XCAST6
eXplicit Multicast on IPv6

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Outline

- Motivation
- Basic idea
- Deployment method
  - Semi-permeable capsule
- Implementations
- Trials
- IETF Standardization

When can we truly start to use inter-domain multicast?

- For a decade and more, many MBone talented researchers have worked in and out of IETF.
  - In the lab – we can make one easily.
  - On academic testbed nets – very hard but possible
  - In commercial Inter-domain net - never
- We want inter-domain multicast env. as easy as unicast we daily use, however…

Our approach

- Focused on what ***<u>we</u>*** really expect for multicast
  - Don’t solve the whole multicast problems.
- At first, think about what truly ***<u>we</u>*** need.
  - Want to be broadcaster? – No.
  - Want to deliver the Hollywood movies? - No.
  - Want to communicate with my friends? – Yes!

Category of Multicast Applications

Focus!

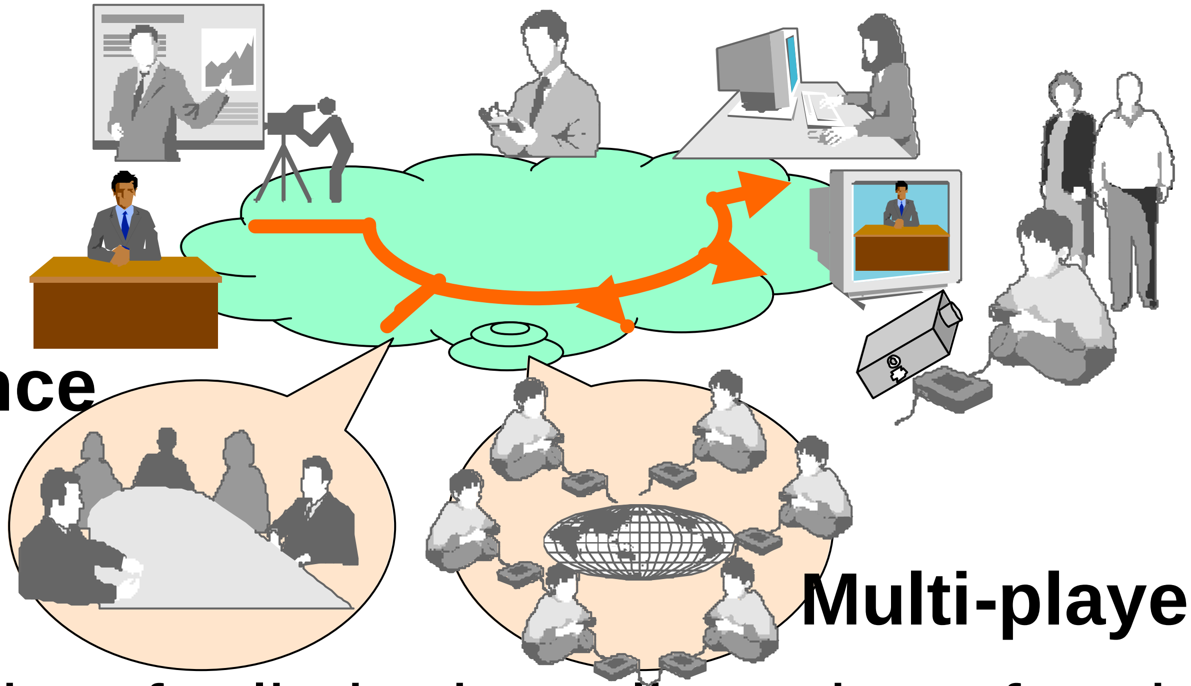
Broadcast-like (one-to-many)	Narrowcast-like (a few-to-a few)
•Multicast of IETF meetings •Broadcast of TV programs	•IP Telephony with conferencing •Video conferencing •Real-time collaborative applications •Multiparty networked games

Existing Multicast (scales with number of receivers)

Small Group Multicast (scales with number of sessions)

(Source Dirk Ooms in Alcatel.com)

Goal: Narrowcast like multicast

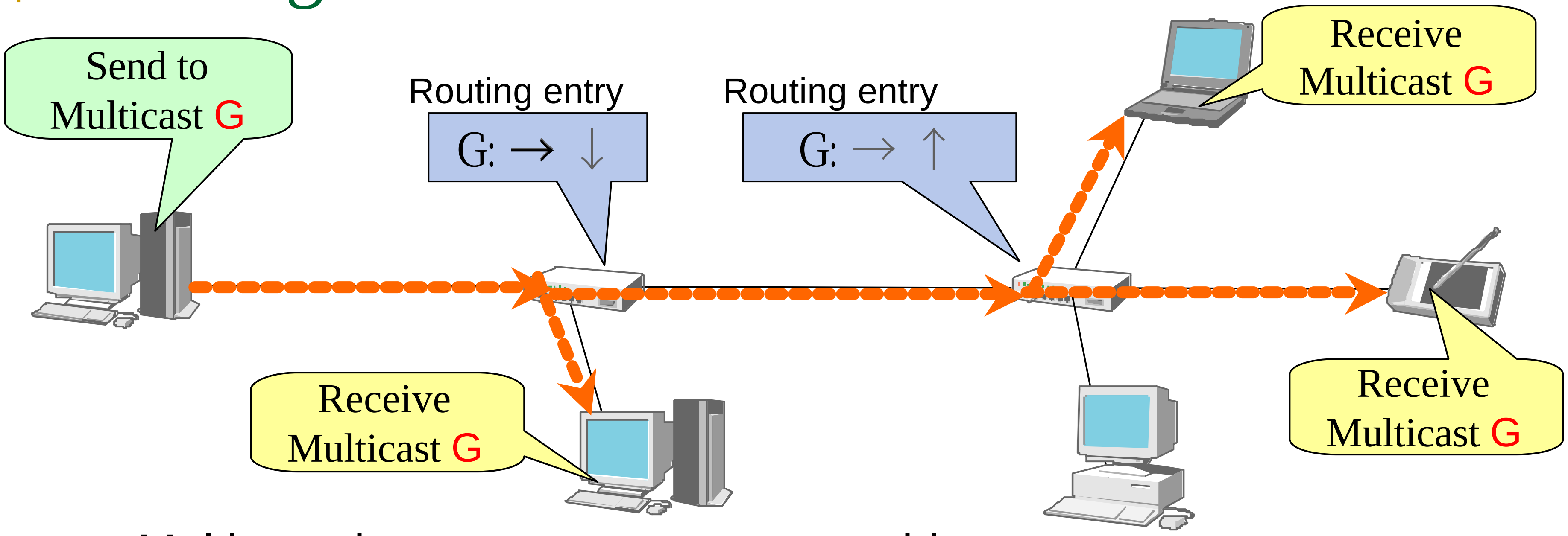


TV conference

Multi-player game

- To deliver for limited small number of nodes
- Network must support very huge number of small groups.
- Anybody can transmit from anywhere on the Internet

Existing Multicast mechanisms



- Multicast data are sent to a group address.
- All routers along the delivery path must maintain the status for each group.
- Intermediate routers need to know where the sender is in order for new nodes to join a multicast group.
- Receivers periodically send keep alive messages.

Scalability Problem of Existing Multicast

Protocol	**Table Size/Cntl Msg**
DVMRP	O(G*S)
PIM-SM - shared - short cut	 O(g) O(g*S)
logical lower bound	 O(g)

G: # of active groups in the DVMRP domain.

g: # of groups running on a router

S: # of source

Sola&Ohta "Scalability of Internet multicast Protocols", Inet 98

- For 1 million multicast groups, we must hold 1 million routing entries and process 1 million join/prune messages per min.

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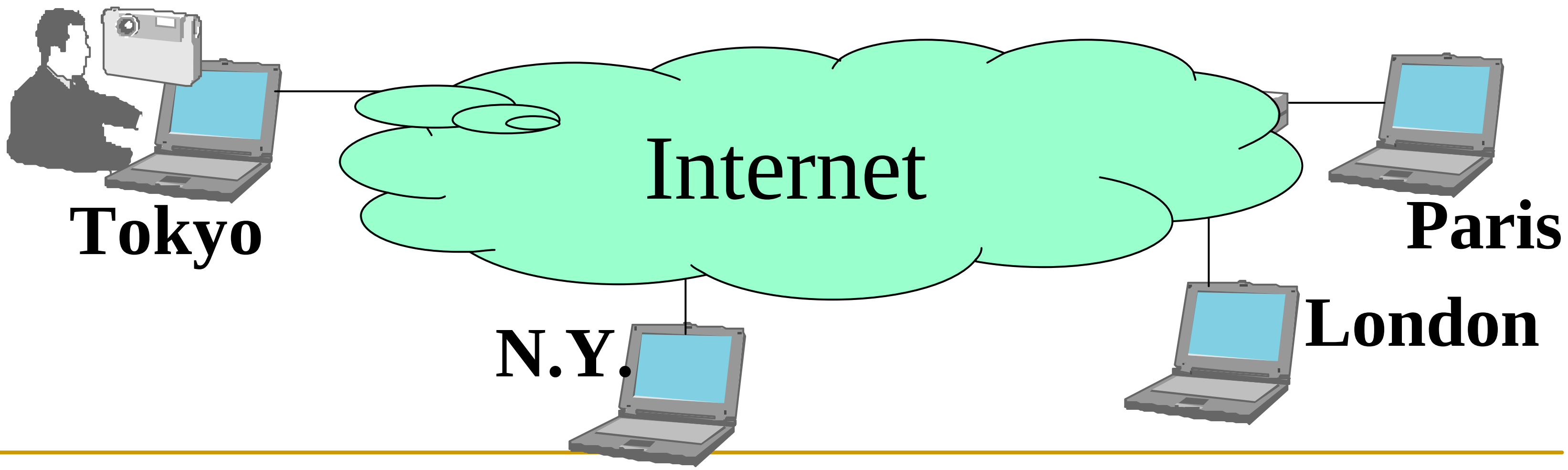
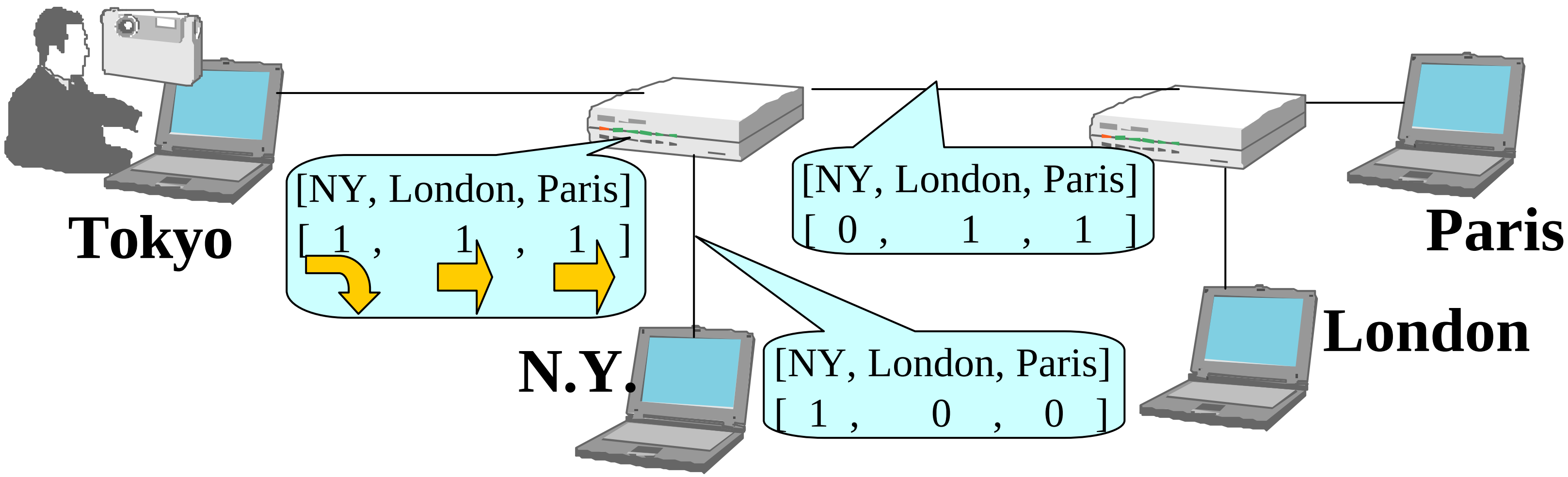
Main idea of XCAST6

- Instead of a group address, an explicit list of unicast destination addresses is stored in an optional IPv6 routing header.

IPv6 header SRC=Tokyo DST=N.Y.	Hop-byHop header TAIL=Paris	IPv6 header SRC=Tokyo DST=XCAST.	ROUTING header [**N.Y., London, Paris**] [1 , 1 , 0]	UDP header

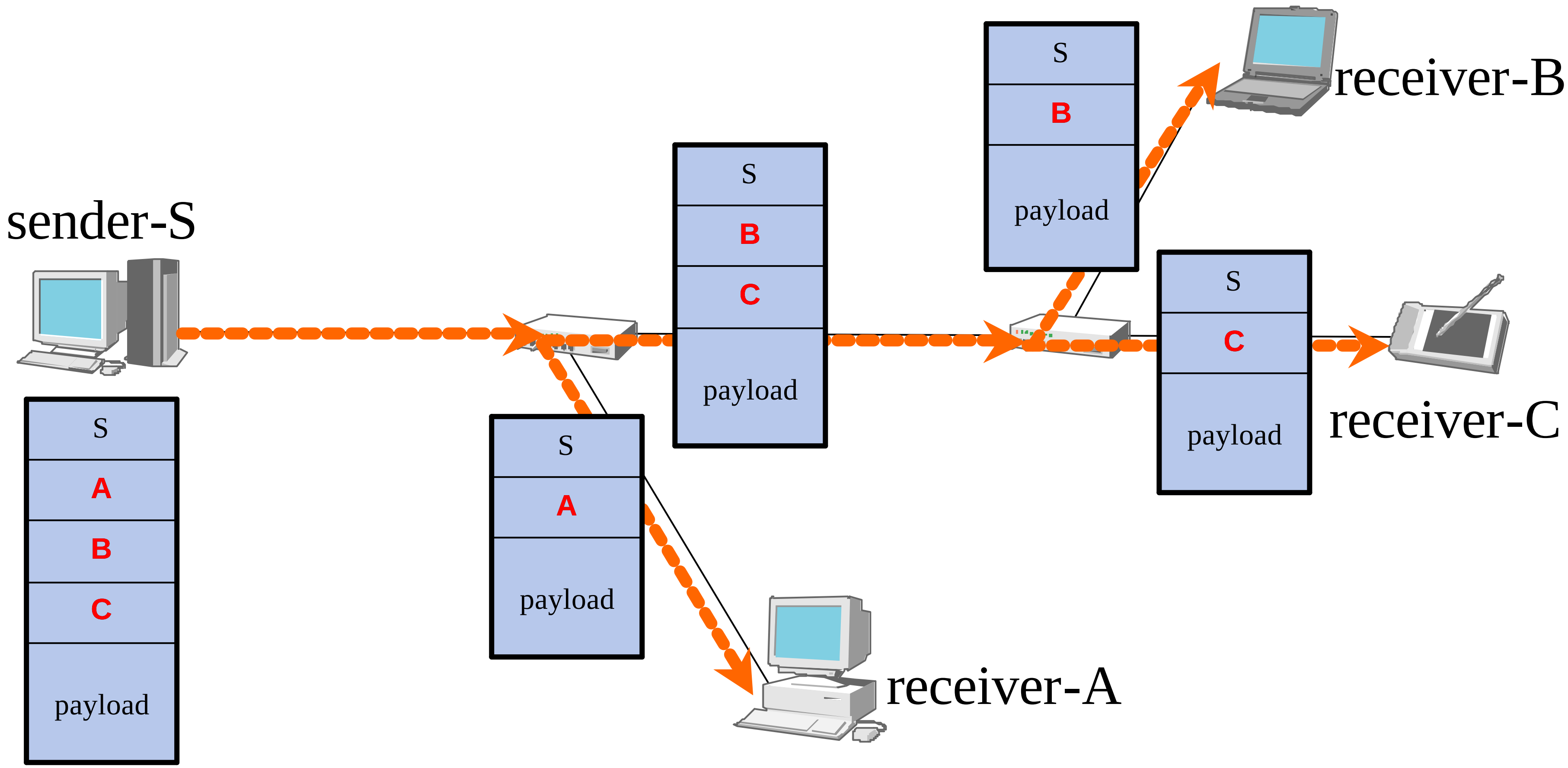


Routing procedure



① Look-up the next-hop for each address using a unicast routing table.

② Bundle up destinations which have same next-hop



sender-S
S
A
B
C
payload
S
A
payload
receiver-A
S
B
C
payload
S
B
payload
receiver-B
S
C
payload
receiver-C

Advantages

- XCAST6 can be delivered using only unicast routing information.
- No need for
  - a special multicast routing protocol
  - maintaining multicast status on intermediate routers
  - group address allocation
  - sender location advertisement
- Unlimited Scalability with respect to the number of groups

Advantages(Cont'd)

- Explicit end-to-end control of multicast group membership.
  - Senders can start transmission anytime without any signaling.
    - With existing multicast, receiver must join before transmission.
  - Sender can change the group membership (destinations) per packet basis.
    - With existing multicast schemes, membership change is done by join/prune process, a complex process.

Disadvantages

- Limit with number of receivers
  - Logically, up to 126 destination in a IPv6 routing headers (8*256 octet).
  - Actually, up to 15 destination for 1024 octets RTP video payload.
    - Ethernet MTU(1500 octet)
    - headers (XCAST, UDP, RTP)

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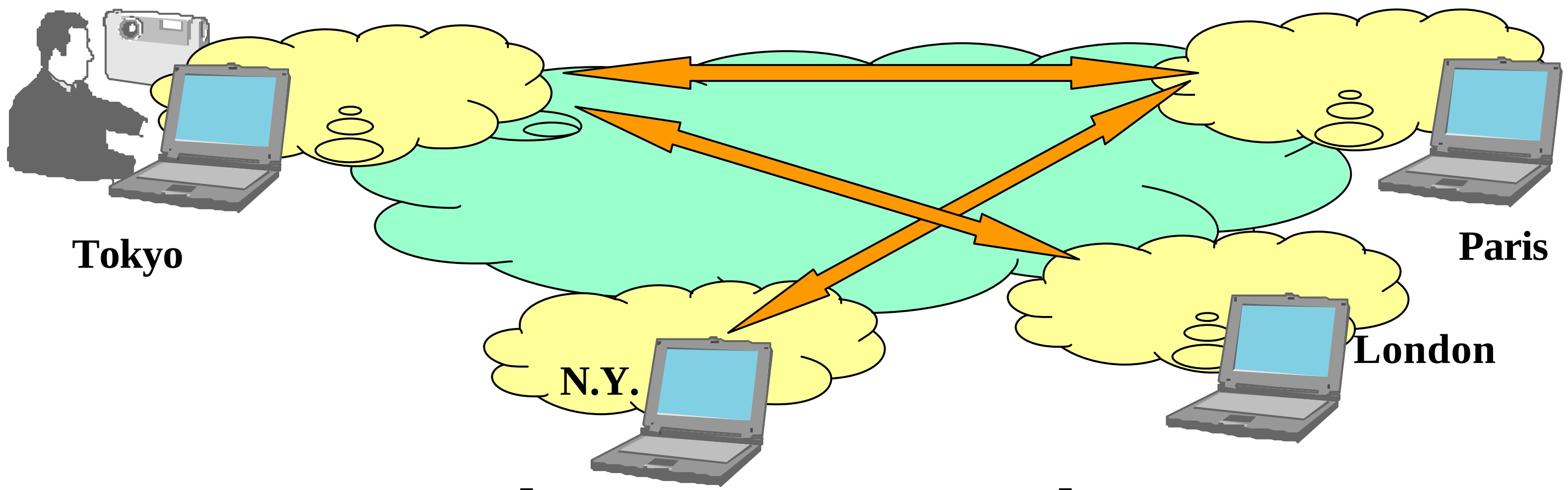
Deployment of existing multicast

Connecting multicast islands by IDMR and tunneling.



- negotiation between network operators
- complicated management
- encapsulation/peeling cost

Big obstacle for deployment

Semi-permeable capsule

- The intermediate router which does not support XCAST6 treats a XCAST6 datagram as a regular unicast datagram.

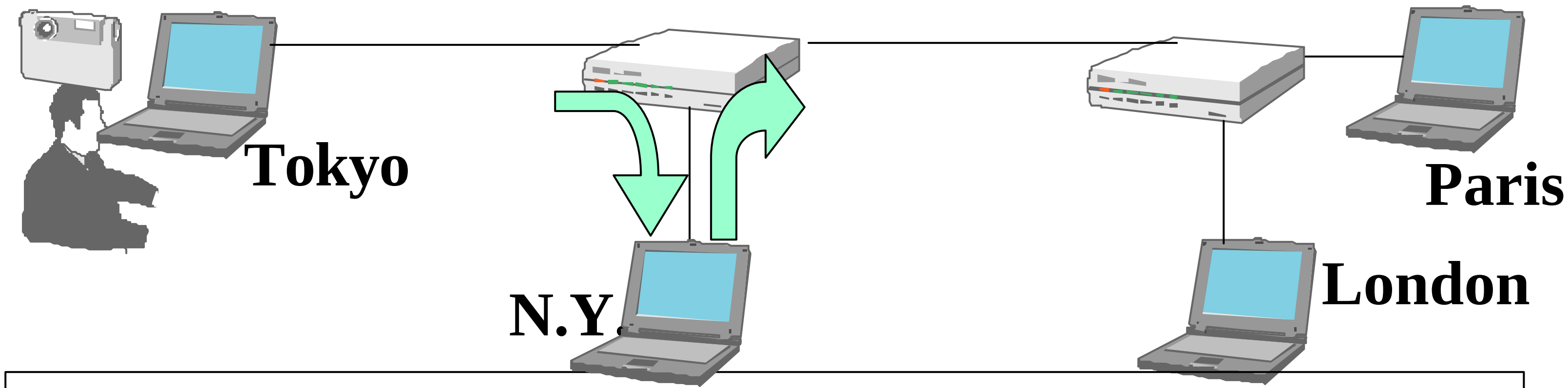
IPv6 header SRC=Tokyo DST=N.Y.	Hop-byHop header TAIL=Paris	IPv6 header SRC=Tokyo DST=XCAST.	ROUTING header [**N.Y., London, Paris**] [1 , 1 , 0]	UDP header

Temporal destination

Type prefix has ‘01’ that means “ignore this option and forward” if router doesn’t know this option.

Semi-permeable capsule(cont'd)

Even if non-XCAST6 routers are on the way, XCAST6 datagrams pass them once and turn back to next destination at next XCAST6 node.



i. End node can transmit XCAST6 in any environment.
ii. Installing more XCAST6 routers, path become optimized gradually.

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Implementations

- WIDE project/FUJITSU Lab.
  - OS: NetBSD 1.6, FreeBSD 4.6.2
  - VIC (Video Conference) & RAT (Robust Audio Tool)
  - http://www.sourceforge.net/projects/xcast6
- ETRI/Soongsil University
  - OS: Linux 2.4.18
  - VIC & RAT
  - http://www.ipv6.or.kr/xcast/

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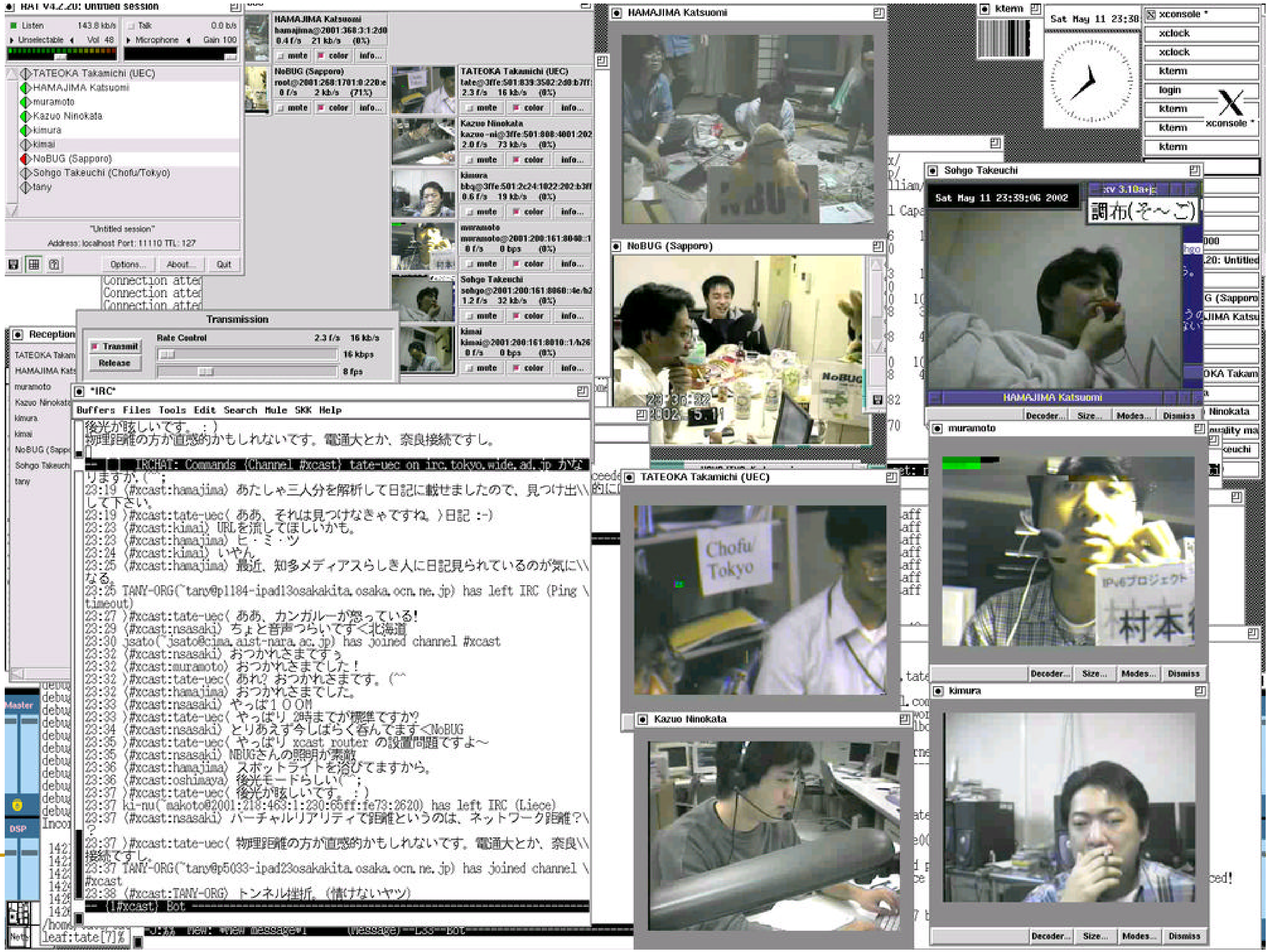
Various meeting and events

- Weekly WIDE XCAST WG meeting
  - Discuss and steer this R&D activity itself.
- Monthly BUGs(*BSD Users Groups) meeting
  - For promotion into the open source community.

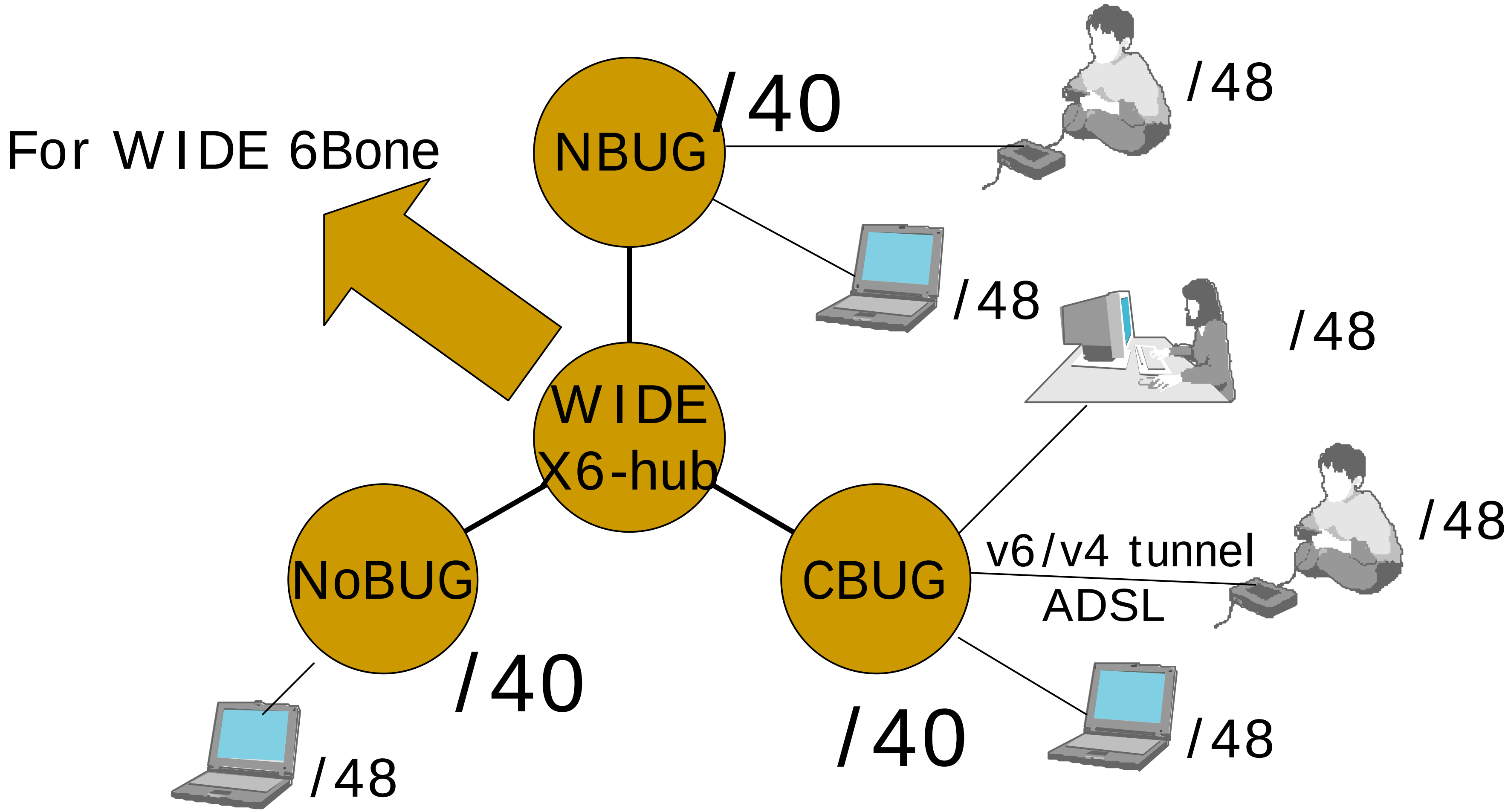
JP-BUGs (BSD Users Groups) meeting



WIDE X6-Bone project

- For more smooth XCAST6 delivery, more XCAST router must be deployed.
- Make pseudo XCAST6 network using special pTLA space (3ffe:051b::/32) .
- Distribute /40 for collaborators (BUGs, LUGs) and connect them for HUB in WIDE backbone.

WIDE X6-Bone project



KR-JP Inter-operability test

- Inter-operability check between *BSD and Linux implementation(July 15 2003 in 54th IETF)
  - Linux(Korea)
    - Soongsil University
  - NetBSD(Japan)
    - Fujitsu Laboratories, Ltd.
    - Fujitsu Limited
    - Nara Advanced Institute of Science and Technology
    - Nippon Telephone and Telegraph East Corporation
    - Matsushita Electric Industrial Co., Ltd.
    - Sony Computer Science Laboratories, Inc.
    - Information Services International-Dentsu, Ltd.
    - NoBUG: Northern Land BSD Users Group (Hokkai-do)
    - NBUG: Nagoya *BSD Users' Group

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IETF Standardization

- 1999: 3 independent drafts were submitted
  - Connectionless Multicast (Alcatel)
  - Multiple Destination Option on IPv6 (Fujitsu)
  - Small Group Multicast (IBM)
- 2000:
  - 1st. BoF in 48th IETF
  - Unified XCAST specification
    - Explicit Multicast Basic Specification
      - draft-ooms-xcast-basic-spec-xx.txt
- 2003:
  - Preparing to start standard track discussion in RMT WG (Transport Area) in 56th IETF.

Conclusion

- XCAST6 is new type of multicast
  - Use list of unicast addresses as a destination of datagram.
  - Suitable for private small group multicast
  - Ultra scalable concerning with the number of multicast groups
  - End-to-end deployment with semi-permeable capsule
- 2 inter-operable implementations for Linux and *BSD
- IETF standardization is just kicked off.

Links & Resources

- XCAST incubation group
  - http://www.xcast-ig.org
- WIDE XCAST WG & X6-Bone
  - http://www.xcast.jp
- *BSD implementations
  - http://www.sourceforge.net/projects/xcast6
- Linux implementation
  - http://www.ipv6.or.kr/xcast/