Core Use-Case Requirements for MSR6

from operational/developer perspective

aka: extracted/summarized from use-cases

IETF114 Philadelphia

v1.1 - 07/21/2022

how to fit 30 years of IP Multicast protocol design, deployment

and multicast app-development experience into too little time and slides

Toerless Eckert (Futurewei USA), tte@cs.fau.de

Core MSR6 use-case requirements

There is really only one requirement:

“Simple”(1) , **IPv6 integrated**(2), **“End-to-End”**(3), **stateless** (4), **IPv6 multicast**(5) for **IPv6-only networks** (6)

(6) What IPv6 only networks ?

A: All IPv6 networks that require IPv6 multicast!

Explained by other drafts/presentations: SP/WAN/Metro native IPv6 (with/without SRv6) (e.g.:IPTV, MVPN), DCN, OTT/Overlays

IMHO also: Any enterprise, transportation, IoT network (small..large)

Not considered by current MSR6 drafts – but should be

Refresh: BIER and IPv6-only networks(6)

BIER RFC8279 (arch) + RFC8296 (header) is new layer ~ L2 / L2.5

BIER router (BFR) forwarding is not IPv6 forwarding (RFC8200)

BIER packets are not IPv6 packets (RFC8200)

Now: “One additional multicast forwarding plane for all unicast networks”

Initially optimized for MPLS: header: label field (BIFT-ID), TC, OAM, signaling, .

Also BIER over L2 only, but little/no operator interest / stalled drafts

BIER-WG solution for IPv6 only networks / IPv6 Multicast ?

Do not build IPv6-only networks !

draft-ietf-bier-bierin6 draft:

Run separate BIER hop-by-hop forwarding plane - ***parallel + overlay***

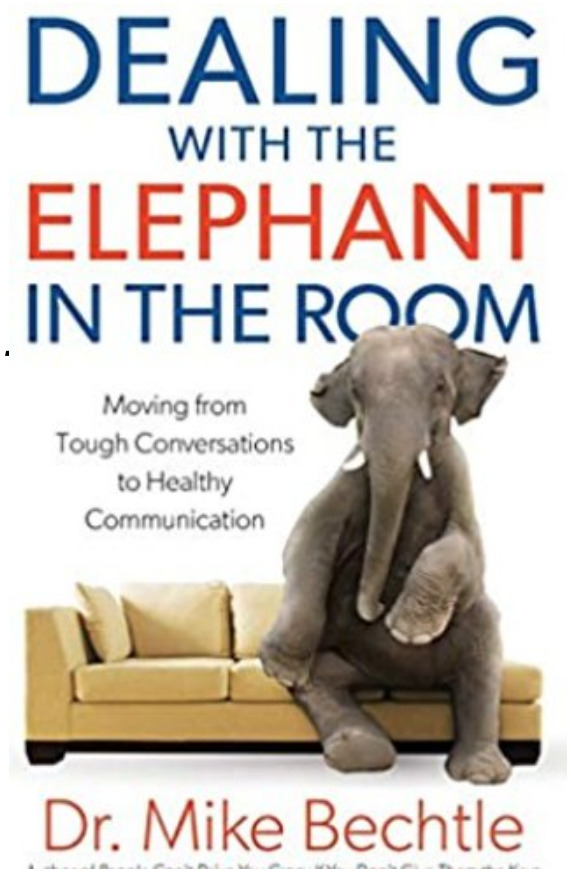
1. End-to-end tunnel for IPv6 Multicast over BIER : 2 headers

   BIER header + IPv6 (multicast) Header (so-called BIER flow overlay)

2. Transit over IPv6-unicast only routers (loose hops) : 3 headers

   IPv6 unicast header (lower) + BIER header + IPv6 (multicast) header

no endorsement,
i have not read the book
i just like the cover



Simplicity(1), End-to-End(2)

Operational / Architectural alignment/integration(2) with IPv6 (unicast)

30 year experience: IP Multicast solutions are most successful when they minimize the additional ecosystem differences / work over the networks unicast solution

Do not introduce additional unnecessary multicast technology – reuse everything you can

1989: IP/IPv6 Multicast is re-using / extending IP (RFC1112)(2)

Allowed to re-use or logically amend IP/IPv6 ecosystem components:
SDKs/ sockets-API(*), QoS Diffserv/IntServ(RSVP)(*), ACLs(*), any IP L2 encaps(*), IPFIX(*), IPsec(*), ..

(*) Most of this would all have to be reinvented / duplicated for BIER but not for MSR6.

Would have put bitstrings into IPv6 addresses if they where long enough (e.g. Cisco drafts in BIER)!

1990th: We tried novel multicast routing (MOSPF, DMVPN, ...)

Replaced by PIM + unicast routing (OSPF, ISIS, RIP,...) – because: do not re-invent routing for multicast!

200x: IPv4 multicast MVPN solution for MPLS/VPN SP networks – additional forward/control!

IPv4 Multicast replaced by native MPLS multicast (mLDP/RSVP-TE/P2P)

PIM/MVPN signaling replaced by BGP/MVPN signaling – because: we want a single protocol!

IMHO: BIER driven by MPLS SP use-cases (MPLS/MVPN). Well aligned/integrated there!

But not for the wide range of IPv6 networks – end-to-end – into IPv6 applications

Non-MPLS networks do not want or need an additional BIER ecosystem

Stateless[4], [1] .. and End-to-End[3]

BIER or native IPv6/MSR6: Scale and Convergence

Finance / Telemetry / Content distribution / adaptive streaming would require
hundreds of thousands of multicast states. Can not create, re-converge, operate!

Native IPv6/MSR6: Operational simplicity (troubleshooting), safety, reliability

All stateful multicast (IP or MPLS): Applications create (tree) state on routers in the network.
No IETF standard multicast circuit beaker / state congestion/control solutions for multicast state.
Any bad or attack multicast application can bring down stateful multicast routers

Unicast state: routing tables - do not grow with traffic, only with topology

Global MPLS SPs where deploying ingress-replication to avoid Multicast state on P nodes (RFC7988)

after we invested 10 years in IETF to specify MPLS multicast – Core reason for BIER

Native IPv6/MSR6: Additional new multicast paradigm for applications

IP Multicast (and SSM): application signaling: flow based – receiver join/leave group/channels

Only with stateless multicast:

Sender can DIRECT EVERY PACKET SEPARATELY – Destinations (and Path – with TE model)

Only way to enable e.g.: adaptive streaming at scale via multicast

BIER always wanted/wants to explore this. But IMHO NO WAY to get a ubiquitous BIER socket API

Prior multicast socket extensions took almost 20 years (e.g.: SSM)

IPv6 extension header API already defined since 2003 (RFC3542) (no BIER API work)

Result 1: Network centric core MSR6 arch reqs./goals

Expressed as Diffs over BIER

For native IPv6 networks

- With or without SRv6: Reuse existing native IPv6, where ever possible
- Common: Core network centric requirements from SP services design (e.g.: MVPN, IPTV).

Native IPv6 source routing hp-by-hop, end-to-end
Native IPv6 multicast, hop-by-hop, end-to-end

- Apply RFC8200 rules hop-by-hop – applicable to IPv6 multicast and/or IPv6 source-routing
- Replace only replication/state rules - not part of RFC8200, but PIM

Day 1 support for path steering and Strict + Loose hops

- Best support for incremental adoption

More scalable BE and TE (path steering) modes

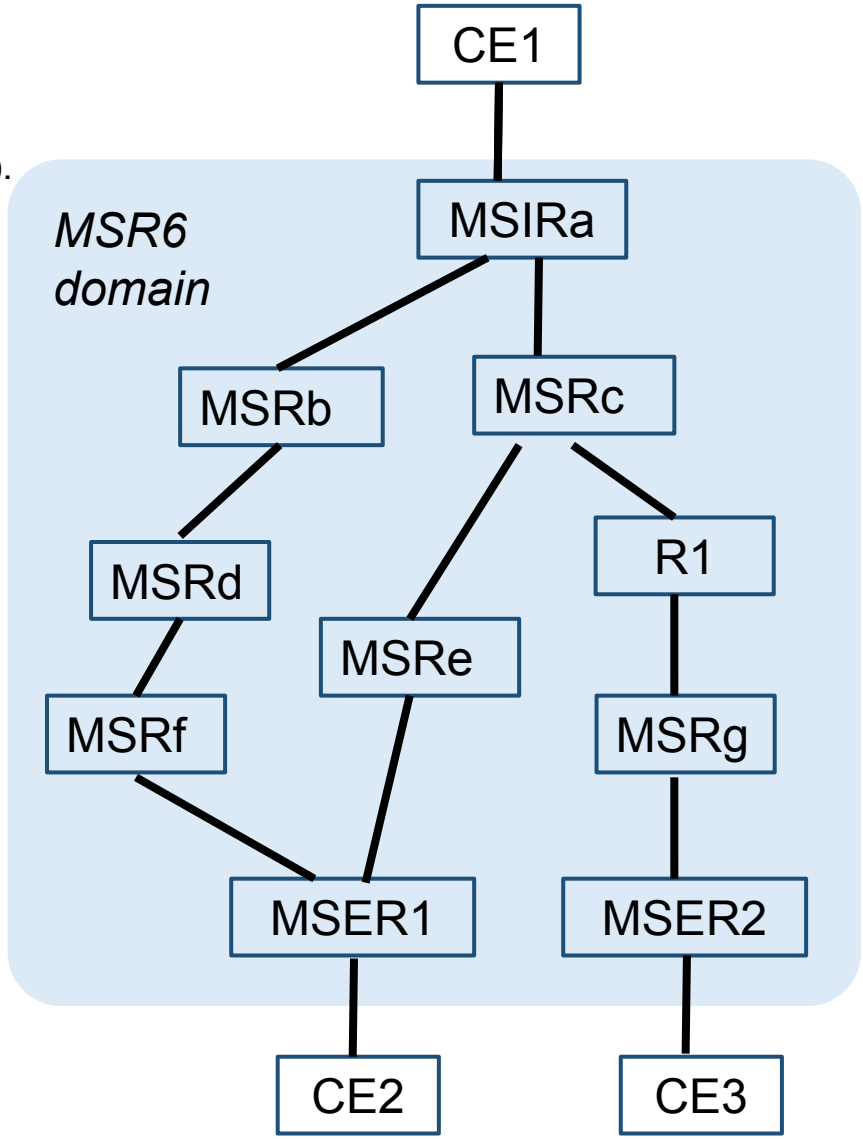
- BIER “flat bitstring” scale limitation for large networks – BIER-TE but also BIER!
  - *See draft-eckert-msr6-rbs for explanations*
- BIER-TE had to re-use BIER forwarding plane as much as possible
- Forwarding planes now can do better!

Integrated support for service guarantees beyond best-effort

- Latency, throughput, loss-protection
- E.g.: support for DetNet natively with MSR6
  not on top of MPLS/BIER + UDP end-to-end tunnels

Terminology

- BIER: BFR, BFIR, BFER (BIER) -> MSR6: MSR, MSIR, MSER



Sample topology showing need for non-equal cost path steering and loose-hop support

Result 2: End-to-End MSR6 architecture reqs./goals "Host based"

Terminology: MH: IPv6/MSR6 Host (or router) with MSR6 Application.

- No MSIR/MSER required
- But easily an add-on in existing network centric architecture deployments

For (use-case examples)

- IPTV Server -> Caches/Streamers in metro SP
- Data-Center IPv6 Multicast (stateless on DCN switches!)

Support for Host is Router

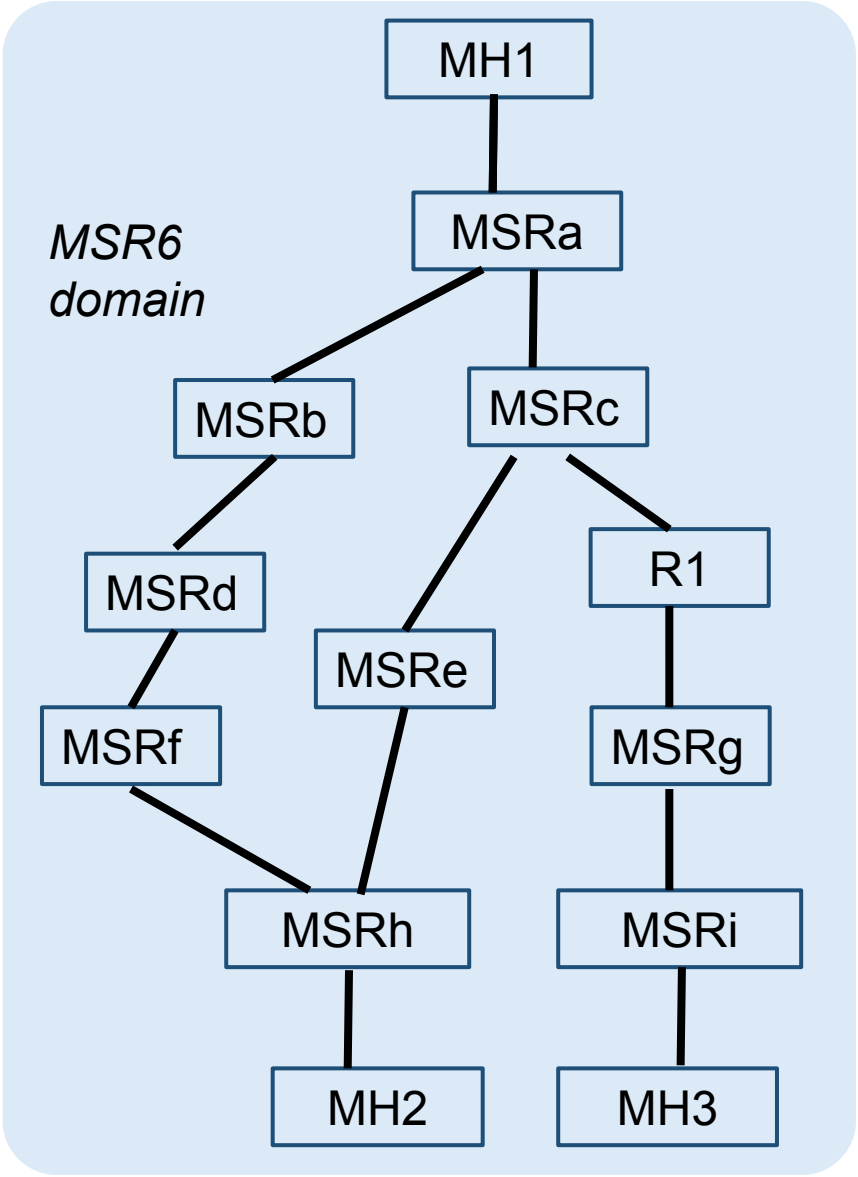
- Eg.: DC Server running all necessary routing (BGP, IGP)
  - E.g.: trusted Hypervisor
- Much easier and important for native IPv6 than BIER (IMHO)

Host API for native source-driven multicast

- Eliminates IP Multicast (RFC1112), SSM (RFC3678) API where not ideal for apps
- E.g.: adaptive streaming cache to subscriber (per-packet functionality)

Support for Host is not router

- More novel network<->host signaling to explore (e.g.: PCEP ?)
- Use-cases: IoT (MANET/ROLL ?), Industrial, Enterprise



Summary / Conclusion

Stateless bitstring replication is the best new multicast direction in 40 years

BIER-WG - great stateless intra-SP solution for MPLS networks

But inferior fit for IPv6 networks and end-to-end applications

IETF/BIER can-not / should not change any more than necessary of the IPv6 ecosystem

Want to improve on what we learned from BIER (and its limitations) to get best IPv6 solution.

MSR6: Keep it simple & *Make IPv6 Multicast great again!*

Native stateless multicast - for all IPv6 networks

Stateless IPv6 multicast into applications (DC, industrial, IoT, SP-edge, ...)

Re-use / share all of BIER that fits!

Stuffed Agenda, No questions now ?!

But welcoming questions any time after the meeting!