Packet descriptions

Outer IP header source address
Outer IP header link local multicast address
Outer MPL Option
Inner IP header source address
Inner IP header multicast address
Inner IP payload

A	LLM	MO	H	FF05	Pyd

Encapsulated LL multicast

Outer IP header source address
Outer IP header MPL domain multicast address
Outer MPL Option
Inner IP header source address
Inner IP header multicast address
Inner IP payload

A	MDM	MO	H	FF05	Pyd

Encapsulated MPL domain multicast

IP header source address
IP header MPL domain multicast address
MPL Option
IP Payload

A	MDM	MO	Pyd

Unencapsulated multicast

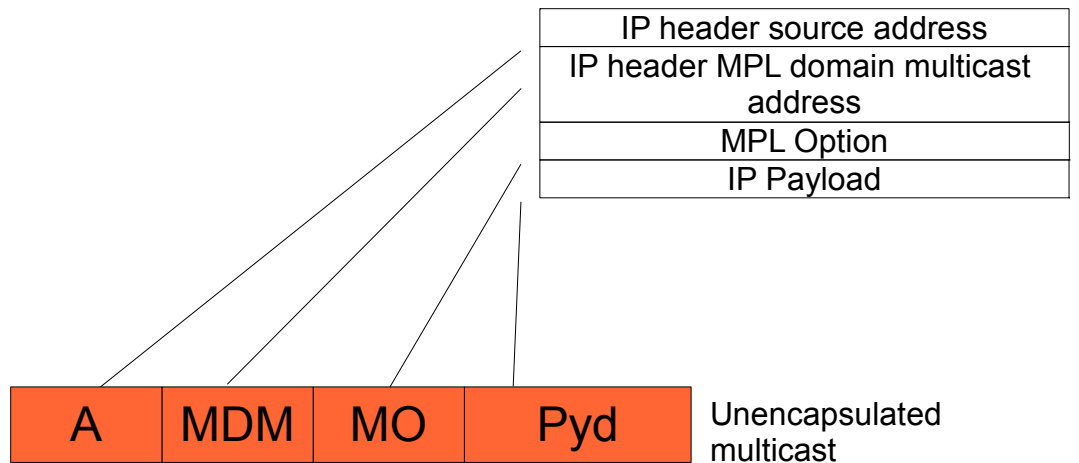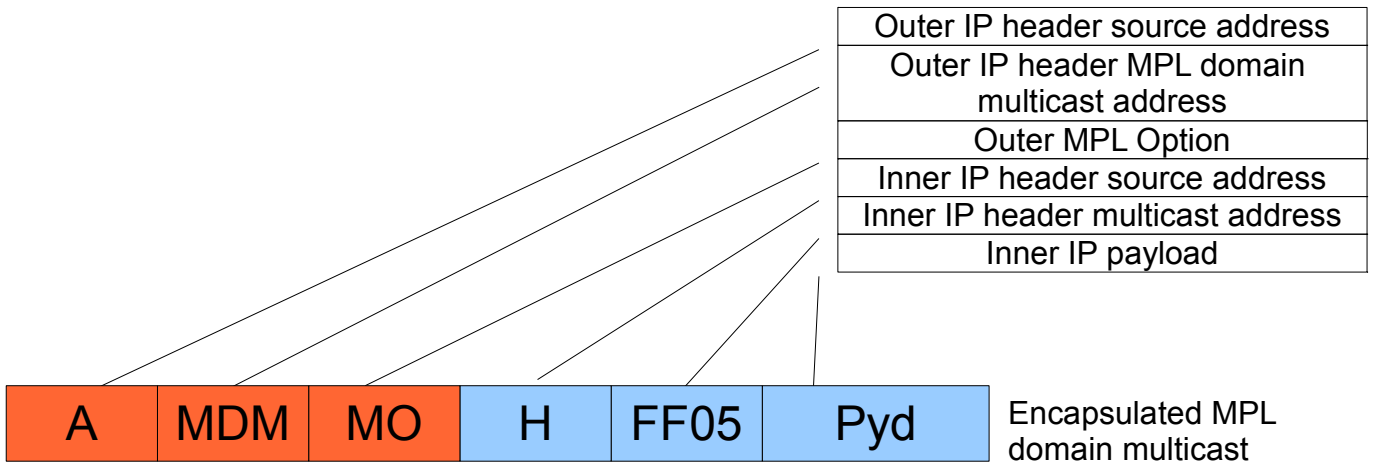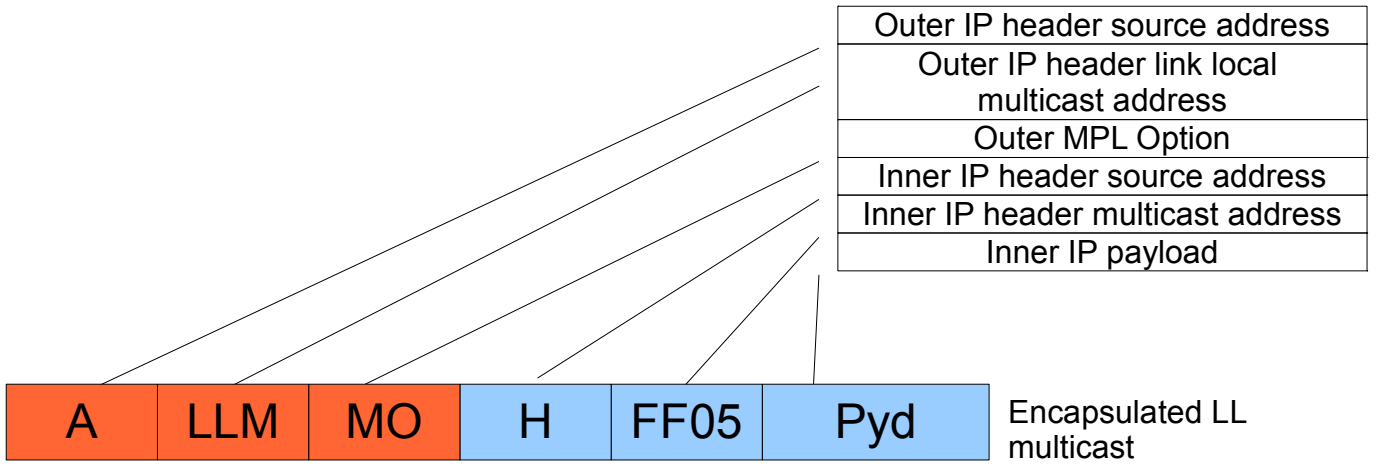| |
|---|
| IP header source address |
| IP header destination address |
| IP payload |

H	FF05	Pyd

Packet outside MPL domain

Encapsulation choices

MPL domain multicast destination address

•Consistent with unencapsulated MPL domain multicast

•Inner packet is effectively tunneled to border routers

•Issues:
  • Is it legitimate to alter the inner packet when forwarding? Strictly speaking no, if treating as tunneled
  • Therefore, how is the inner packet hop count decremented properly?
  • One solution could be to decrement by the appropriate amount when decapsulating. This would then render the hop count accurate at every point where it is processed, at the intermediate routers and the border router. The appropriate amount would be how much the outer header has been decremented, i.e. the radius of propagation. If the initial hop count is known, then this is possible

Link local multicast destination address

•Not consistent with unencapsulated MPL domain multicast (cannot use link local unencapsulated of course)

•Consistent with sending RPL HbH headers

•Inner packet is extracted and recapsulated every hop

•Inner packet hop count can be decremented as it is extracted

Conclusion

•Neither is wrong, neither is exactly right, so which is "more right"?

•The main issue with the MPL Option multicast address encapsulation is it is not strictly legal to manipulate the inner packet as it is is being multicast tunneled

Rough analogies
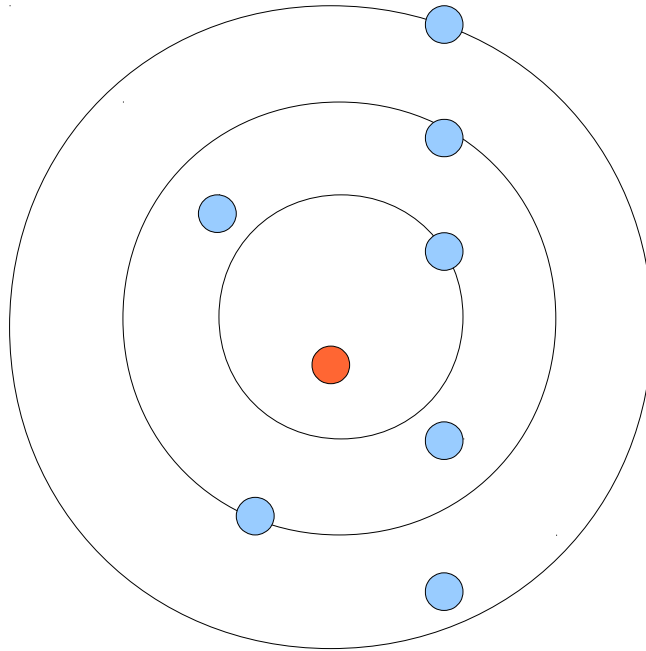
MPL domain multicast: Tunnel propagates through MPL domain; inner packet is "tee'd" off at every node. Outer packet is forwarded as is. MPL Option (and maybe unicast prefix-based multicast group) used to control propagation
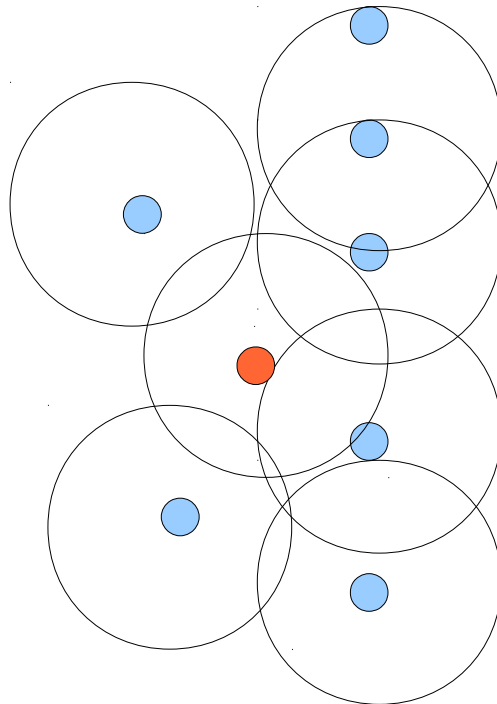

Link local multicast: Outer packet only goes one hop. Receiving node decapsulates and recapsulates at every node before further rebroadcast at link local scope. MPL Option (and maybe unicast prefix-based multicast group) used to control propagation

# Processing graph of link local encapsulated packet

Outer packet forwarded according to MPL rules

Inner packet decapsulated for processing then recapsulated for forwarding
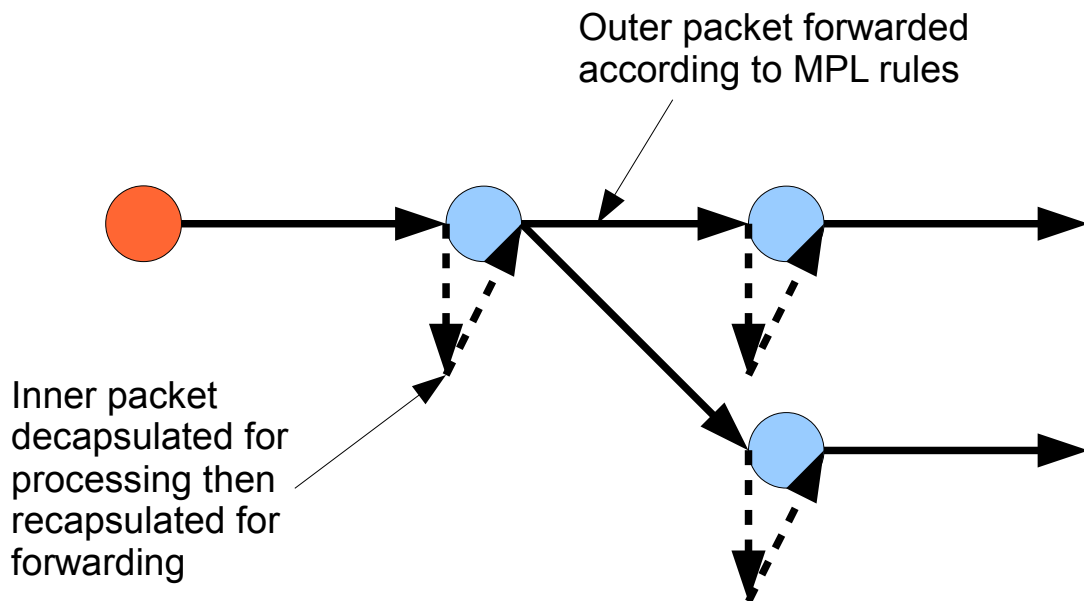
•Outer header broadcasts link local scope; outer packet only goes one hop.
•Receiving node decapsulates at every node for potential processing.
•For interfaces subscribed to inner header multicast address (administration needed):
   • If interface is MPL-aware
      • Decapsulated packet has hop count decremented, is recapsulated with link local scope and rebroadcast. MPL Option used to control propagation
   • If interface is not MPL-aware:
      • Decapsulated packet has hop count decremented and rebroadcast

Processing graph of MPL domain encapsulated packet

Packet forwarded according to MPL rules

Packet for processing
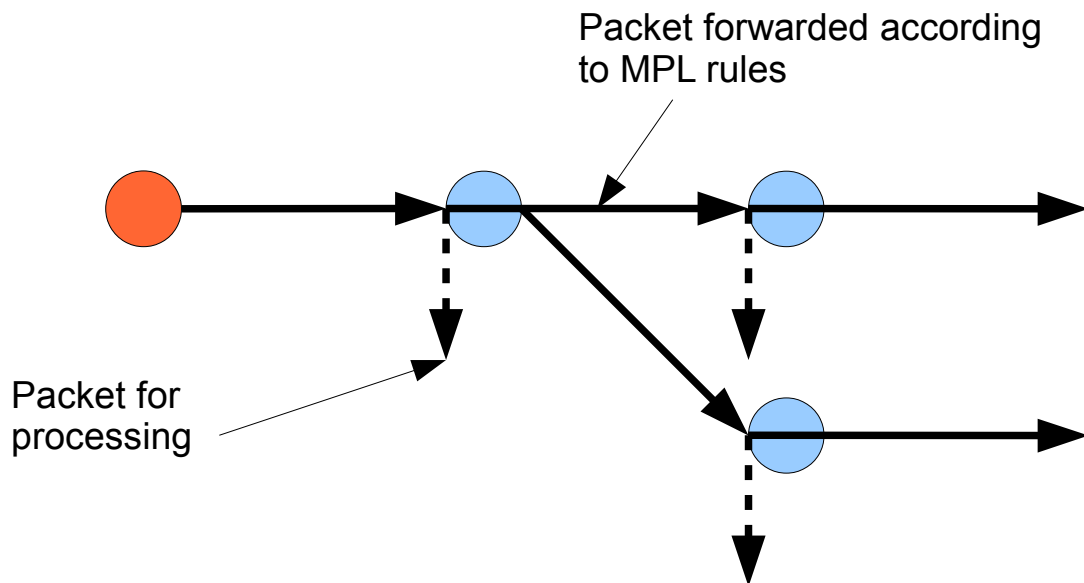
- Outer header broadcasts MPL domain scope; outer packet is effectively forwarded
- Receiving node decapsulates at every node for potential processing
- For interfaces subscribed to outer header multicast address (administration needed):
    - If interface is MPL-aware
        - Encapsulated packet is rebroadcasted due to forwarding. MPL Option used to control propagation. **Problem – how is hop count decremented?**
    - If interface is not MPL-aware:
        - Decapsulated packet has hop count decremented and rebroadcast

# Processing graph of MPL domain unencapsulated packet

Packet forwarded according to MPL rules

Packet for processing
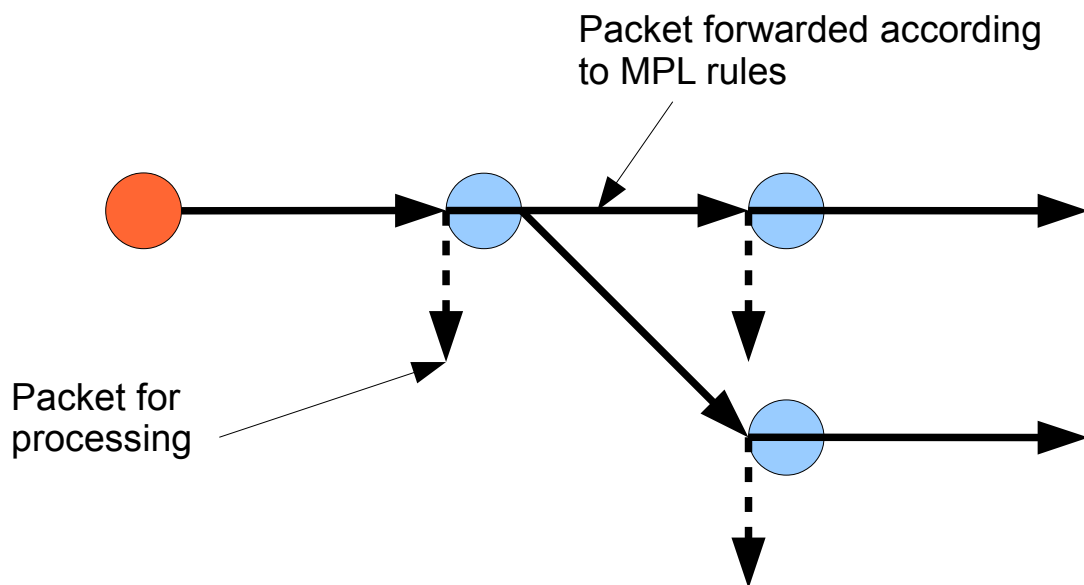
Header broadcasts subnet local scope; packet is effectively forwarded
Receiving node potentially processes unencapsulated packet
•For interfaces subscribed to header multicast address (administration needed):
- If interface is MPL-aware
  - Packet has hop count decremented and is rebroadcasted due to forwarding. MPL Option used to control propagation.
- If interface is not MPL-aware:
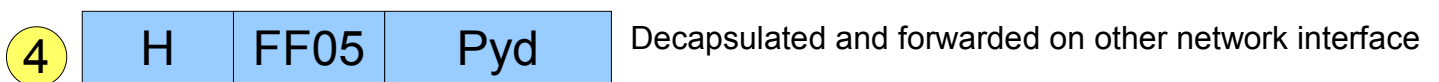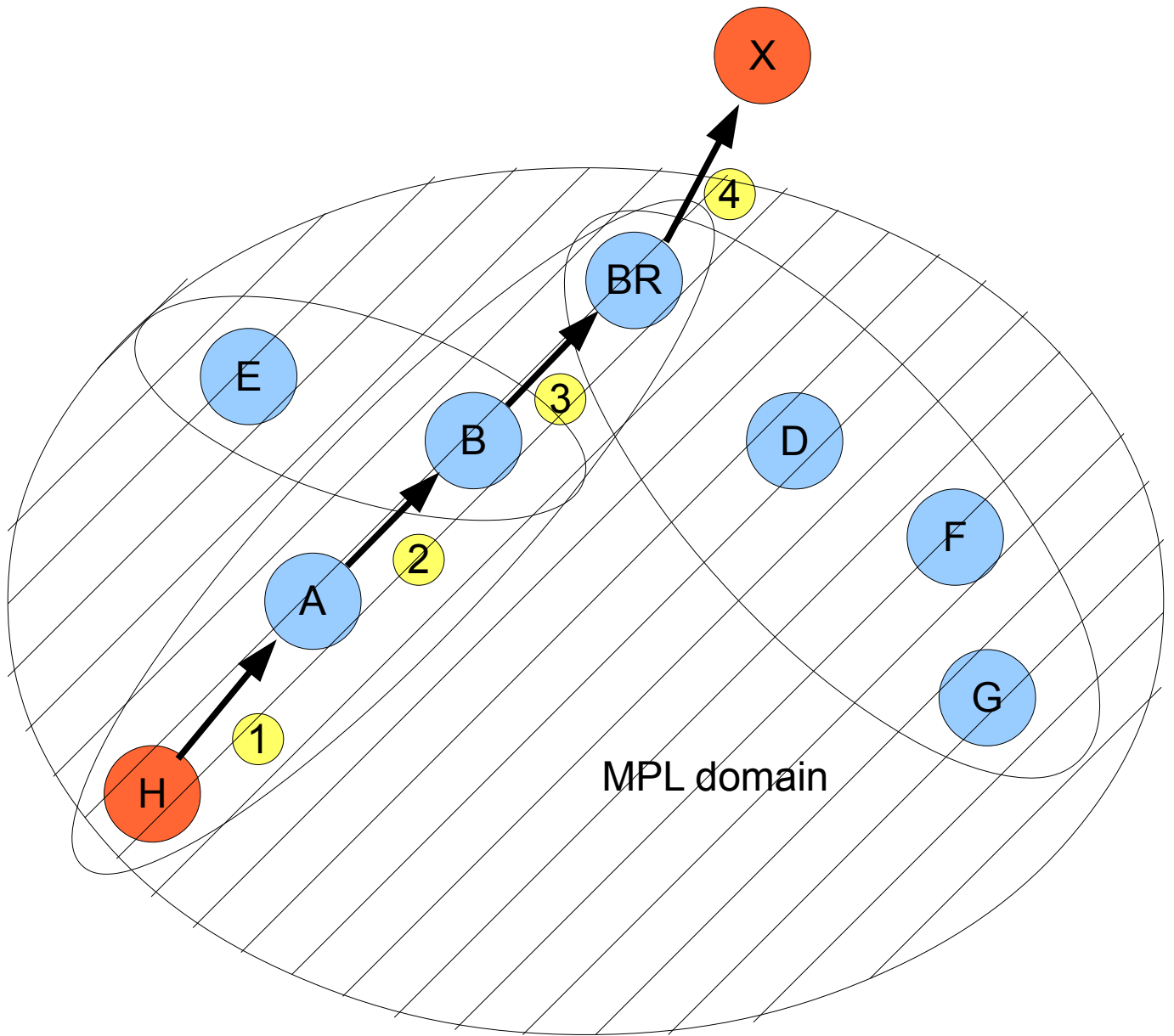 - Packet should not be rebroadcast as MPL Option is still present
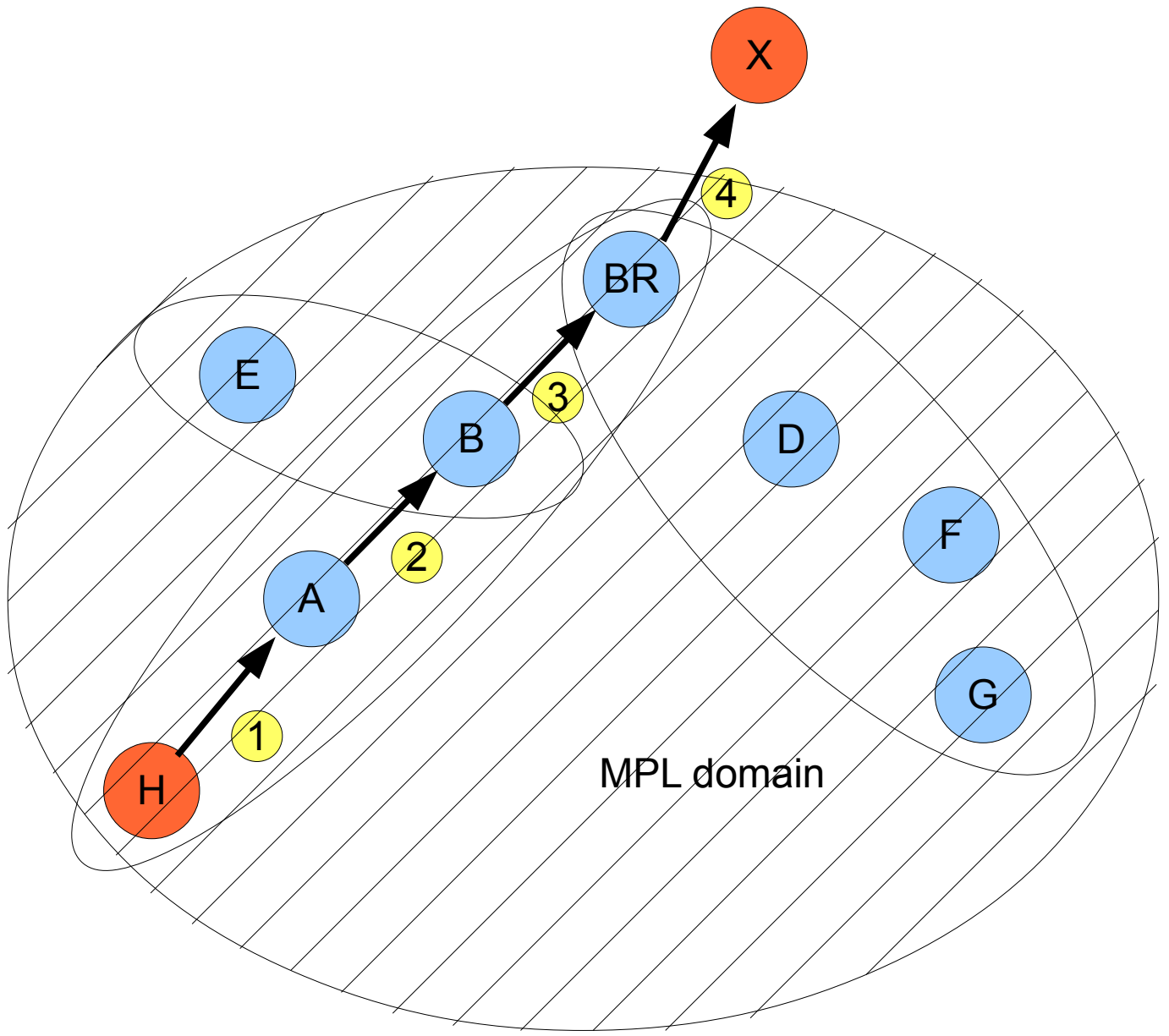
(1)	H	LLM	MO	H	FF05	Pyd

(2)	A	LLM	MO	H	FF05	Pyd

(3)	B	LLM	MO	H	FF05	Pyd

(4)	H	FF05	Pyd

(4) Decapsulated and forwarded on other network interface

Notes

- Host is "MPL-aware". Packet may be unicast to A
- Destination is site local, therefore need encapsulation at (1) as it may emanate from the BR
- Source addresses change per hop; inner packet decapsulated for processing and hop count decrementing and recapsulated every hop
- MPL Option controls forwarding of outer packet
- Remains decapsulated at (3) as it is leaving the MPL domain

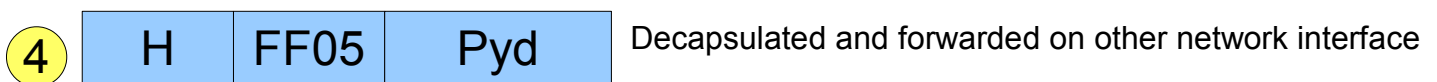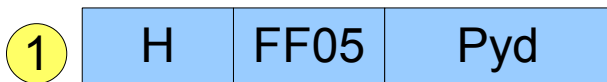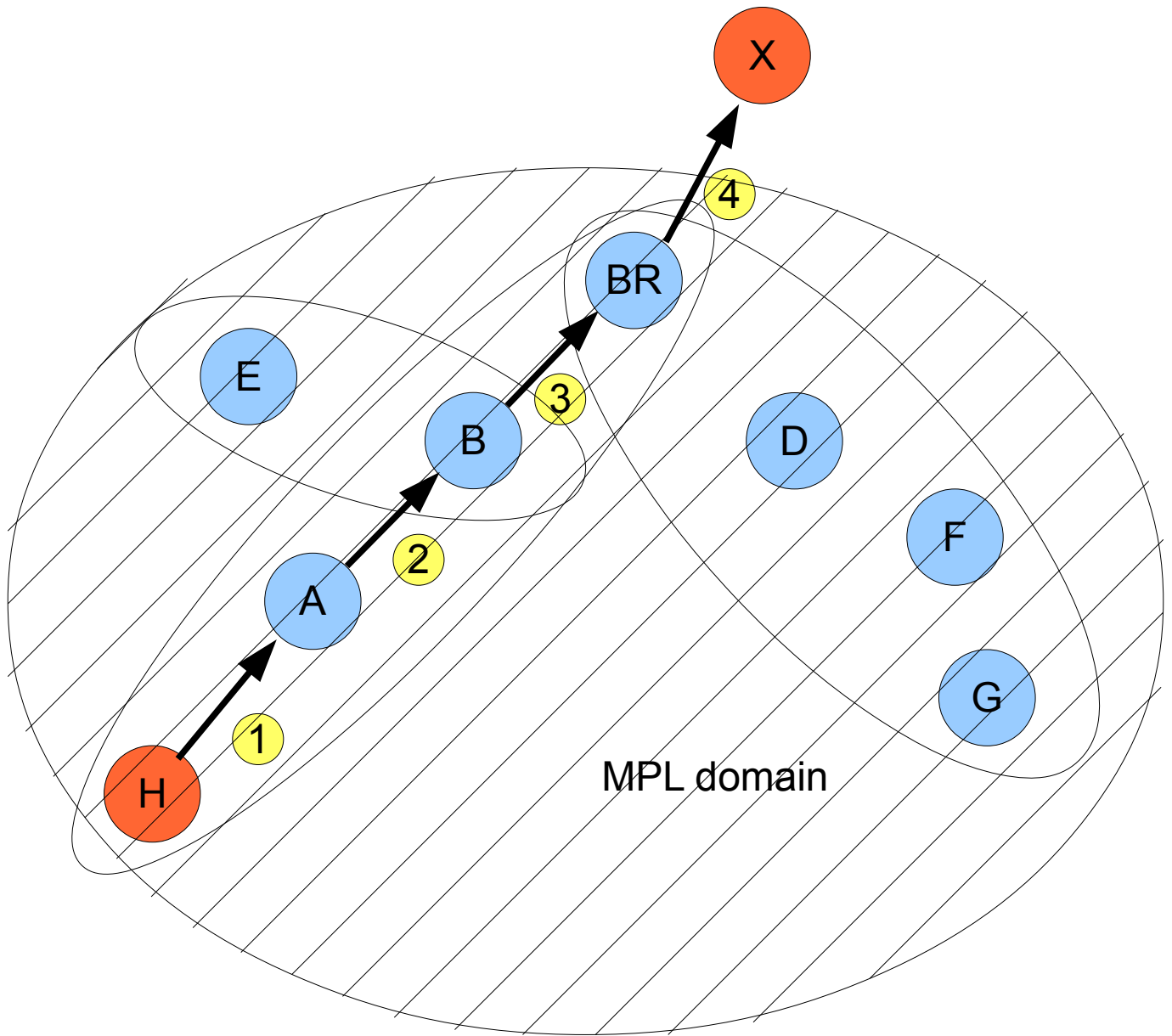# Site local multicast originating from MPL-aware 6LH using link local multicast

1 | H | MDM | MO | H | FF05 | Pyd |

2 | H | MDM | MO | H | FF05 | Pyd |

3 | H | MDM | MO | H | FF05 | Pyd |

4 | H | FF05 | Pyd | Decapsulated and forwarded on other network interface

Notes

- Host is "MPL-aware". Packet may be unicast to A
- Destination is site local, therefore need encapsulation at (1) as it may emanate from the BR
- Source address does not change per hop; inner packet decapsulated for processing. Packet forwarded (how is hop count decremented?)
- MPL Option controls forwarding of outer packet
- Remains decapsulated at (3) as it is leaving the MPL domain

Site local multicast originating from MPL-aware 6LH using MPL domain multicast
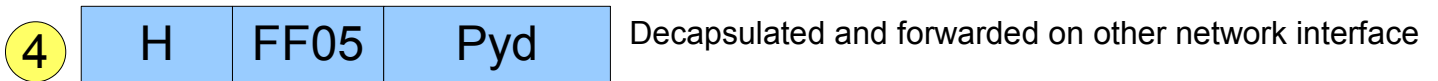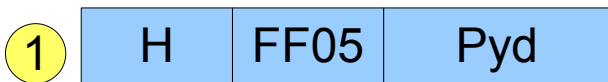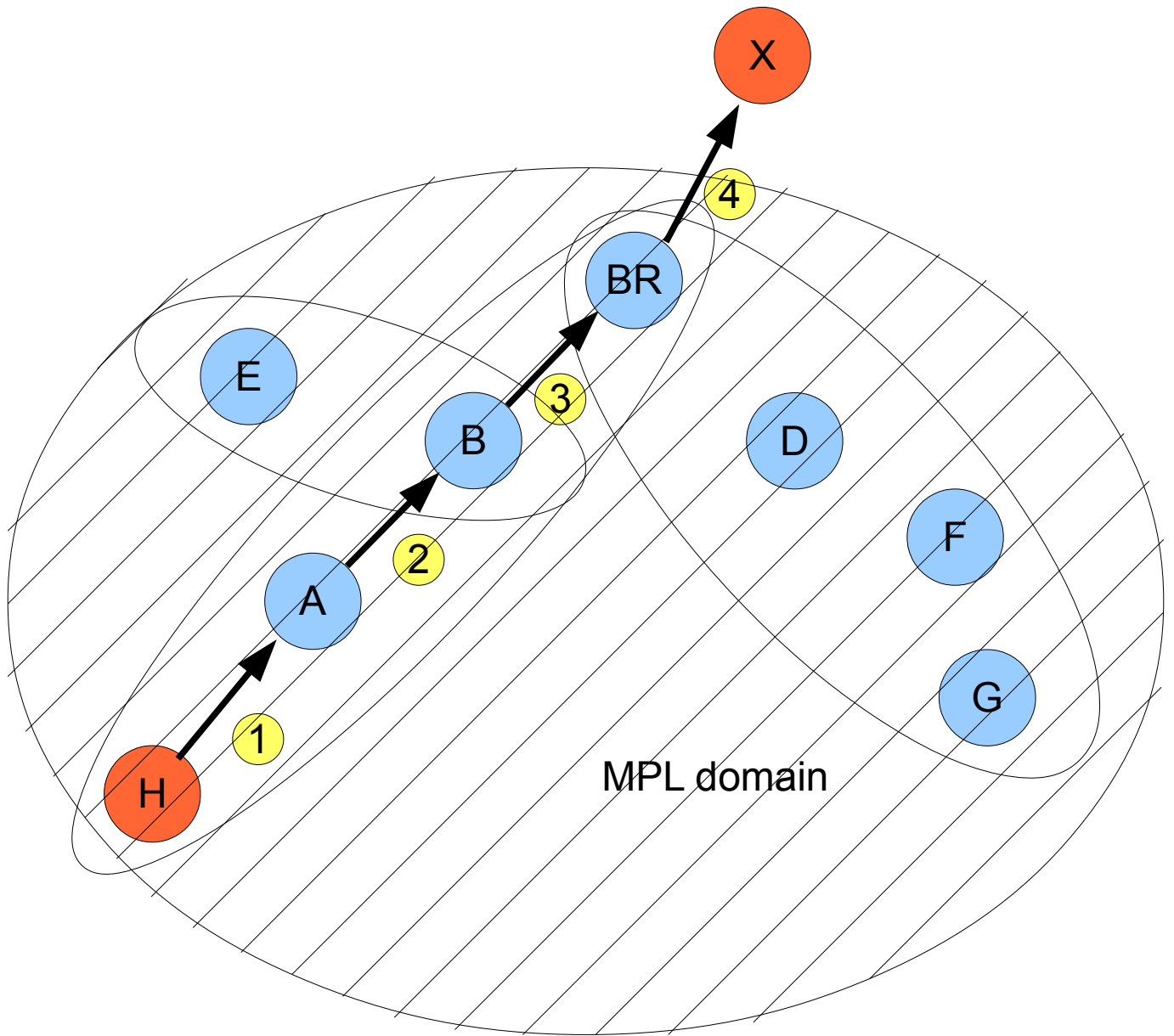
| 1 | H | FF05 | Pyd | | | |

| 2 | A | LLM | MO | H | FF05 | Pyd |

| 3 | B | LLM | MO | H | FF05 | Pyd |

| 4 | H | FF05 | Pyd | Decapsulated and forwarded on other network interface |

Notes

• Host is not "MPL-aware". Packet may be unicast to A
• Destination is site local, therefore need encapsulation at (2) as it may emanate from the BR
• Source addresses change per hop; inner packet decapsulated for processing and hop count decrementing and recapsulated every hop
• MPL Option controls forwarding of outer packet
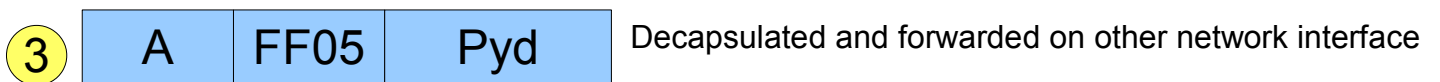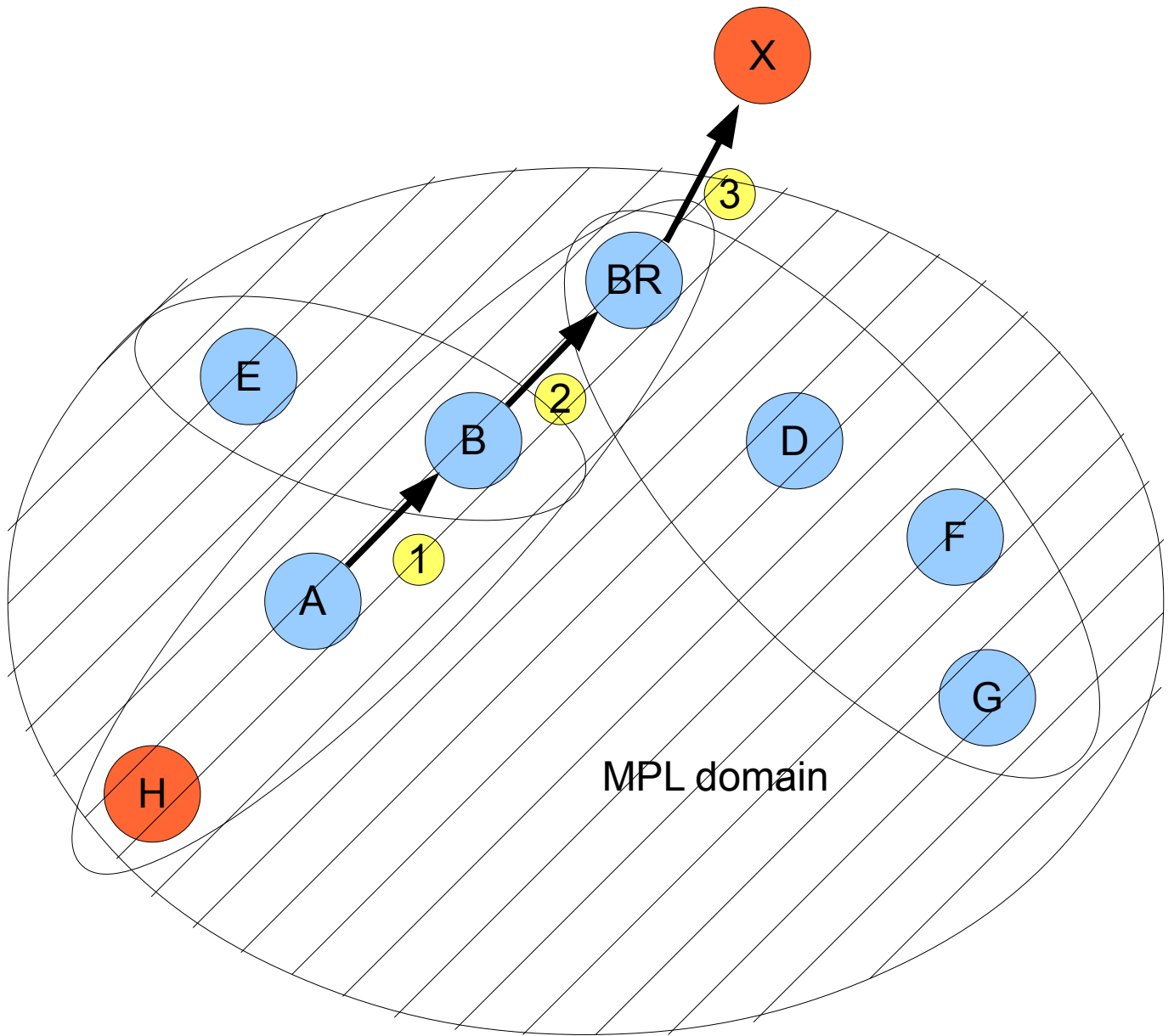• Remains decapsulated at (3) as it is leaving the MPL domain

Site local multicast originating from 6LH using link local multicast

Notes

- Host is not "MPL-aware". Packet may be unicast to A
- Destination is site local, therefore need encapsulation at (2) as it may emanate from the BR
- Source address does not change per hop; inner packet decapsulated for processing. Packet forwarded (how is hop count decremented?)
- MPL Option controls forwarding of outer packet
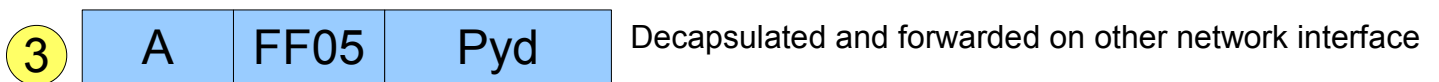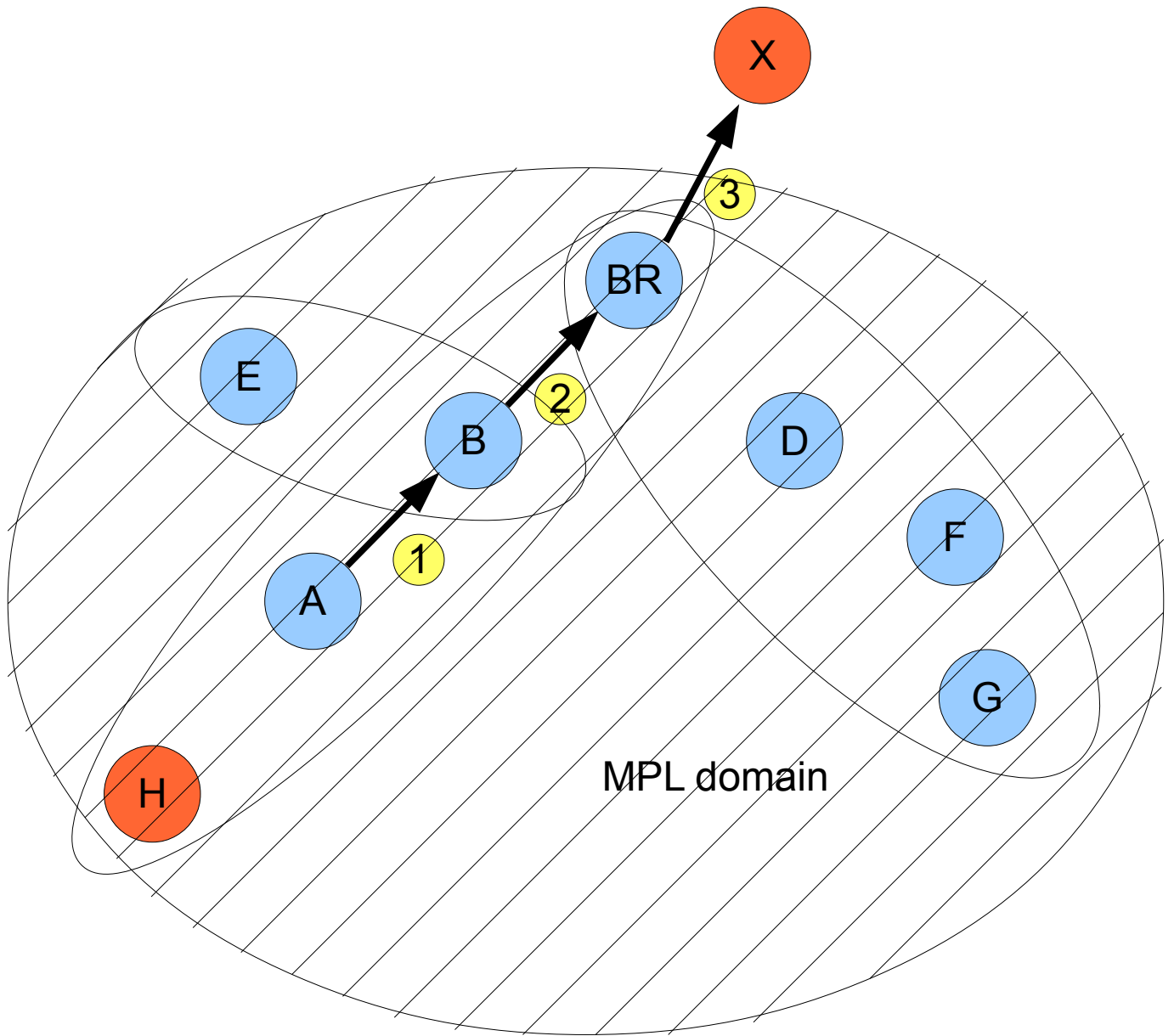- Remains decapsulated at (3) as it is leaving the MPL domain

Site local multicast originating from 6LH using MPL domain multicast

| 1 | A | LLM | MO | A | FF05 | Pyd |

| 2 | B | LLM | MO | A | FF05 | Pyd |

| 3 | A | FF05 | Pyd | Decapsulated and forwarded on other network interface |

Notes

• Destination is site local, therefore need encapsulation at (1) as it may emanate from the BR
• Source addresses change per hop; inner packet decapsulated for processing and hop count decrementing and recapsulated every hop
• MPL Option controls forwarding of outer packet
• Remains decapsulated at (3) as it is leaving the MPL domain

Site local multicast originating from 6LR using link local multicast

| 1 | A | MDM | MO | A | FF05 | Pyd |

| 2 | A | MDM | MO | A | FF05 | Pyd |

| 3 | A | FF05 | Pyd | Decapsulated and forwarded on other network interface

Notes

• Destination is site local, therefore need encapsulation at (1) as it may emanate from the BR
• Source address does not change per hop; inner packet decapsulated for processing. Packet forwarded (how is hop count decremented?)
• MPL Option controls forwarding of outer packet
• Remains decapsulated at (3) as it is leaving the MPL domain

Site local multicast originating from 6LR using MPL domain multicast
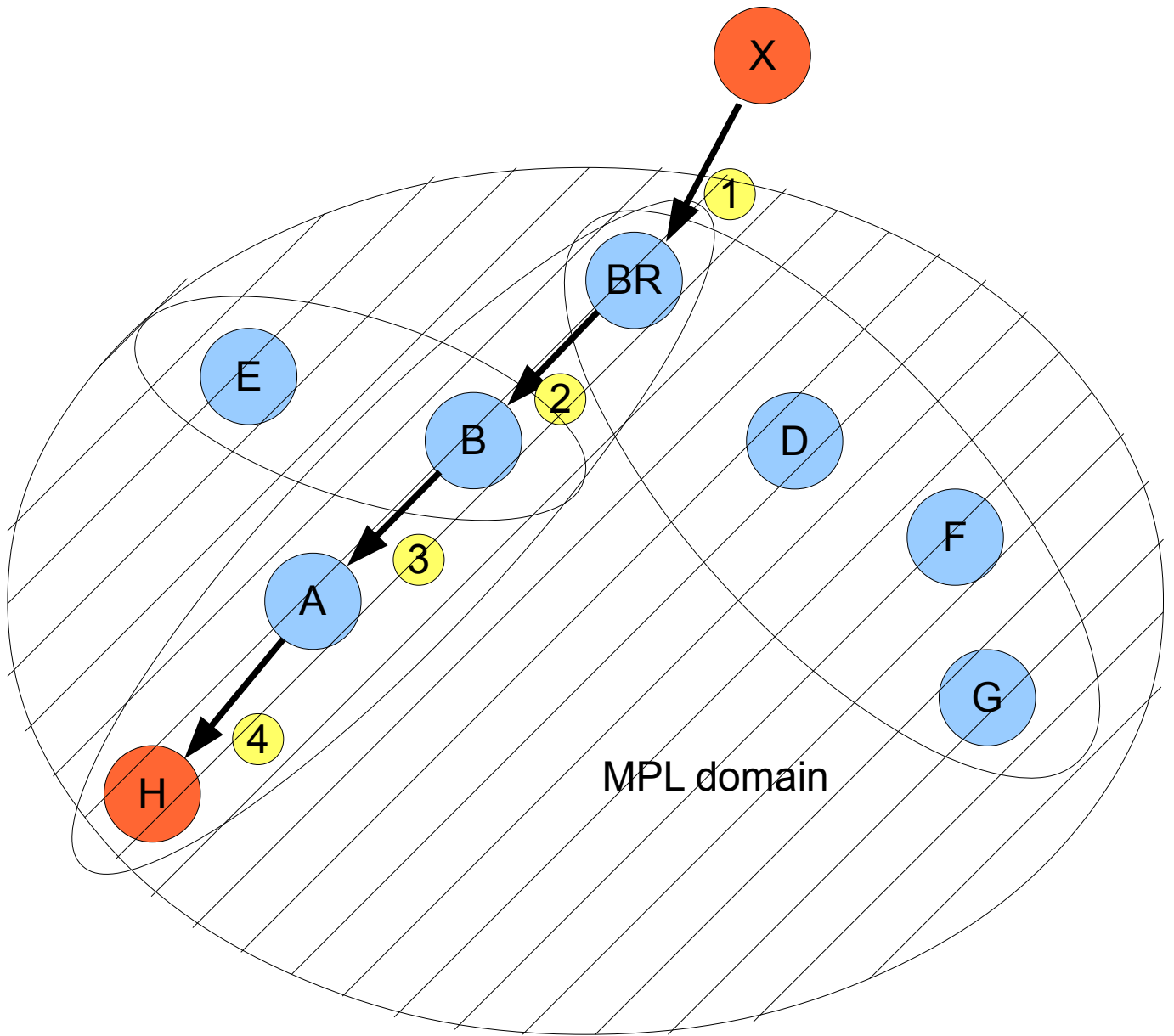
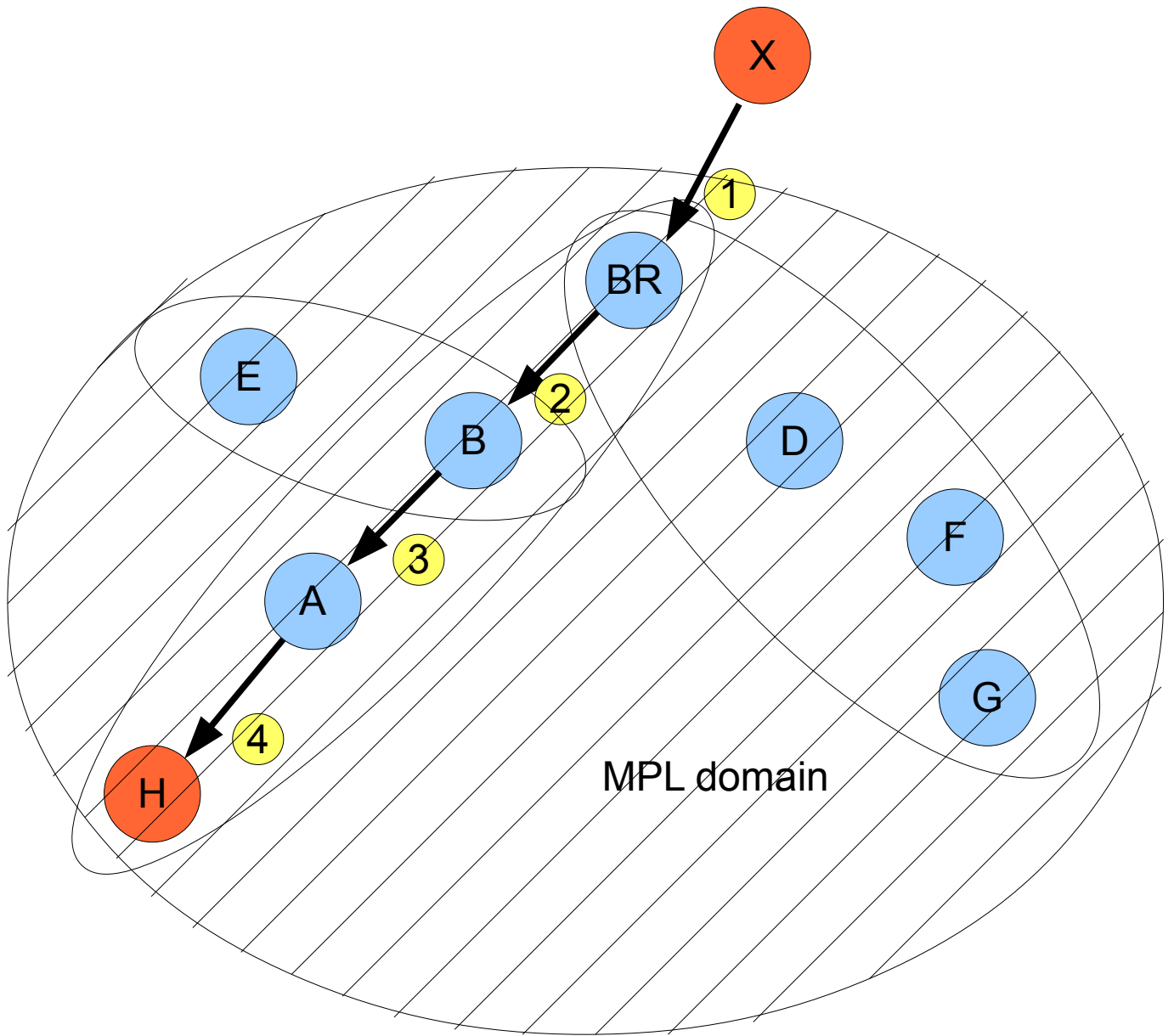| 1 | X | FF05 | Pyd | | | No MPL multicast information |

| 2 | BR | LLM | MO | X | FF05 | Pyd |

| 3 | B | LLM | MO | X | FF05 | Pyd |

| 4 | A | LLM | MO | X | FF05 | Pyd |

Notes

- BR encapsulates as it originates from outside MPL domain. Note there may need to be a policy to determine which traffic gets routed to LLN
- Source addresses change per hop; inner packet decapsulated for processing and hop count decrementing and recapsulated every hop
- MPL Option controls forwarding of outer packet

Site local multicast originating externally using link local multicast

Notes

• BR encapsulates as it originates from outside MPL domain. Note there may need to be a policy to determine which traffic gets routed to LLN
• Source address does not change per hop; inner packet decapsulated for processing. Packet forwarded (how is hop count decremented?)
• MPL Option controls forwarding of outer packet

Site local multicast originating externally using MPL domain multicast
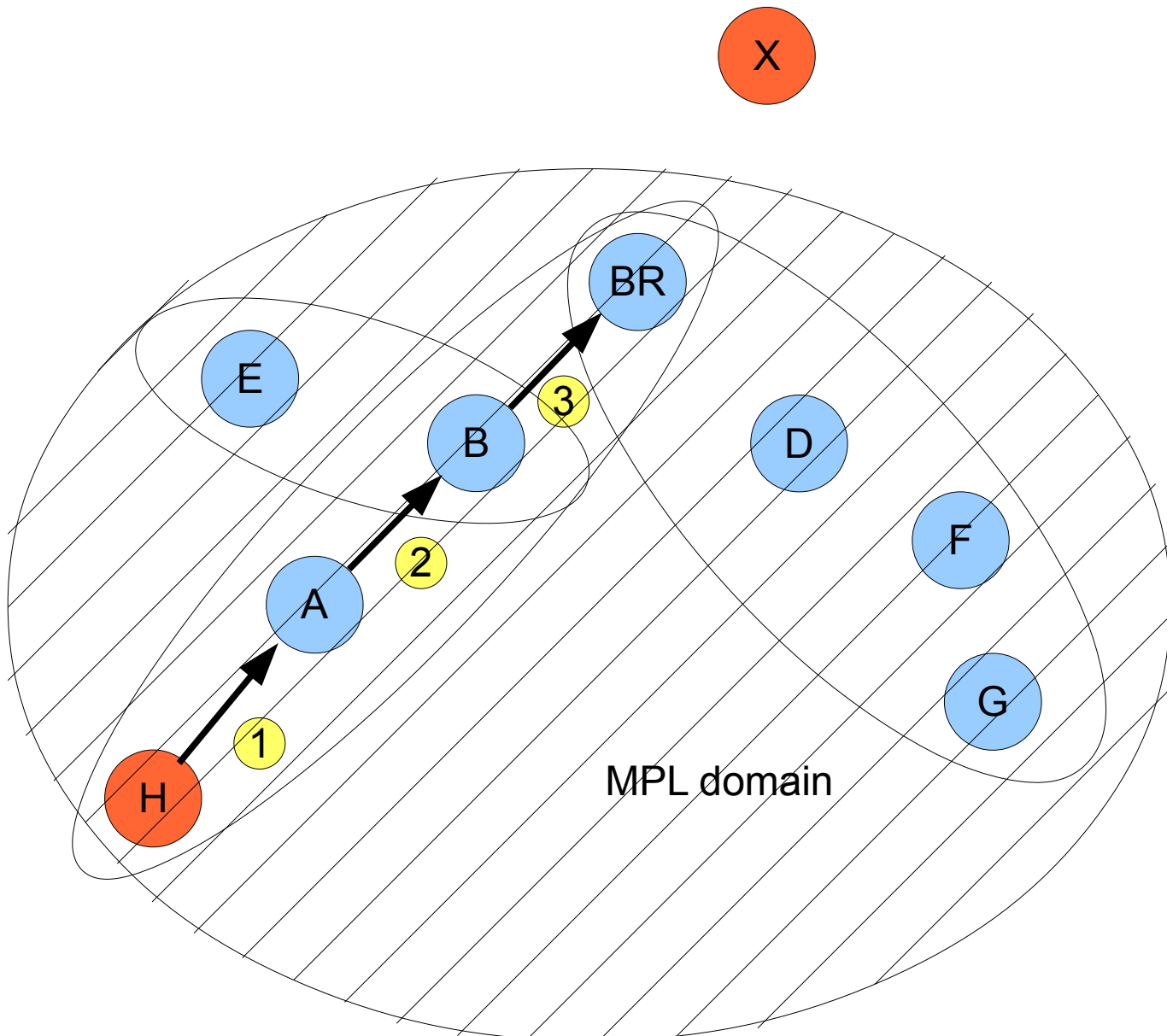
| 1 | H | MDM | MO | Pyd |

| 2 | H | MDM | MO | Pyd |

| 3 | H | MDM | MO | Pyd |

Notes

•Host is "MPL-aware".
•Destination is subnet local and assumed to be within MPL domain (adminstration needed), therefore no encapsulation needed at (1)
•Source address does not change per hop. MPL forwarding forwards packet as per MPL rules
•MPL Option controls forwarding of outer packet

MPL domain multicast within MPL domain