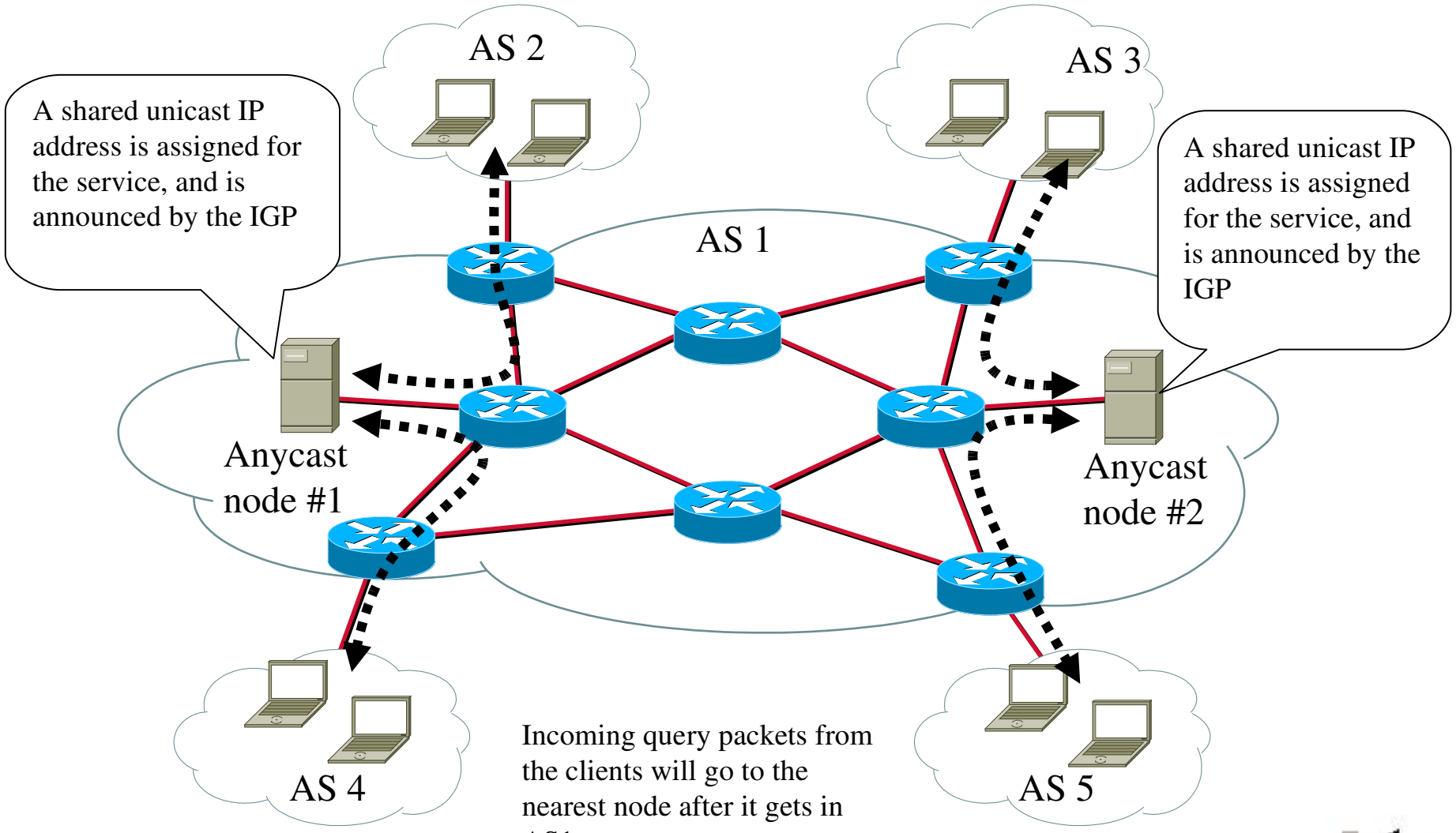
Background

- IP anycast is…
  - A technology to share a single IP address in multiple servers
    - IGP anycast for inside AS
    - BGP anycast for outside AS
  - DNS service is one of the effective thing to introduce IP anycast
    - 1 packet udp transaction for both query and response
      (Response packet may fragment in EDNS0, but still no problem)
    - very short tcp session
  - IP anycast technology is now being deployed in authoritative name servers
    - Root servers (C, F, I, J, K, M)
    - Some TLD servers (.JP, .MX, .DE etc.)

BGP Anycast Overview



IGP Anycast Overview



Motivations

- Common motivations for using DNS anycast are,
  - Localize the DoS attack damages
  - Provide nameservers all over the world
  - IPv6 deployment
  - Simple maintenance and recovery

Localize the DoS attack damages

- IP Anycast can localize the DoS attack damages to the single node.
  - Other nodes will not be affected from the DoS attack
  - Only the nearest nodes from the DoS attacker will be damaged
  - In the DDoS case, if the attackers are gathering in the similar network, affects will be localized too.

Provide nameservers all over the world

- Placing more nameservers is one of the solutions to increase the stability of the DNS
- IP anycast can help to plan the placement of secondary servers
  - Adding a new anycast node improves the accessibility of the users
  - Users access only the nearest node

IPv6 deployment

- Adding IPv6 glue data in the higher level zone decrease the limit number of NS in less than 13
  - Number of NS is limited by the DNS response packet size of 512 octets
  - Serving AAAA (IPv6) information in the glue record require more data size in the additional section than A (IPv4) only

Simple maintenance and recovery

- IGP anycast can simplify server maintenance
  - Operator can stop individual server without outage of the service
- BGP anycast can simplify maintenance of the whole site
  - Operator can shutdown the BGP peer without outage of the service
  - Useful in the case of network troubles
- Able to rebuild the DNS node without thinking of other infrastructures placed in the same network

The current situation of .JP

- JP DNS servers:
  - 5 NSes
    - {a,b,d,e,f}.dns.jp
      - c.dns.jphas retired in Mar. 2005
  - Operated by 5 different organizations, with responsibility of JPRS
    - All organizations own their networks by their own AS numbers
  - Hold numbers of zones
    - .JP ccTLD zones (1 TLD and 63 SLDs)
      - 769,445 domains (1 Nov. 2005)
    - Also serve 339 of in-addr.arpa zones for JPNIC (NIR)

Introducing IP anycast servers to .JP

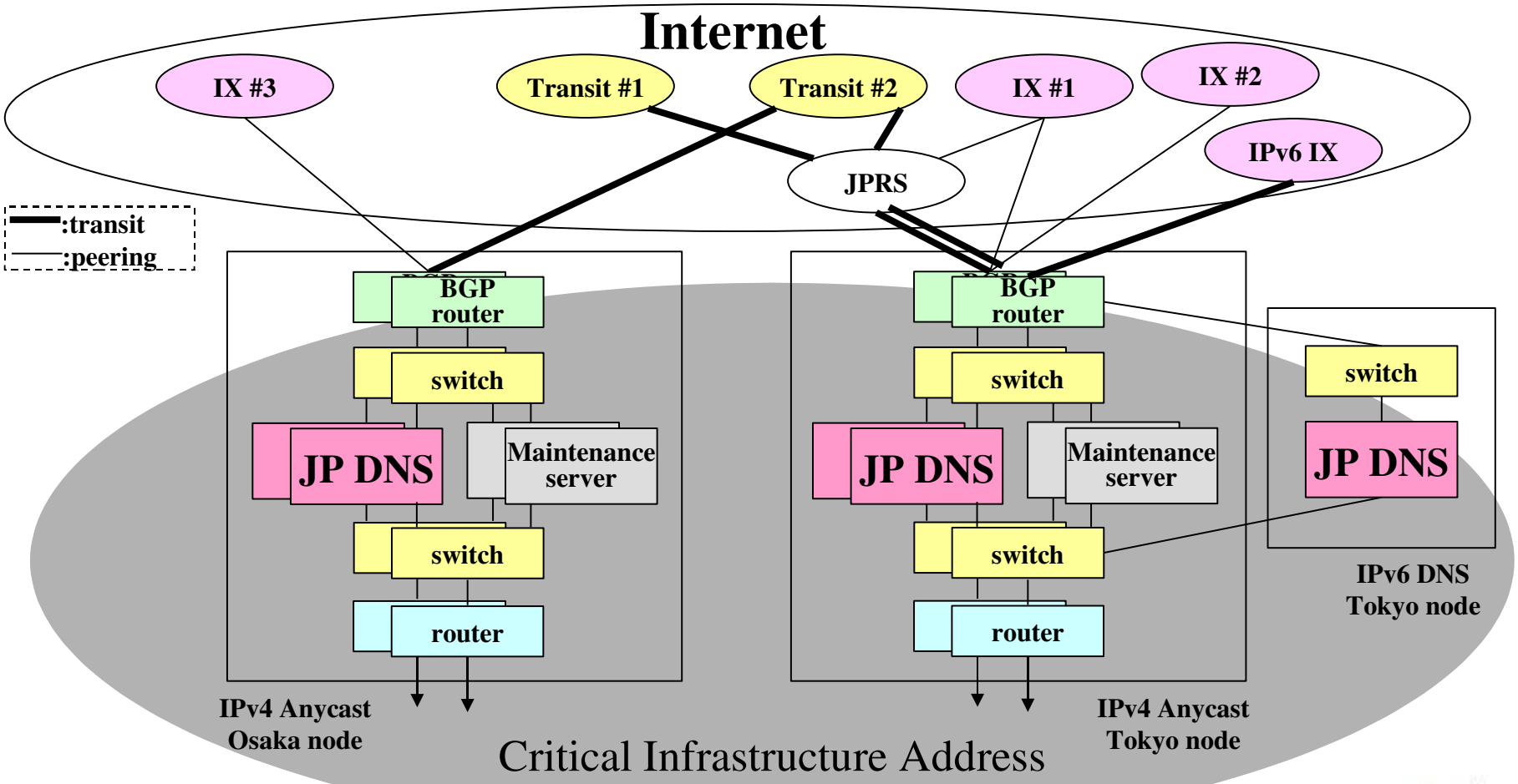
- Severe crisis of the power outage in Tokyo (2003)
  - JP DNS operators tried to move some of the servers out of Tokyo
    - Using IP address of their main network prevent us to change the location without changing the IP address at that time
    - This was the potential problem, which prevent us to recover the DNS without thinking of other infrastructures placed in the same network, even in the severe network trouble
  - JP DNS could not add more NSes
    - JP DNS operators were thinking of the deployment of IPv6 at that time
    - 4 IPv6 servers out of 6 NSes is the limit

  Fortunately, the power outage did not happen

Introducing IP anycast servers to .JP (2)

- JP DNS took the following solution
  - Keep the number of NS in 6
  - Move to PI (Provider Independent) addresses and new ASNs if possible
  - Add more servers using IP anycast technology
    - Now we have servers in Tokyo, Osaka and US

Technical details of a.dns.jp



Concerns of IP Anycast management

- IP address issues
  - Anycast need PI address or unused /24 address block
    - ccTLD can have PI address blocks for their nameservers
  - Unicast address still needed for each anycast nodes
    - To update the zone data, to maintain the servers
  - At least 1 NS should remain in unicast (RFC 3258)
- Budget issues
  - IP anycast requires transit and / or IX connectivities for each nodes
  - Maybe expensive for individual service
    - This network serves only 1 IP address to the public
- Measurement issues
  - It is hard to know all the servers are up in anycast address
    - Checking unicast address is not enough
    - Multiple measuring address required

Nameserver configurations

- Multiple addresses are needed in a server
  - One for IP anycast service
  - One (or more) unicast address(es) for maintenance and zone update
- Not so much difference from unicast servers
  - in BIND9, following options should be considered to make zone updates to work
    - query-source
    - transfer-source
    - notify-source

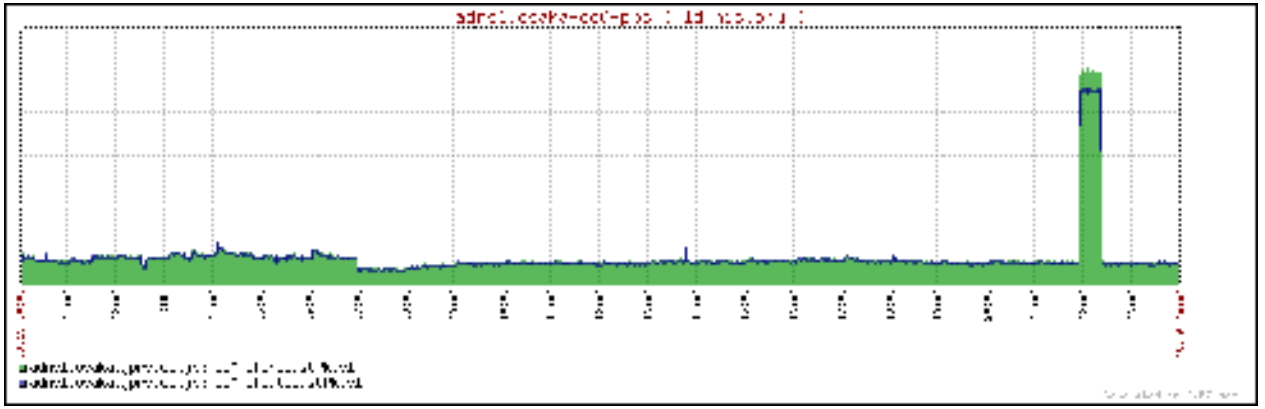
Consideration points

- Local nodes and global nodes
  - Local nodes are for IX connections
    - No-export option in BGP peers
  - Global nodes are for transit connections
  - 2 global nodes and several local nodes may be good
  - Some trouble may occur by uRPF (unicast Reverse Path Forwarding)
    - Some ISPs use uRPF technology for very intelligent network filtering

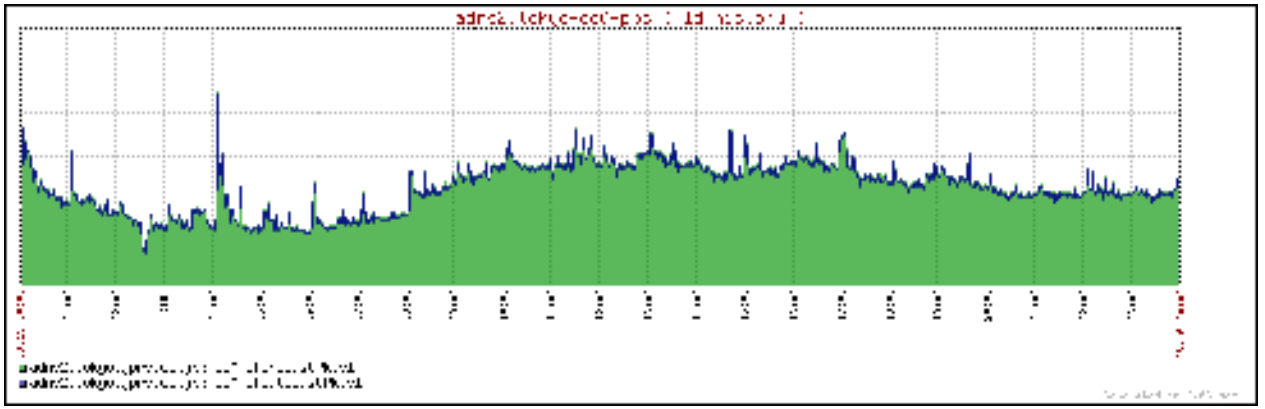
Example of IP Anycast effect

- DoS like queries in Osaka node did not harm any in Tokyo node

Osaka node



Tokyo node



BCPs

- Some BCP activities exist
  - Distributing Authoritative Name Servers via Shared Unicast Addresses
    - RFC 3258
  - Operations of Anycast Services
    - draft-ietf-grow-anycast-02.txt
  - BGP Anycast Node for Authoritative Name Server Requirements
    - draft-morishita-dnsop-anycast-node-requirements-01.txt

Appendix: NS maximum number estimation

- DNS protocol has limitation in UDP response packet size
- More NSs make .JP DNS more reliable
  - Name compression
- Estimation for .JP (dns.jp)
- "preferred-glue a" and / or EDNS0 may moderate the limitation

NS	AAAA	A	Add.	Judge
3	3	3	AAAA x3, A x3	Nice
4	3	4	AAAA x3, A x4	Nice
5	3	5	AAAA x3, A x4	OK
6	3	6	AAAA x3, A x3	OK
7	3	7	AAAA x3, A x2	OK
8	3	8	AAAA x3, A x1	OK
9	3	9	AAAA x3, A x0	Bad
10	3	10	AAAA <3, A x 0	NG

NS	AAAA	A	Addi.	Store
4	4	4	AAAA x4, A x3	OK
5	4	5	AAAA x4, A x2	OK
6	4	6	AAAA x4, A x1	OK
7	4	7	AAAA <4, A x0	NG
5	5	5	AAAA x5, A x1	OK
6	5	6	AAAA x5, A x0	Bad
7	5	7	AAAA <5, A x0	NG
6	6	6	AAAA <6, A x0	NG

Questions?

http://jprs.jp/

http://日本レジストリサービス.jp/