

System Administration

Week 06, Segment 3
Networking II: ARP and NDP

**Department of Computer Science
Stevens Institute of Technology**

Jan Schaumann

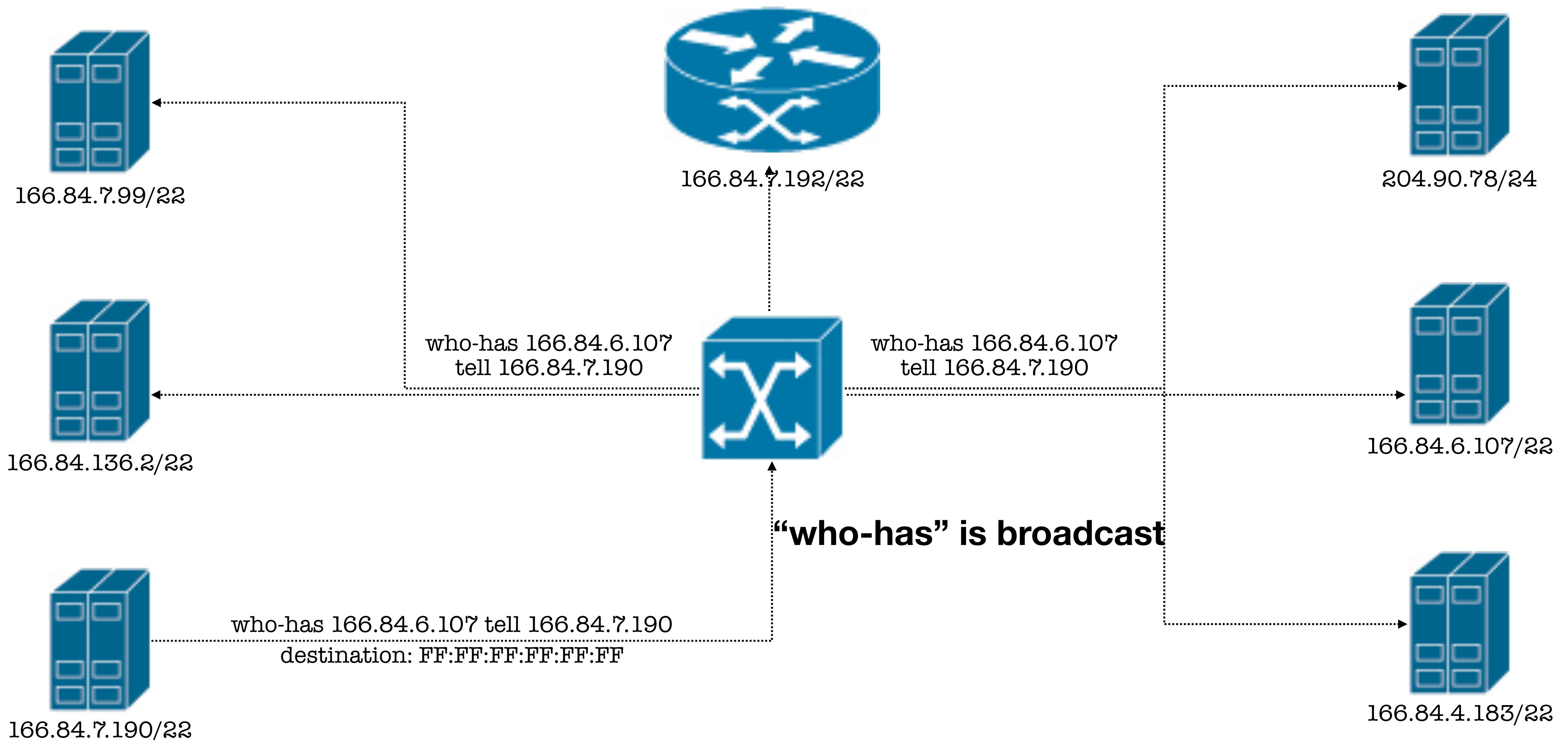
jschauma@stevens.edu

<https://stevens.netmeister.org/615/>

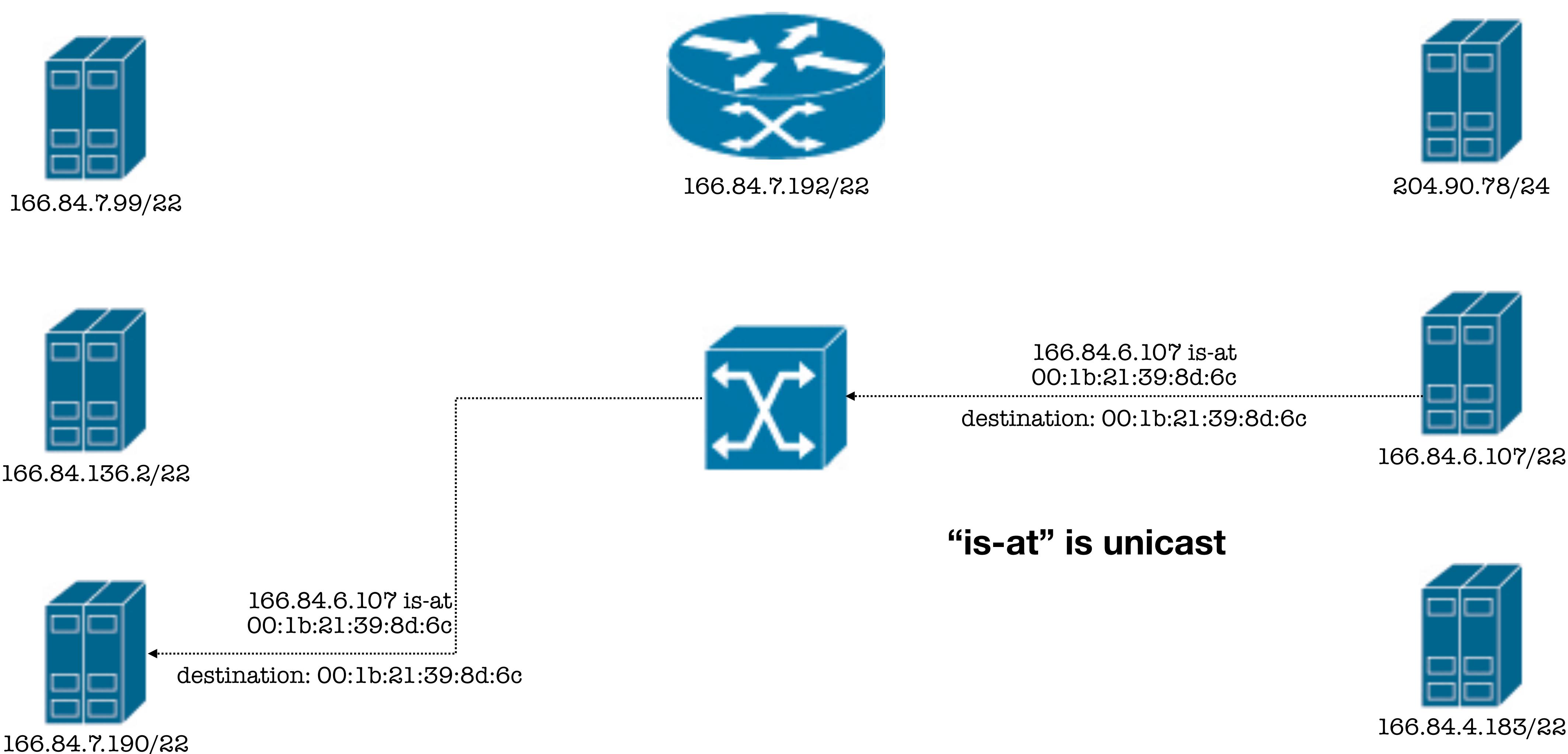


13:06:51.049225 ARP, Reply 166.84.7.99 **is-at** e0:76:63:72:39:00, length 28
13:06:51.056026 ARP, Request who-has 166.84.137.254 tell 166.84.136.3, length 42
13:06:51.064827 ARP, Request who-has 166.84.136.232 tell 166.84.136.2, length 42
13:06:51.070293 ARP, Request who-has 166.84.136.221 tell 166.84.136.2, length 42
13:06:51.072309 ARP, Request who-has 166.84.136.57 tell 166.84.136.3, length 42
13:06:51.072312 ARP, Request who-has 166.84.6.228 tell 166.84.7.191, length 42
13:06:51.074429 ARP, Request who-has 166.84.4.172 tell 166.84.7.191, length 42
13:06:51.076901 ARP, Request who-has 166.84.5.196 tell 166.84.7.191, length 42
13:06:51.076902 ARP, Request who-has 166.84.4.131 tell 166.84.7.191, length 42
13:06:51.079632 ARP, Request who-has 166.84.6.204 tell 166.84.7.191, length 42
13:06:51.088656 ARP, Request who-has 166.84.7.242 tell 166.84.7.190, length 42
13:06:51.090902 ARP, Request who-has 166.84.136.169 tell 166.84.136.2, length 42
13:06:51.094493 ARP, Request who-has 166.84.136.11 tell 166.84.136.2, length 42
13:06:51.094497 ARP, Request who-has 166.84.6.177 tell 166.84.7.190, length 42
13:06:51.095393 ARP, Request who-has 166.84.7.192 tell 166.84.7.99, length 28
13:06:51.095465 ARP, Request who-has 166.84.136.139 tell 166.84.136.3, length 42
13:06:51.098670 ARP, Request who-has 166.84.136.178 tell 166.84.136.2, length 42
13:06:51.098672 ARP, Request who-has 166.84.6.59 tell 166.84.7.190, length 42
13:06:51.098673 ARP, Request who-has 166.84.6.216 tell 166.84.7.190, length 42
13:06:51.098897 ARP, Reply 166.84.7.192 **is-at** 00:1b:21:73:59:5a, length 42
13:06:51.098900 ARP, Request who-has 166.84.6.90 tell 166.84.7.190, length 42
13:06:51.107174 ARP, Request who-has 166.84.137.62 tell 166.84.136.2, length 42
13:06:51.107785 ARP, Request who-has 166.84.4.229 tell 166.84.7.191, length 42

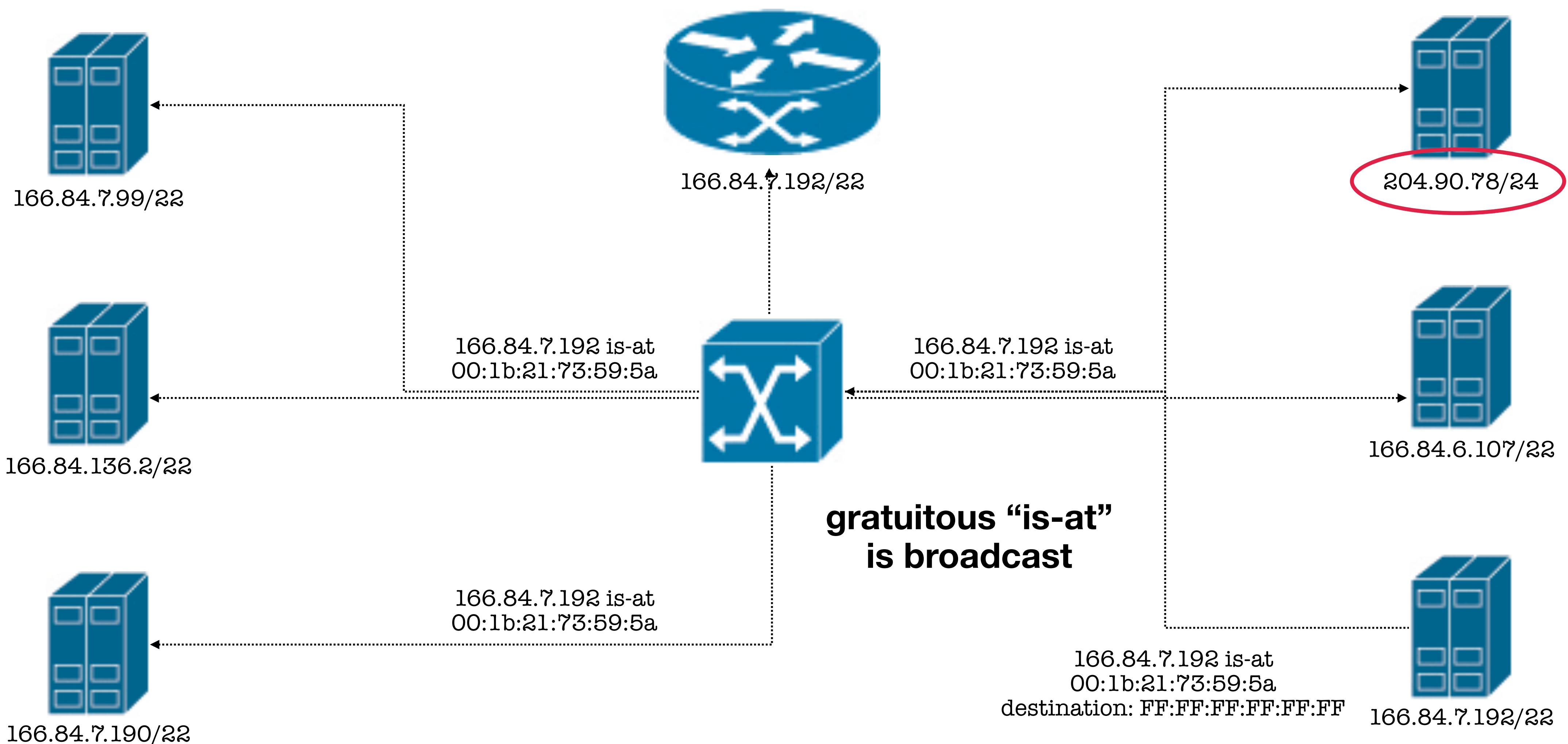
--More--(byte 91704)



RFC826:
Ethernet Address Resolution Protocol – or –
Converting Network Protocol Addresses to 48-bit Ethernet Address for
Transmission on Ethernet Hardware



RFC826:
 Ethernet Address Resolution Protocol – or –
 Converting Network Protocol Addresses to 48-bit Ethernet Address for
 Transmission on Ethernet Hardware



**gratuitous “is-at”
is broadcast**

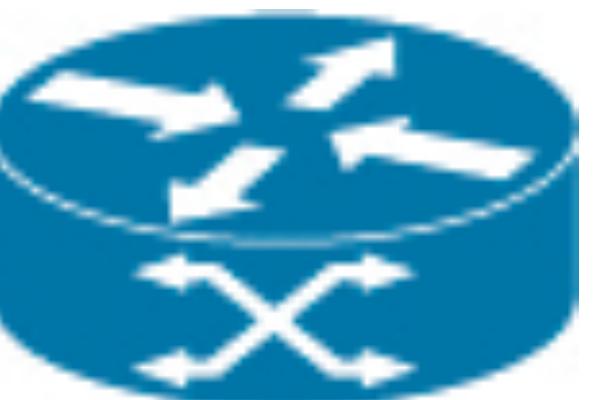
RFC826:
Ethernet Address Resolution Protocol – or –
Converting Network Protocol Addresses to 48-bit Ethernet Address for
Transmission on Ethernet Hardware



```
fe80::e076:63ff:fe88:2d20%xennet0      e2:76:63:88:2d:20 xennet0 23h59m41s S
fe80::e276:63ff:fe62:0%xennet0        e0:76:63:62:00:00 xennet0 23h59m46s S
fe80::e076:63ff:fe88:2d47%xennet0      e2:76:63:88:2d:47 xennet0 23h59m46s S
fe80::e276:63ff:fe62:3535%xennet0      e0:76:63:62:35:35 xennet0 23h59m46s S
fe80::e276:63ff:fe62:3737%xennet0      e0:76:63:62:37:37 xennet0 23h59m46s S
fe80::e276:63ff:fe62:3434%xennet0      e0:76:63:62:34:34 xennet0 23h59m46s S
fe80::e276:63ff:fe62:3333%xennet0      e0:76:63:62:33:33 xennet0 23h59m46s S
fe80::e276:63ff:fe72:3000%xennet0      e0:76:63:72:30:00 xennet0 23h59m46s S
fe80::f92a:aef3:789b:730d%xennet0      00:50:56:9c:f9:be xennet0 23h59m46s S
fe80::e276:63ff:fe62:3534%xennet0      e0:76:63:62:35:34 xennet0 23h59m46s S
fe80::e276:63ff:fe62:3130%xennet0      e0:76:63:62:31:30 xennet0 23h59m46s S
fe80::e276:63ff:fe62:3233%xennet0      e0:76:63:62:32:33 xennet0 23h59m46s S
fe80::20c:29ff:fe49:3e14%xennet0      00:0c:29:49:3e:14 xennet0 23h59m46s S
fe80::e276:63ff:fe62:3839%xennet0      e0:76:63:62:38:39 xennet0 23h59m46s S
fe80::e076:63ff:fe06:2d08%xennet0      e2:76:63:06:2d:08 xennet0 23h59m46s S
fe80::e076:63ff:fe88:2d25%xennet0      e2:76:63:88:2d:25 xennet0 23h59m46s S
fe80::e276:63ff:fe62:3735%xennet0      e0:76:63:62:37:35 xennet0 23h59m46s S
fe80::e276:63ff:fe62:3436%xennet0      e0:76:63:62:34:36 xennet0 23h59m46s S
fe80::20c:29ff:fedb:3ba1%xennet0      00:0c:29:db:3b:a1 xennet0 23h59m46s S
fe80::e076:63ff:fe88:2d24%xennet0      e2:76:63:88:2d:24 xennet0 23h59m46s S
fe80::e276:63ff:fe62:3231%xennet0      e0:76:63:62:32:31 xennet0 23h59m46s S
fe80::20c:29ff:fe6c:d65b%xennet0      00:0c:29:6c:d6:5b xennet0 23h59m46s S
fe80::e276:63ff:fe70:3100%xennet0      e0:76:63:70:31:00 xennet0 23h59m46s S
```



2001:470:30:84:e276:63ff:fe72:3900/64
fe80::e276:63ff:fe72:3900%xennet0/64



fe80::21b:21ff:fe73:595a/64



2001:470:30:84:e276:63ff:fe62:3137/64
fe80::e276:63ff:fe62:3137/64



2001:470:30:84:e276:63ff:fe62:3100/664
fe80::e276:63ff:fe62:3100/64



2001:470:30:84:e276:63ff:fe62:3434/64
fe80::e276:63ff:fe73:595a

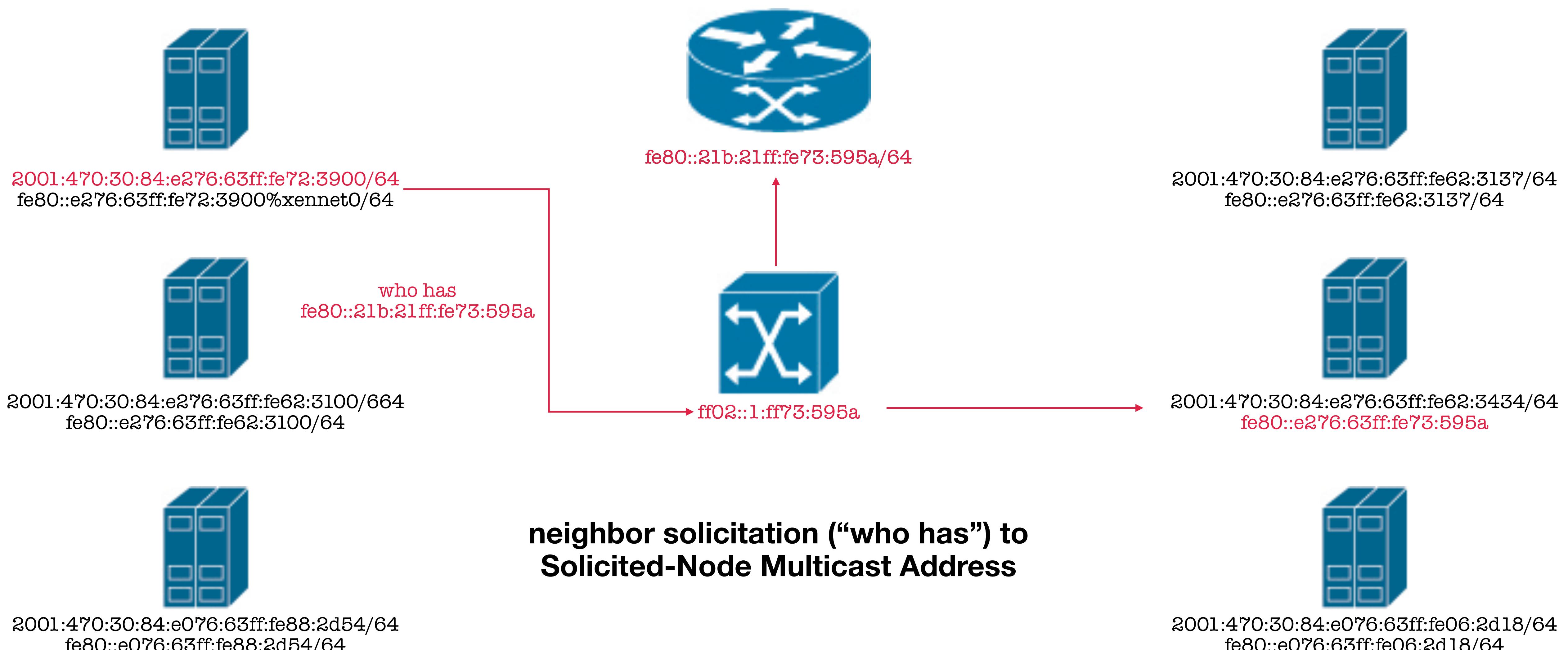


2001:470:30:84:e076:63ff:fe88:2d54/64
fe80::e076:63ff:fe88:2d54/64



2001:470:30:84:e076:63ff:fe06:2d18/64
fe80::e076:63ff:fe06:2d18/64

RFC4861: Neighbor Discovery for IP version 6 (IPv6)

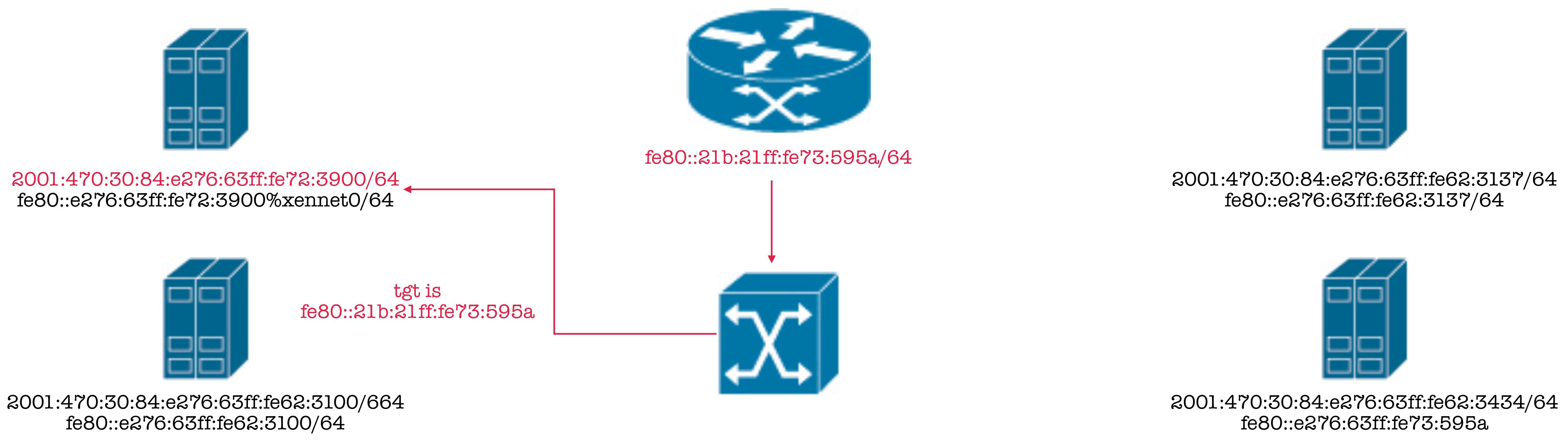


**neighbor solicitation (“who has”) to
Solicited-Node Multicast Address**

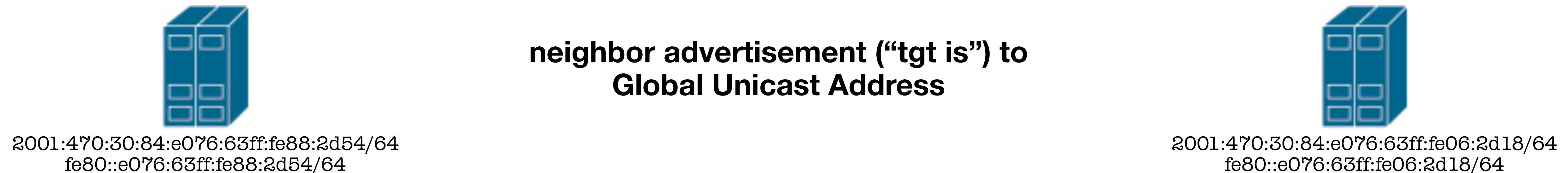
Host 1:
 $\text{2001:470:30:84:e076:63ff:fe88:2d54/64}$
 $\text{fe80::e076:63ff:fe88:2d54/64}$

Host 4:
 $\text{2001:470:30:84:e076:63ff:fe06:2d18/64}$
 $\text{fe80::e076:63ff:fe06:2d18/64}$

RFC4861:
 Neighbor Discovery for IP version 6 (IPv6)



neighbor advertisement (“tgt is”) to Global Unicast Address



RFC4861:
Neighbor Discovery for IP version 6 (IPv6)



2001:470:30:84:e276:63ff:fe72:3900/64
fe80::e276:63ff:fe72:3900%xennet0/64



fe80::21b:21ff:fe73:595a/64



2001:470:30:84:e276:63ff:fe62:3137/64
fe80::e276:63ff:fe62:3137/64



2001:470:30:84:e276:63ff:fe62:3100/664
fe80::e276:63ff:fe62:3100/64



→ ff02::1



2001:470:30:84:e276:63ff:fe62:3434/64
fe80::e276:63ff:fe73:595a

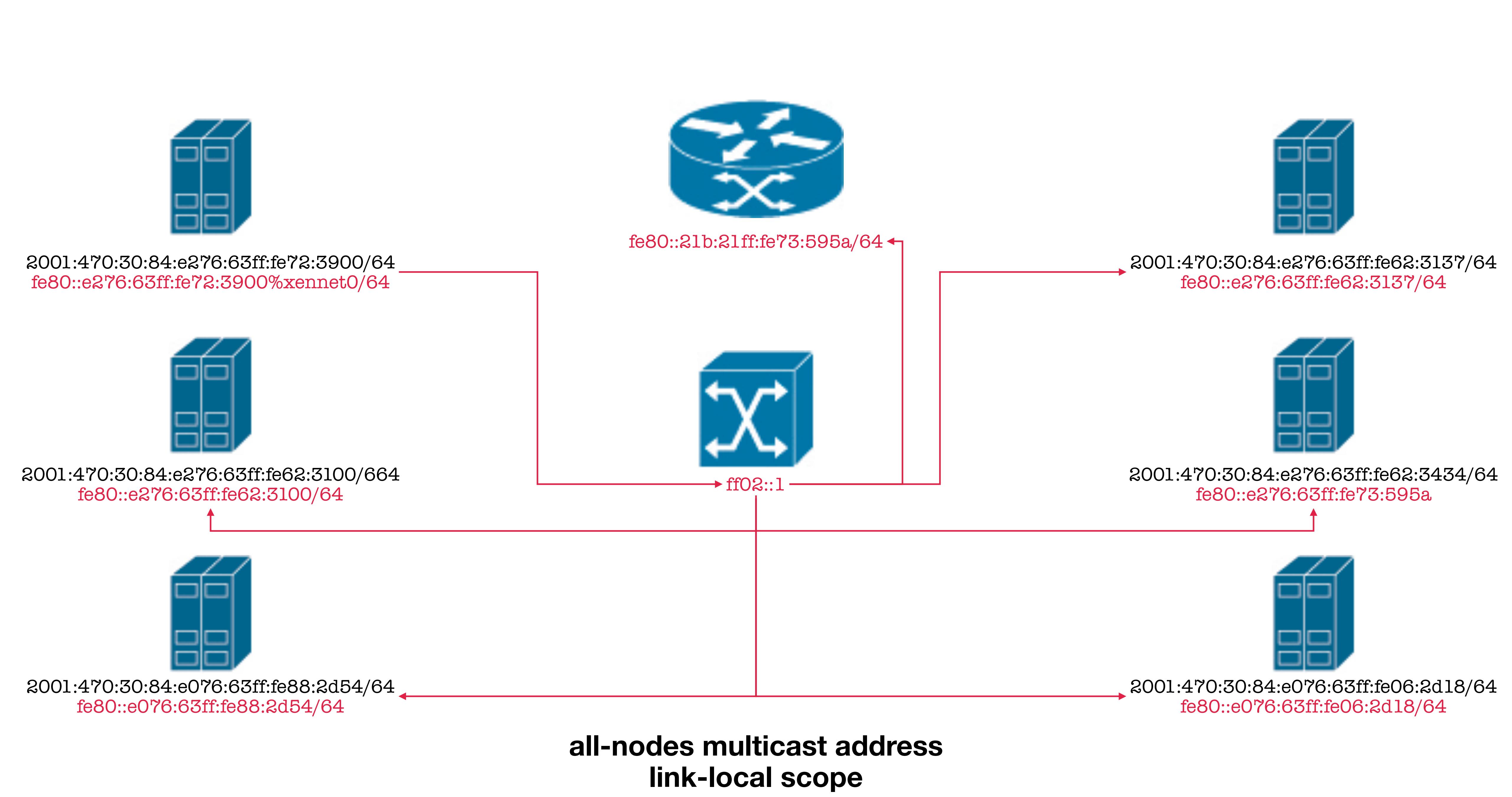


2001:470:30:84:e076:63ff:fe88:2d54/64
fe80::e076:63ff:fe88:2d54/64



2001:470:30:84:e076:63ff:fe06:2d18/64
fe80::e076:63ff:fe06:2d18/64

**all-nodes multicast address
link-local scope**



Summary

- Address Resolution Protocol (ARP): RFC826
 - who-has broadcast (to FF:FF:FF:FF:FF:FF MAC)
 - is-at unicast (unless gratuitous)
- Neighbor Discovery Protocol (NDP): RFC4861
 - neighbor solicitation (“who has”) to Solicited-Node Multicast Address
 - neighbor advertisement (“tgt is”) to Global Unicast Address
 - unsolicited neighbor advertisements to All-Nodes Multicast Address

Next up: ICMP