Multicast Mobility in MI Pv6:
Problem Statement & Brief Survey
Update

- draft-irtf-moboptsmmcastv6-ps-01.txt -

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Outline

- Scope & Focus of the Document
- Status of the Draft
- Changes in Version 1
  - Hybrid Architectures
  - Interface Issues: MLD
  - Layer 2 Aspects: Wireless
- Discussion: Roadmap & Open Issues
Aim of the Document

- Provide a comprehensive exploration of
  - MMcast problem space
  - Existing conceptual ideas for solution
  - Perspectives on operational environments

- Outline a conceptual roadmap for initial steps

For use of future mobile multicast protocol designers
The Key Problems

Provide Seamless Multicast Services to and from MNs

- Approach native multicast forwarding in an infrastructure-compliant manner
- At Listeners:
  - Ensure multicast reception in visited networks
  - Organize context transfer between mcast-enabled access networks
  - Expedite multicast forwarding on handovers
- At Sources:
  - Sustain address transparency at end nodes (address duality problem)
  - Ensure persistence of receiver contact
  - Bridge tardy tree reconstruction/transformation procedures
- At SSM Sources:
  - Manage address transparency at routers (source filtering)
  - Comply to source-specific security constraints

- Focus on deployable solutions, minimize protocol extensions
Scope: Focal Scenario - MIPv6

Covers key issues
- Mobile Multicast Membership
  - as Listener
  - as Source (ASM/SSM)
- Interplay of Multicast Routing and Mobility
Key issues inherited

Additional complexity basically covered by:

- Encapsulation for clamping to fixed Internet positions
- Flooding within mobile network (depending on the MANET routing)
Status of the Draft

- State at IETF68: draft-schmidt-mobopts-mmcastv6-ps-02.txt
- Now RG Document: draft-irtf-mobopts-mmcastv6-ps
- Version 00 - Minor update including
  - Interdomain protocols and deployment issues
  - Security aspects: CGA-support in listener & source updates
- Version 01 – Major update including
  - Hybrid approaches ➔ SAM RG
  - Layer 2 aspects,
    examples 802.11, 802.16, 3GPP, DVB-H/IPDC, 802.21
  - First conceptual review by Kevin C. Almeroth
- Version 02 – in preparation – following your input 😊
Hybrid Approaches

- Motivation: Bridge Interdomain Deployment Gap
- Establish Multicast Gateways or Peers
  - Within End System Domain (Buford)
  - At Access Routers (Almeroth)
- Transfer to Overlay Multicast
  - Tunnelling: AMT
  - Explicit: XCAST
  - DHT-based Overlays
- Mobility: Establish a Homogeneous Mobility-agnostic DHT Overlay (Wählisch)
- Work of SAM RG
Interface Issues: MLD

- MN has per interface aggregated states (groups + source filters)
- AR has per network aggregated states
- MLD frequently serves as L2 Mcast trigger
  - Lightweight MLDv2 (mboned): diminish exclude mode
- MLD state transfer → Mcast context transfer
- Issues: MLD is slow – adjust Query Interval timer?
  - On leave → state pruning (timeout)
  - Leave on Pt-to-Pt Links → membership query dispensable
  - Leave expedition otherwise → state table at AR
  - On prediction → early state acquisition & early leave
  - On proxy → state maintenance (without forwarding)
Layer 2 Aspects: Wireless Multicast

Shared, limited media largely profit from group distribution services
widely supported

Technologies of significant difference:

- **Connectionless broadcast type: 802.11**
  - Reduced reliability
  - Congestion thread

- **Connection-oriented point-to-multipoint type: 802.16, 3GPP/MBMS**
  - Complex control
  - Reduced efficiency (no layer 2 source-to-destination transition)

- **Connection-oriented broadcast type: DVB-H/IPDC**
  - Unidirectional (downstream only)
Layer 2 Aspects: Wireless Mcast (2)

- Address mapping: IPv6 Mcast → MAC/Channel ID
  - 802.11: $112 \rightarrow 32$ (Ethernet)
  - 802.16: To CID (16 bits, 8 reserved)
    proposal $112 \rightarrow 4$ (with Scope)/ $8$ (for Ethernet CS)
  - DVB-H: To PID (13 bits),
    based on dynamic tables

- Service mapping:
  - MLD Snooping
  - Multicast VLAN Registration (MVR – for Ethernet CS)
802.11: Multicast on Broadcast NW

- A mobile Station sends multicast data to an AP in point-to-point channel (ToDS bit on)
  - Treated as acknowledged unicast

- The AP repeats multicast frames to the BSS and propagates them to the ESS
  - Treated as unacknowledged broadcasts

- Limited Reliability
  - Increased probability of lost frames from interference, collisions, or time-varying channel properties

- Delayed Distribution
  - AP buffers mcast packets and waits for DTIM, if stations in power saving mode

- Congestion Threat
  - Distribution System experiences multicast as flooding
    - Most APs provide configurable mcast rate limiting
    - Replicate mcast packets over all APs in same IP subnet
    - MLD Snooping: at AP bridge (BSS : ESS) or connecting switches
802.16: Multicast on Point-to-Multipoint

- SS sends multicast data to BS in point-to-point channel
- Multicast traffic identification at AR
  - But CID-initiation only at BS
- BS may initiate downlink multicast distribution
  - Assigns common CID to all group members (SSs)
  - Automatic Repeat Request (ARQ) not applicable
- BS operates as L2 Switch and may support MLD snooping (even MLD proxying in 802.16e)
  - On reception SS cannot distinguish multicast from unicast stream
- Two link models: Point-to-Point and Shared IPv6 Prefix
  - Point-to-point contradicts IP-layer mcast service mapping
- Address mapping: High CID collision rate, little selectiveness
Vertical Handovers

- Context transfer needed for L2-only HOs
- Vertical transfer addressed in 802.21
  - But required beyond IEEE protocols (DVB, 3GPP)
- Mobility service transport for Media Independent Handovers (MIH) assigned to L3

Issues
- Service discovery
- Service context transformation
- Service context transfer
- Service invocation
Proposed Roadmap for Initial Steps

1. Multicast Listener Support
   i. Extend Unicast Solutions FMI Pv6, HMI Pv6, …
   ii. Contribute Mobility Aspects to Specs in AMT and Hybrid Multicast Solutions
   iii. Accelerate MLD
   iv. Contribute to Vertical L2 Context Transfer

2. Multicast Sender Support for ASM

3. Multicast Sender Support for SSM

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Open Questions

- **Deployment Aspects:**
  - Further prospects relevant for deployment?

- **Layer 2 Aspects:**
  - **Gaps to fill?**
    - Performance data for 802.16, MBMS, DVB-H?

- **Multihoming:**
  - Are there Multicast-specific Issues?
    - Interface/connectivity maintenance → unicast
    - Of course: Multicast context transfer may use multiple bindings … as unicast does
Open Issues

- Anything else missing?

Please send your feedback to mobo@irtf.org to advance the quality of this document.