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Policy and Scope Management for Multicast Channel Announcement

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Outline

• Multicast session announcement architecture
  – Session Announcement Protocol (SAP)
  – Scoping mechanism

• Channel Reflector
  – Protocol and architecture
  – Scope control and policy control

• Multicast routers cooperating with Channel Reflector
  – Integration of multicast routing scoping and session announcement scoping
  – Address SSM inconsistency

• Conclusion and future works
IP Multicast Addressing Architecture

- Multicast address assignment and resolution
  - Transient multicast address is dynamically assigned to each multicast session (or application).
    - 224.0.0.0 – 239.255.255.255 for IPv4
    - ff00::/8 for IPv6
  - Multicast data receiver needs to resolve each session information (incl. multicast address, media information, etc.) whenever he wants to join a session.
Multicast Session Announcement

- Multicast session announcement
  - Data sender multicasts each session information by Session Announcement Protocol (SAP) (RFC2974).
  - Multicast data sender or network administrator usually wants to define a data distribution area.

- Scope definition (Scoping)
  - Purpose
    - Offer a certain level of privacy
    - Preserve bandwidth resources outside of the data distribution area
Scoping Architecture

- Current scoping techniques
  - TTL scoping
    - Defined by IP TTL value (1<site<16<org.<32<global)
  - Administrative scoping (RFC2365)
    - Defined by multicast address prefix (239/8 for IPv4, ff{x{4|5|8|e}/16 for IPv6)
SAP Analysis

- **Scope control**
  - Data sender must aware of the network topology and configuration
- **Policy control**
- **Scalability**
- **Latency**
- **SSM conformance**
  - All potential data receivers must join the common multicast address (*, 224.2.127.254) for global sessions.
- **IPv6 conformance**
Source-Specific Multicast

Any-Source Multicast (ASM) with PIM-SM

Source-Specific Multicast (SSM)
Architectural Mismatch

• **Multicast routing scoping**
  – TTL scoping, Administrative scoping
  – Scope area definition relies on multicast routing protocols
    • Very difficult to define a precise scope area we want to use

• **Session announcement scoping**
  – Scope area is limited by a scope announcement level
  – Scoping mechanism relies neither on TTL nor on multicast address prefix
  – Our proposal: **Channel Reflector**
Channel Reflector

• Properties
  – Channel Reflector (CR) is a hierarchical directory system.
  – One “primary CR” exists in a wide network, and each controlled domain has one or more “site CR(s)”.
  – New scope label is each site CR’s FQDN (e.g. cr.foo.com).
  – End user accesses a site CR as it is a regular Web server.
Channel Announcement

• Scope control
  – Each site CR has own “Scope List” which consists of upstream site CRs FQDNs.
  – Multicast channel information is registered with one “scope label” from the Scope List on the site CR.
  – This channel information is transferred hop-by-hop toward the scope boundary and registered on CRs inside the scope boundary.
Channel Announcement - cont.

• Policy control
  – Decision regarding which channel information is imported and forwarded to the neighbor CRs depends on each CR’s policy configuration.
  – Policy can be decided with many kinds of factors, like data sender address, bandwidth, contents, time duration, and so on.
Channel Information – Examples

Diagram:

- **A**
  - **Scope List**: (S1,G1):A
  - **Channel Info.**: A

- **B**
  - **Scope List**: (S1,G1):A, (S1,G2):B
  - **Channel Info.**: A, B

- **C**
  - **Scope List**: (S1,G1):A, (S1,G2):B, (S2,G3): -
  - **Channel Info.**: A, B, C

- **D**
  - **Scope List**: (S1,G1):A, (S1,G2):B, (S3,G3):D, (S4,G4): -
  - **Channel Info.**: A, B, D
Scope Label Distribution

• Messages
  – SCOPE_NOTIFICATION (JOIN/LEAVE)
    • Message is sent to a parent CR;
      – (JOIN) when a site CR comes up, in order to obtain a Scope List
      – (LEAVE) when a site CR leaves from policy tree or changes its parent CR, in order to request disabling the site CR to act as a child CR (the parent CR stops forwarding any information to the site CR)
  – SCOPE_ANNOUNCEMENT (LABELS)
    • Message is sent to child CRs;
      – when a site CR receives SCOPE_NOTIFICATION (JOIN) from a child CR, or
      – when a site CR changes own Scope List
Scope Label Distribution – Examples

SCOPE_NOTIFICATION (JOIN)

SCOPE_NOTIFICATION (LEAVE)

SCOPE_ANNOUNCEMENT (LABELS)
Channel Information Distribution

• Messages
  – CHANNEL_ANNOUNCEMENT
    • Message is sent to all scoped CRs (inside scope boundary), in order to announce a new multicast channel.
  – CHANNEL_CANCEL
    • Hard-state approach needs an explicit message to cancel previously announced information.
  – CHANNEL_RETRIEVE
    • Message retrieves partial channel information rather than all the channel information kept in the neighbor CRs.
    • This is useful to retrieve channels which were previously discarded because of the previous policy.
Channel Information Distribution – Examples

- E.g. 1
  - CR-B is the original CR
  - Scope boundary is CR-A

- E.g. 2
  - CR-A is the original CR

- E.g. 3
  - CR-C is the original CR
  - Scope boundary is CR-B
Interdomain Support
Next Step

• What’s next?
  – Channel Reflector should prevent multicast data transmitting to any network.
  – Policy and scope definitions should be inherited to multicast routers

• Solution – Multicast router cooperating with Channel Reflector
  – Integration of multicast routing scoping and session announcement scoping
  – Fix SSM inconsistency
    • Multicast channel validation mechanism
    • (Possibility) ASM-to-SSM translation
Useless Routing Path

- There is no source address discovery function in a multicast routing protocol for SSM
  - Multicast router does not recognize invalid or unavailable (S,G) joins
SSM Inconsistency

- SSM requirement: IGMPv3/MLDv2 host-side implementations
- Non-SSM capable node cannot trigger any join whose multicast address range is in an SSM range
  - But the node can receive the multicast data…

![Diagram of SSM Inconsistency]

- (S1,232.1.1.1) Join
- (*/232.1.1.1) Join

- Yes!
- Reject

- SSM Receiver
- Non-SSM Receiver
Multicast Communication Model

- ASM communication
  - Communication from a sender to a router
  - Communication from a sender to a receiver
Multicast Communication Model - cont.

- SSM communication
  - There is no communication between a sender and a router
Proposed Communication Model

- New multicast communication
  - Channel Reflector binds router, sender and receiver
  - Router and receiver can consult available channel information incl. (S,G) addresses

![Diagram showing proposed communication model with Multicast Router, Channel Reflector, Sender, and Receiver with IGMP, MLD connections]
Channel Validation Procedures

• Multicast routers
  – Access to defined site CR
    {whenever they receive (*,G)/(S,G) join | when defined cache is expired}
  – Validate source and group addresses by stored channel information
  – Discard invalid or unavailable (*,G)/(S,G) join
  – (possibility) Can translate (*,G) join to (S,G) join(s)
Channel Validation – Example
Experiences

• Channel information is described with XML base SDPng (I-D) syntax.

• Protocol and format
  – (currently) SOAP over HTTP
Experiences - cont.

XML Parser

PIM (S,G) Join

SOAP Call

/HTTP

SOAP Response

/HTTP

IGMP (S,G) Join

R

channelerd

XML data set

<?xml version="1.0" encoding="UTF-8"?>
<document
xmlns:ns=http://channelreflector.net>
<ns:ChannelReflector>
  <label>CR.example.com</label>
</ns:ChannelReflector>
<ns:ChannelInfo>
  <group>232.0.1.2</group>
  <source>
    <addr>test.example.com</addr>
    <port>54321</port>
    <scope>CR.example.com</scope>
    <type>test</type>
    <next>
      ...
    </next>
  </source>
  <ns:ChannelInfo>
    ...
  </ns:ChannelInfo>
</ns:ChannelInfo>
</document>
Conclusion

• Summary
  – Analysis of SAP protocol and multicast scoping architecture
    • Multicast routing scoping and session announcement scoping
  – Channel Reflector: an interdomain multicast channel announcement system
  – Multicast routers cooperate with Channel Reflector
    • Multicast routers can verify each multicast join
    • Policy and scope definitions can be inherited to multicast routers
    • (Possibility) Multicast routers translate (*,G) join to (S,G) join(s)
      – Non-SSM capable nodes can join SSM channel
Future Works

• Implementation and evaluation
  – Channel Reflector implementation
    • Building-blocks to a complete implementation
    • Routing daemon implementation modification
  – Collaboration will be started with Wacharapol Pokavanich, AIT.

• Simulation and analysis
  – Channel Reflector simulation
  – Scalability vs. preciseness for router cooperation
    • Access per join request? Cached channel information?
    • Access per each report? Only for an initial join?
  – ASM-to-SSM translation – feasibility and experience
  – Joint work with Vincent Roca, INRIA Rhone-Alpes.

• Call for more collaboration!
  – Evaluation, function enhancement, and so on.
Publications

• Papers
  [1] Hitoshi Asaeda and Vincent Roca,
  “Consideration of Multicast Channel Announcement Architecture”,
  [2] Hitoshi Asaeda and Vincent Roca,
  “Policy and Scope Management for Multicast Channel Announcement”,
  Submitted to IEICE Trans. for Inf. & Syst.
  [3] Hitoshi Asaeda and Walid Dabbous,
  “Multicast Routers Cooperating with Channel Announcement Systems”,

• Activity in the IETF
      and Henning Schulzrinne,
  "A Framework for the Usage of Internet Media Guides",
Thank you.

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