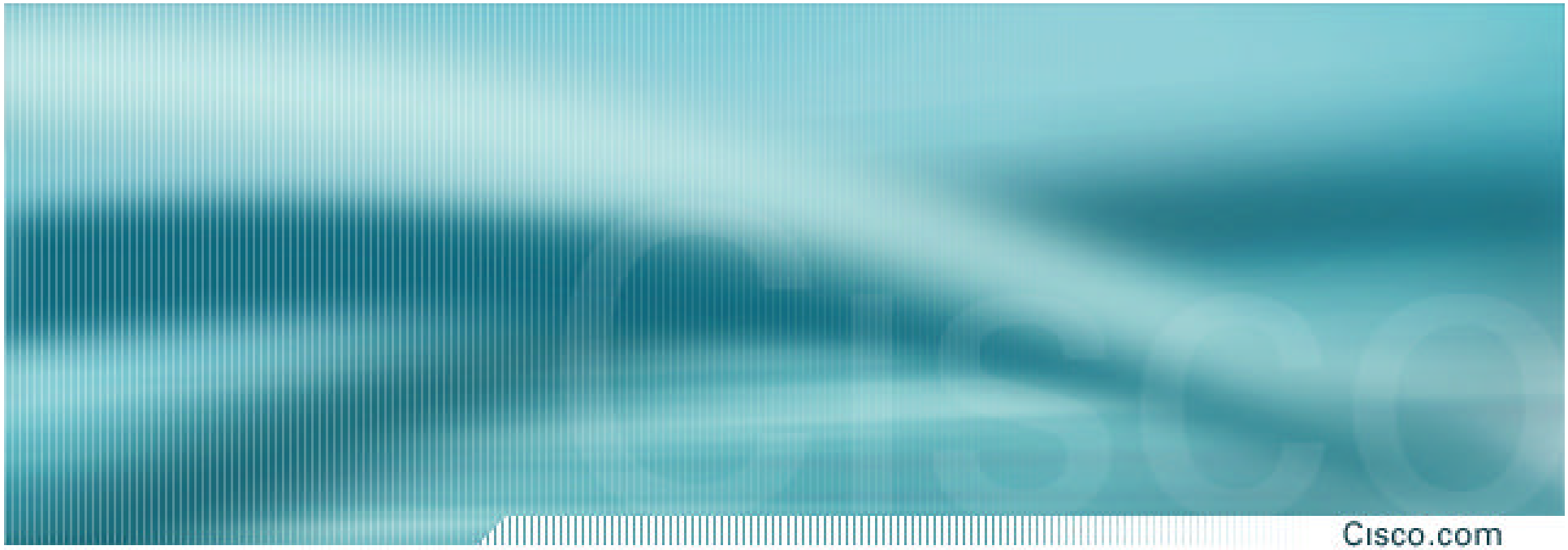

IPv6 Multicast

Philip Smith <pfs@cisco.com>

1st South Asian IPv6 Summit/SANOG 3

15-22 January 2004

Bangalore, India

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Preliminaries

- **Thanks to Cisco IPv6 team for the content**
- **Presentation slides available on**

  ftp://ftp-eng.cisco.com/pfs/seminars/SANOG3-Multicast-IPv6.pdf

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Agenda

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- **Solutions and Markets Drivers**
- **IPv6 Multicast Protocols**
- **Deployment Scenarios**
- **Cisco IOS IPv6 Multicast Components**
- **Conclusion**

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Why consider IPv6 Multicast?

- **Cannot and don't want to use IPv4 at all**
  - **Applications require IPv6**
- **Good chance to simplify and improve the multicast model through use of IPv6**
  - ***more attractive, lower TCO service:***
    - **Embedded RP addresses, Unicast prefix addresses**
    - **No fragmentation below 1280 bytes**
    - **Powerful address scoping (no TTL scoping !)**
    - **Potentially simpler interdomain solutions**
    - **No DVMRP, perhaps no need for PIM-DM, and likely no need for MSDP**
    - **Proven routing technology (PIM), lessons learned from v4 implementations**
- **Good chance to get new applications to utilize IP multicast**
  - **A lot of research is spent on just "anything with IPv6"**
- **Good chance to establish IPv6 multicast as a ubiquitous day-1 service**

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End-to-End, Fully Integrated Solutions

- **IPv6 Multicast deployed as a part of end-end solutions:**
  - **Initial Target Applications**
    - **Interactive TV, gaming, mobile services, conferencing**
  - **IPv6 Stacks & Applications supporting Multicast**
  - **Network infrastructure**
    - **IPv6 Multicast services**

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IPv6 Multicast – O.S. & Application Support

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- **Stacks**
  - **KAME host stack**
  - **Microsoft Windows XP**
  - **Linux**
  - **OpenVMS and True64**
- **Applications**
  - **Standard MBONE Tools (vic, rat, ...) support IPv6**
  - **Video streaming applications add IPv6 support (DVTS, Videolan,...)**
  - **Many emerging commercial applications**

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IPv4 versus IPv6 Multicast

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IP Service	IPv4 Solution	IPv6 Solution
Address Range	32-bit, class D	128-bit
Routing	Protocol Independent All IGPs,and BGP4+	Protocol Independent All IGPs,and BGP4+ with v6 mcast SAFI
Forwarding	PIM-DM, PIM-SM, PIM-SSM, PIM-bidir	PIM-SM, PIM-SSM, PIM-bidir
Group Management	IGMPv1, v2, v3	MLDv1, v2
Domain Control	Boundary/Border	Scope Identifier
Interdomain Solutions	MSDP across Independent PIM Domains	Single RP within Globally Shared Domains

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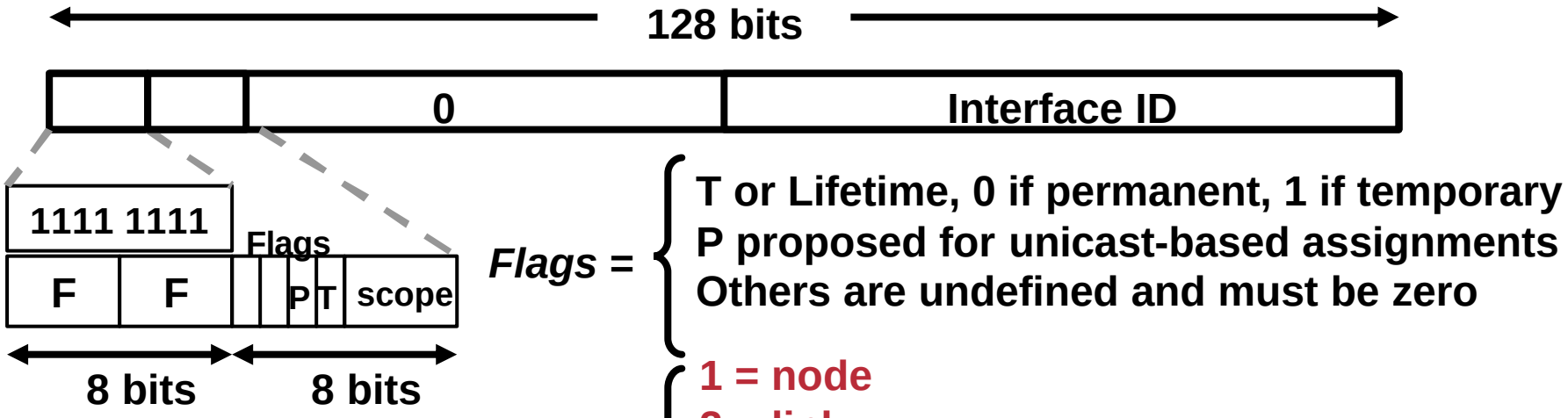
Expanded Address Space
Multicast Addresses (RFC 2373)



- **Multicast is used in the context of one-to-many**

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IPv6 Multicast Forwarding

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- **PIM-Sparse Mode (PIM-SM)**

  draft-ietf-pim-sm-v2-new-08.txt,

- **PIM-Source Specific Mode (PIM-SSM)**

  draft-ietf-ssm-overview-04.txt (v6 SSM needs MLDv2)

  unicast prefix based multicast addresses ff30::/12

  - **SSM range is ff3X::/32**
    - **current allocation is from ff3X::/96**

- **PIM-bidirectional Mode (PIM-bidir)**

  draft-ietf-pim-bidir-05.txt

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Multicast Listener Discovery – MLD

- MLD is equivalent to IGMP in IPv4
- MLD messages are transported over ICMPv6
- Version number confusion:
  - MLDv1 corresponds to IGMPv2
    - RFC 2710
  - MLDv2 corresponds to IGMPv3, needed for SSM
    - draft-vida-mld-v2-06.txt
- MLD snooping
  - draft-ietf-magma-snoop-04.txt
- CGMP for v6 under consideration

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Domain Control

- **Definitions:**
  - **A PIM domain is topology served by common RP for all sources and receivers of same group.**
  - **A routing domain is consistent with AS.**
- **Its necessary to constrain the PIM messages, rp-mappings, and data for groups within the PIM domain:**
  - **In IPv4 we used multicast boundary/ BSR border**
  - **In IPv6 we use scopes and zones**

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IPv6 Scoping support

- **Scopes: draft-ietf-ipv6-addr-arch-v4-00.txt**

  Example scopes:

  link-local (2)

  site-local (5)

  global (E or 14)

- **Zone is a connected region of topology of a given scope**
- **Initial implementation similar to v4 boundaries:**
  - **Can configure interface with zone and scope**

    `ipv6 zone <zoneid> scope <2-15>` `CAUTION: This is still being worked.`

  - **PIM messages and data traffic within that scope are ignored on that interface**
  - **Initially a zone can only contain one interface**

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IPv6 Interdomain Solutions

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- **SSM Solutions**
  - **Not dependent on RP**
  - **MLDv2/PIM-SSM for SSM based solutions**

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IPv6 Interdomain Solutions

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- **ASM solutions (SM/RP/register based)**
  - **v4: Inter-PIM domains (inter-AS and inter PIM)**
    - **Currently no MSDP work in IETF for IPv6**

      Remember, MSDP also used for v4 Anycast RP
  - **Shared Global PIM domains (inter-AS, intra-PIM)**
    - **Single RP per global group**
      - **Statically assigned**
      - **BSR or *auto-RP* mechanism**
        - **» how to secure though for inter-AS?**
      - **Embedded RP addressing**

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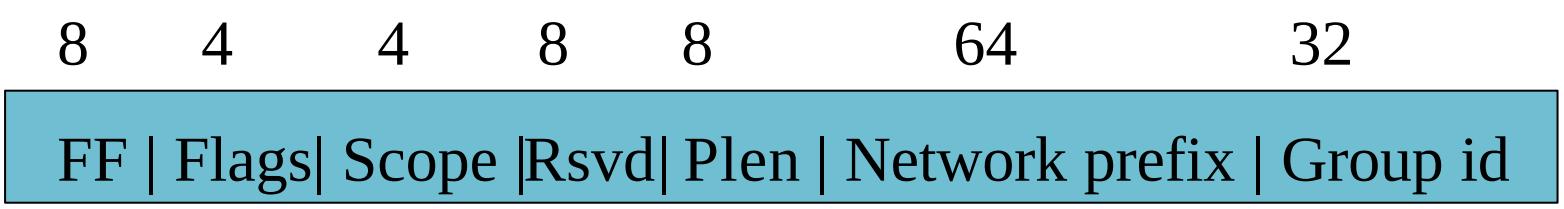
Embedded RP Addressing

- **RFC 3306 – Unicast Based Multicast addresses**



Flags = 00PT, P = 1, T = 1=> Unicast based address

FF36:0030:1234:5678:9abc::0001

1234:5678:9abc::/64 derived address

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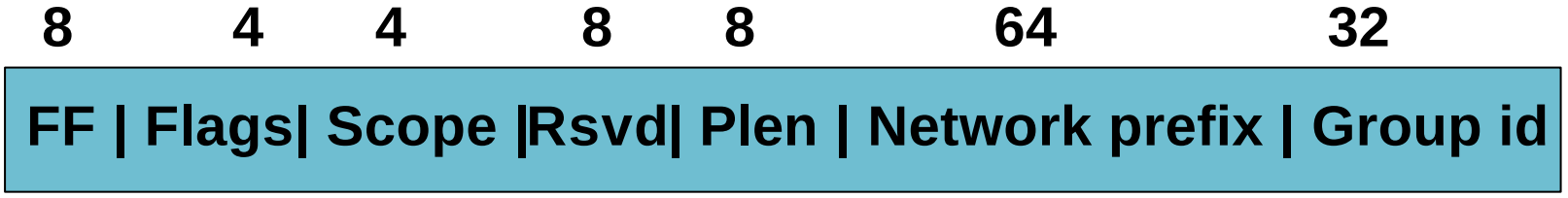
Embedded RP Addressing

draft-savola-mboned-mcast-rpaddr-00.txt



New Address format defined :

Flags = 0RPT, R = 1, P = 1, T = 1=> RP address embedded

FF76:0130:1234:5678:9abc::0001

1234:5678:9abc::1 is the embedded RP address.

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Embedded RP Addressing

- Establishes 3rd party resource dependency (key driver for MSDP) – is that OK ?
- Still require MSDP for anycast RP redundancy.
- Simple to implement for PIM-SM & incremental.
- DRs/RPs need to recognize Address Format to derive RP address.
- Intermediate routers need interpret embedded information in J/P messages.
- Scalability concerns… flat virtual topology.
- No support for Bi-Dir PIM in current form.

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Tunneling v6 multicast

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v6 in v4

v6 in v4

`tunnel mode ipv6ip`

v6 in v4 GRE

`tunnel mode gre`

v6 in v6

v6 in v6

`tunnel mode ipv6`

v6 in v6 GRE

`tunnel mode gre ipv6`

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Transit solutions

- **6PE (not VPN solutions)**

  IPv6 packets across non-v6 core

- **v6 MPLS-VPNs**

  IPv6 core providing IPv6 MPLS forwarding

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Evaluating an IPv6 Multicast environment

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- **Client/Server applications**

  Server can be dual stack, serving IPv4 and IPv6 clients.

- **Peer-to-Peer applications**

  All hosts run IPv6

- **Both require an IPv6 Multicast aware infrastructure.**

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Enterprise Solutions and Deployments

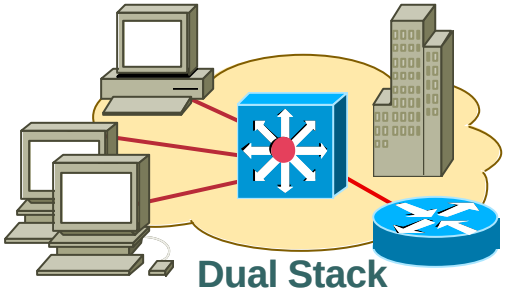
- **Campus deployment scenarios:**

PIM-SM with RP, PIM-bidir with RP, PIM-SSM

- scoped PIM domains

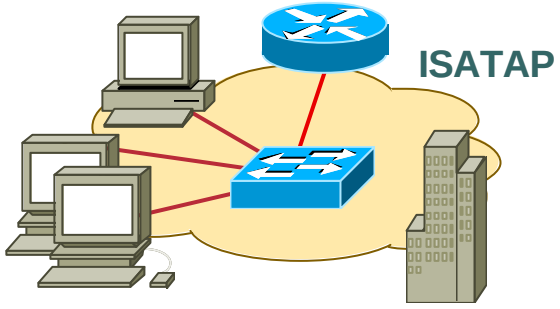
MLDv1 or MLDv2 with support for EXLUDE mode

Native IPv6 Multicast



Enterprise

Non-native v6, host « router



Enterprise

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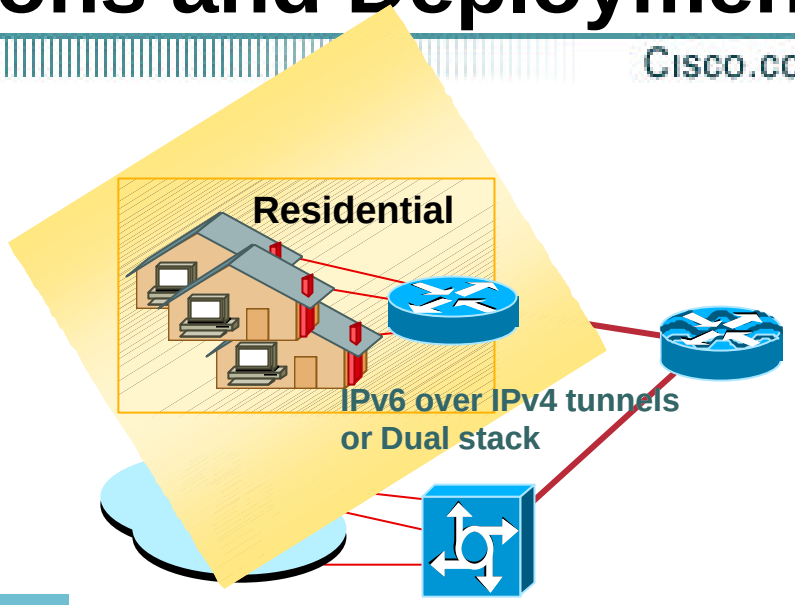
Service Provider Solutions and Deployment

- **Intra-AS**

  With Access Customers

- **Inter-AS:**

  Among transit or peers



PIM-SSM with MLDv2

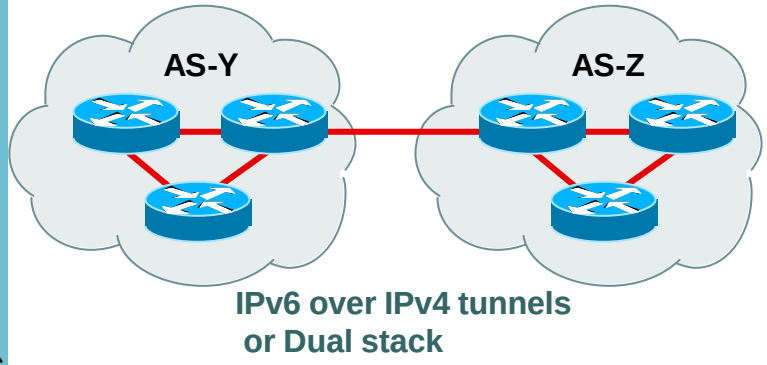
PIM-SM

- embedded RP addressing

- scoped for non-global groups

- shared domains for global groups

mBGP with v6 mcast SAFI support



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M6bone

- **IPv6 version of the MBONE**

  www.m6bone.net

  Basically an experimental IPv6 Multicast network

  (MBONE is a IPv4 Multicast network in which many organisations participate)

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Strategic Goals for IPv6 Multicast

- **Build on success with IPv4 Multicast**
  - **Leverage extensive IOS v4 feature richness**
- **Expedite new solutions specific to v6**
- **Leverage experience in v4 multicast markets**
  - **Finance, Service Provider, Enterprise, Entertainment, Voice**
- **Emphasize end-end integration (apps, stacks, etc)**

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Phase 1: Done

- **PIM** — **12.3(1)T, 12.2S RLS3, 12.0(26)S**
  - **Source Specific Multicast (PIM-SSM)**
  - **Sparse-mode (PIM-SM)**
    - **Full support for DR functionality (registers, etc)**
    - **Static RP assignment with multiple RP mapping**
- **Scoping support (replaces v4 boundary function)**
- **MLDv1 and v2**
  - **Support INCLUDE and EXCLUDE mode reports in MLDv2**
  - **Full MLDv1/v2 compatibility**
  - **Explicit tracking in v2 mode**
- **v6-in-v4 tunneling**

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Phase 2: Active

- **PIM**
  - **Support for embedded RP mapping**
- **Multicast specific Routing**
  - **mBGP (also in 12.0(26)S for initial GSR release)**
  - **translate update for seamless migration into existing BGP peerings**
  - **static mroutes (also in 12.0(26)S for initial GSR release)**
- **BSR, Forwarding support for BSR messages (also in 12.0(26)S for initial GSR release)**
- **Security and access-control**
  - **MLD access-groups for receiver control**
  - **Register filters for source control**
  - **Enhanced boundaries, policy per sources and per groups**
- **Distributed Fast Switching (also in 12.0(26)S for initial GSR release)**
- **v6-in-v6 tunnelling**

Support for interdomain v6 mcast solutions.

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Futures: Input needed please

- **PIM**

  Bidirectional PIM (PIM-bidir)

- **BSR**

  BSR compliance with functionality from auto-RP

- **mVPN v6 ???**
- **CGMP support for v6 (MLD snooping in development by platform groups)**
- **v6 MIBs**
- **enhanced security services**
- **Transitional services**

  6PE, 6to4, ISATAP

Please let us know what else you need

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Conclusion

- Cisco IOS IPv6 Multicast in initial deployment now
- Multicast Applications can be developed and tested over an infrastructure running Cisco IOS IPv6 Multicast
- IPv6 Multicast is an IPv6 service fully integrated with other Cisco IPv6 solutions

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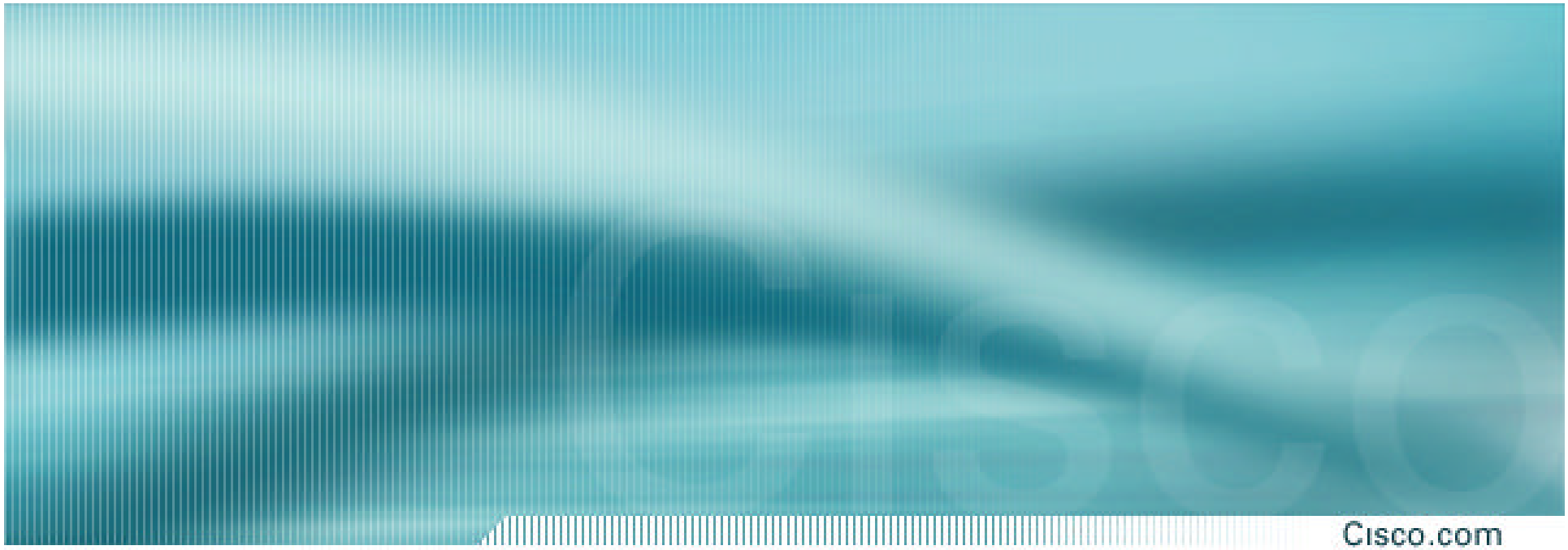

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