Crowd Buzz

Scalable Audio Communication for MMVEs using Latency Optimized Hypercube Gossiping

Philipp Berndt <philipp.berndt@tu-berlin.de>
Matthias Hovestadt, Odej Kao
Complex and Distributed IT-Systems
Technische Universität Berlin

OVERVIEW: Outline of the presentation

I. Auditory Virtual Environments

II. Communication Topologies

III. Hypercube Gossiping

IV. Evaluation

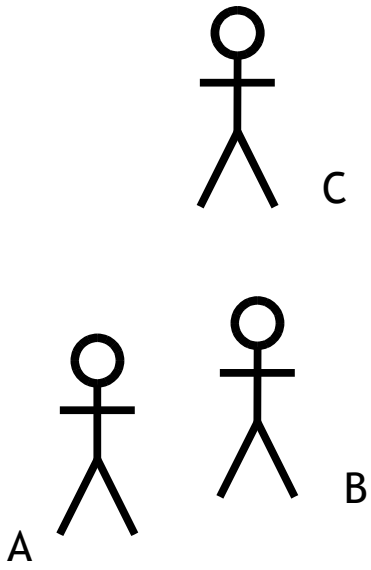
V. Future Research

VI. Summary and Discussion


http://www.smeet.de - sMeet Club World - Iceweasel
sMeet beta
Hallo Philipp!
Räume
Mein Profil
Guthaben 7.405,78 €
Exit
beisen würde...lol..
dragon79: wäre auch nicht schlimm, aber vorsicht hier wird auch zurückgebissen
dragon79: lol
dertigerinmir: rrrrrrrrr
The_Devil: janis?
Sunshine_BIH: /me wünscht euch allen einen schönen guten abend
---------- aktuelle Chatunterhaltung ----------
Deine Nachricht
Telefon
Konferenz
Webcam
Sharing
Deine gespeicherten Nummern
Festnetz2 +12 XXXXXXX
Handy +49 XXXXXXX
Neu +49 XXXXXXX 1
Festnetz1 +49 XXXXXXX
H24 +49 XXXXXXX
Privat +49 XXXXXXX
Neuer Eintrag
Telefonnummer eingeben und mit allen in diesem Raum telefonieren!
Deine Telefonnummer mit Vorwahl (bleibt geheim):
Rückruf ins Festnetz: 0,00 €/min
Rückruf aufs Handy: 0,27 €/min
Waiting for p-ca-4.smeet.de...

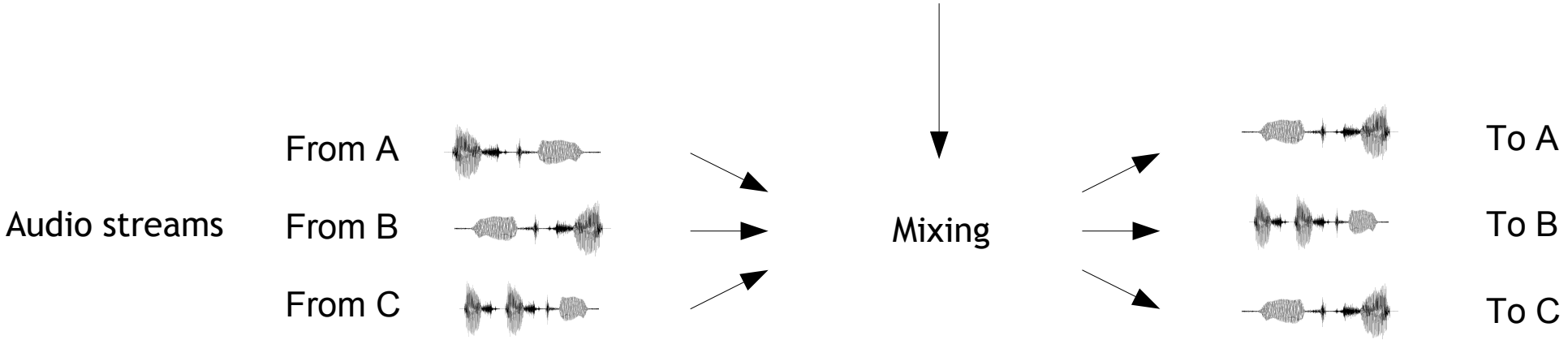
AUDIO COMMUNICATION IN VEs:
The General Problem

Virtual locations



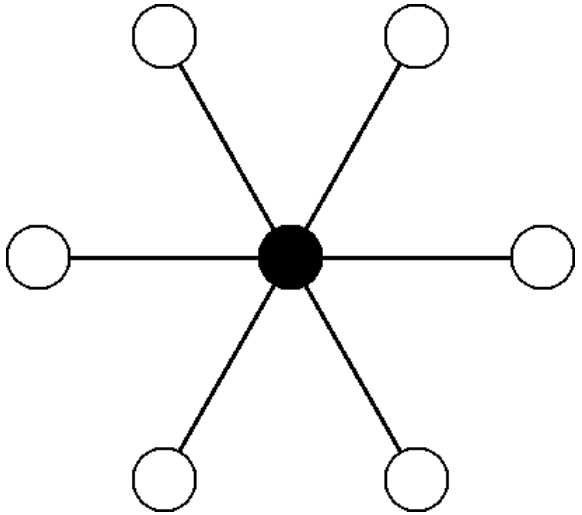
γ(A,B)
:
γ(C,B)

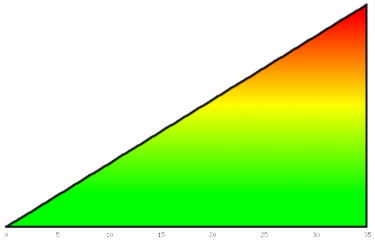
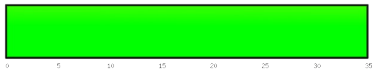
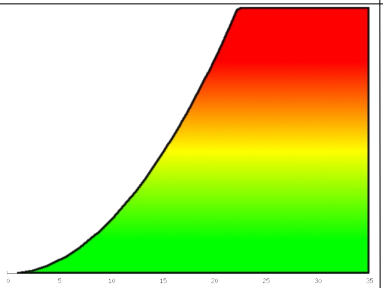
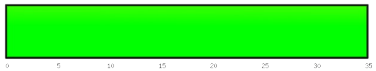
	A	B	C
A	-	0.9	0.4
B	0.9	-	0.5
C	0.4	0.5	-



SERVER CENTRIC TOPOLOGY:
Easy on the client, hard on the server

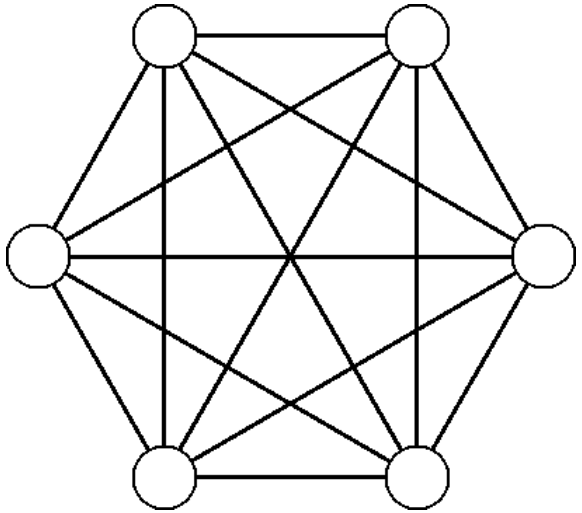
Topology: Central Server

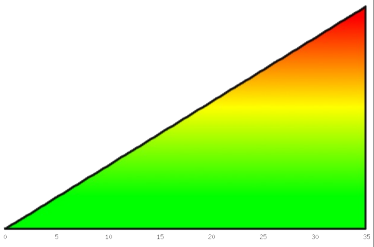
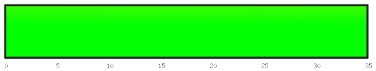


Resources	Provider	User
Traffic	 linear	 constant
Effort	 quadratic	 constant

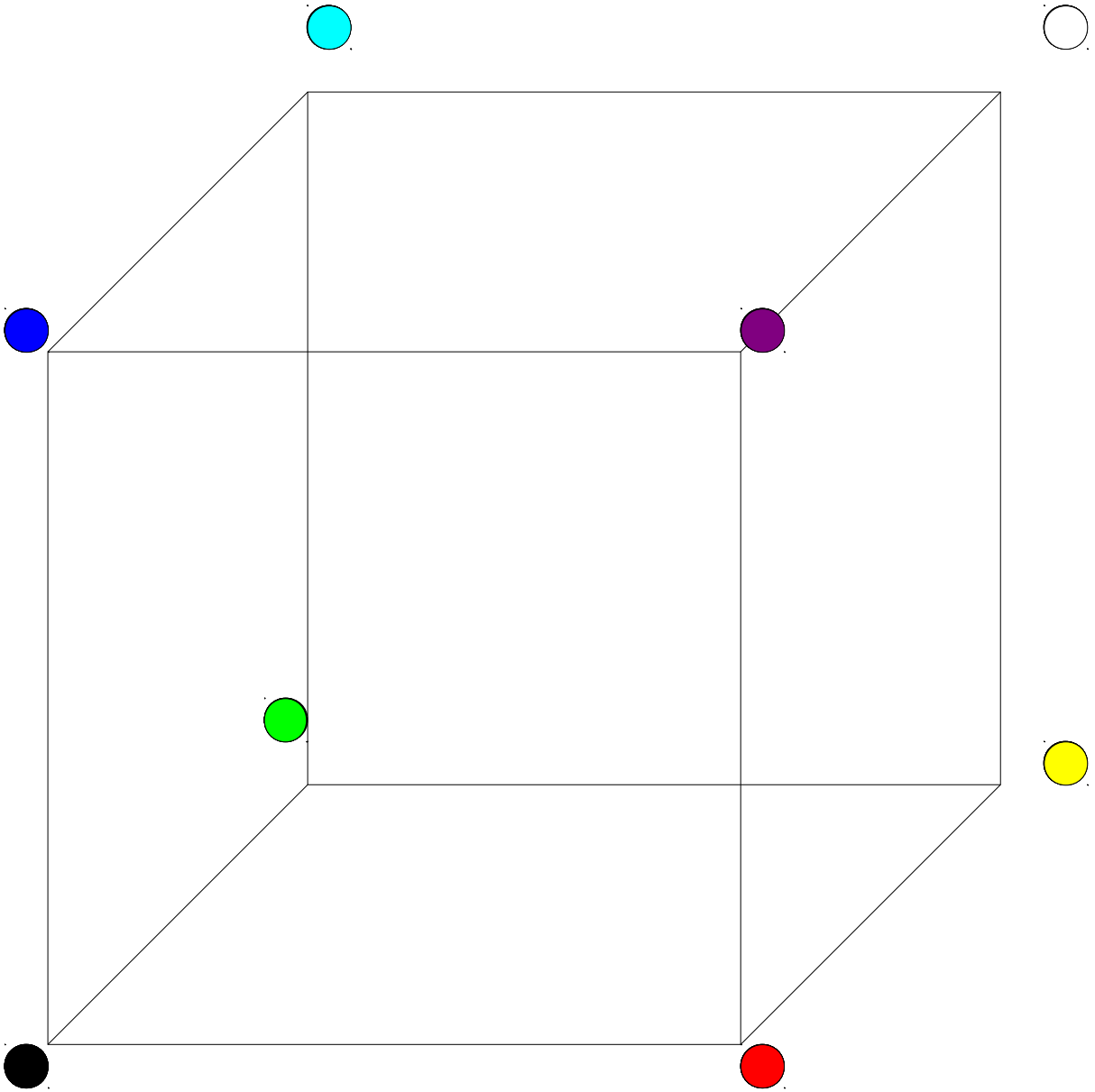
FULL MESH TOPOLOGY: Too much traffic

Topology: Full Mesh



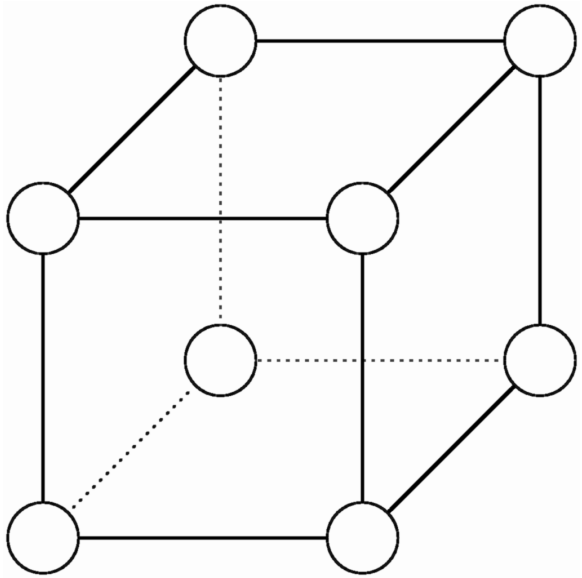
Resources	Provider	User
Traffic	 constant	 linear
Effort	 constant	 linear

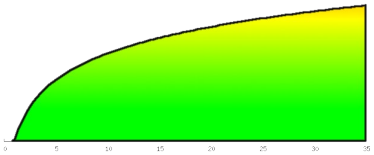
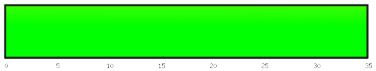
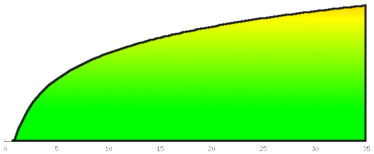
HYPERCUBE TOPOLOGY: Communication Scheme



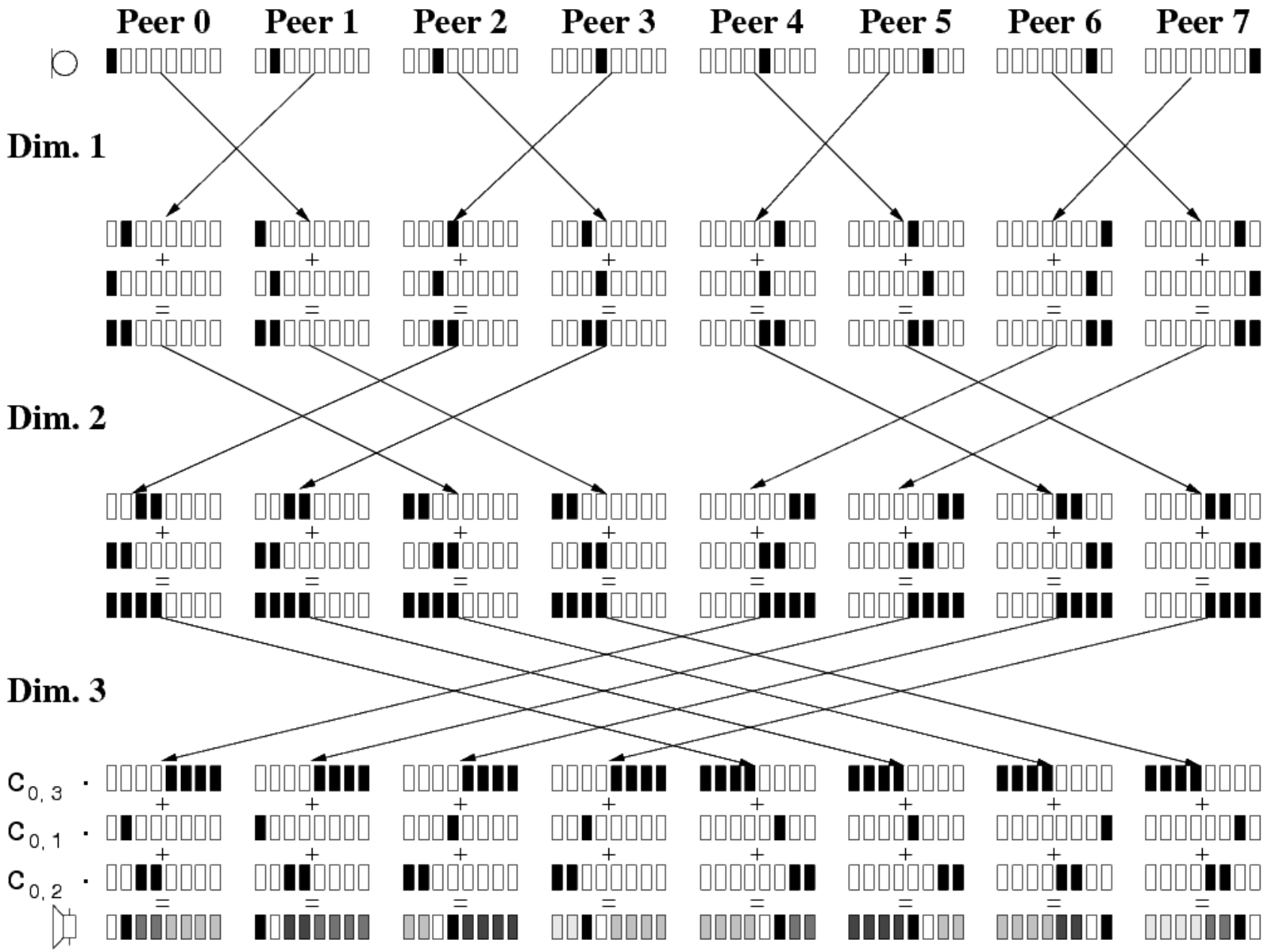
HYPERCUBE TOPOLOGY: Lower resource usage

Topology: Symmetric Distributed Processing

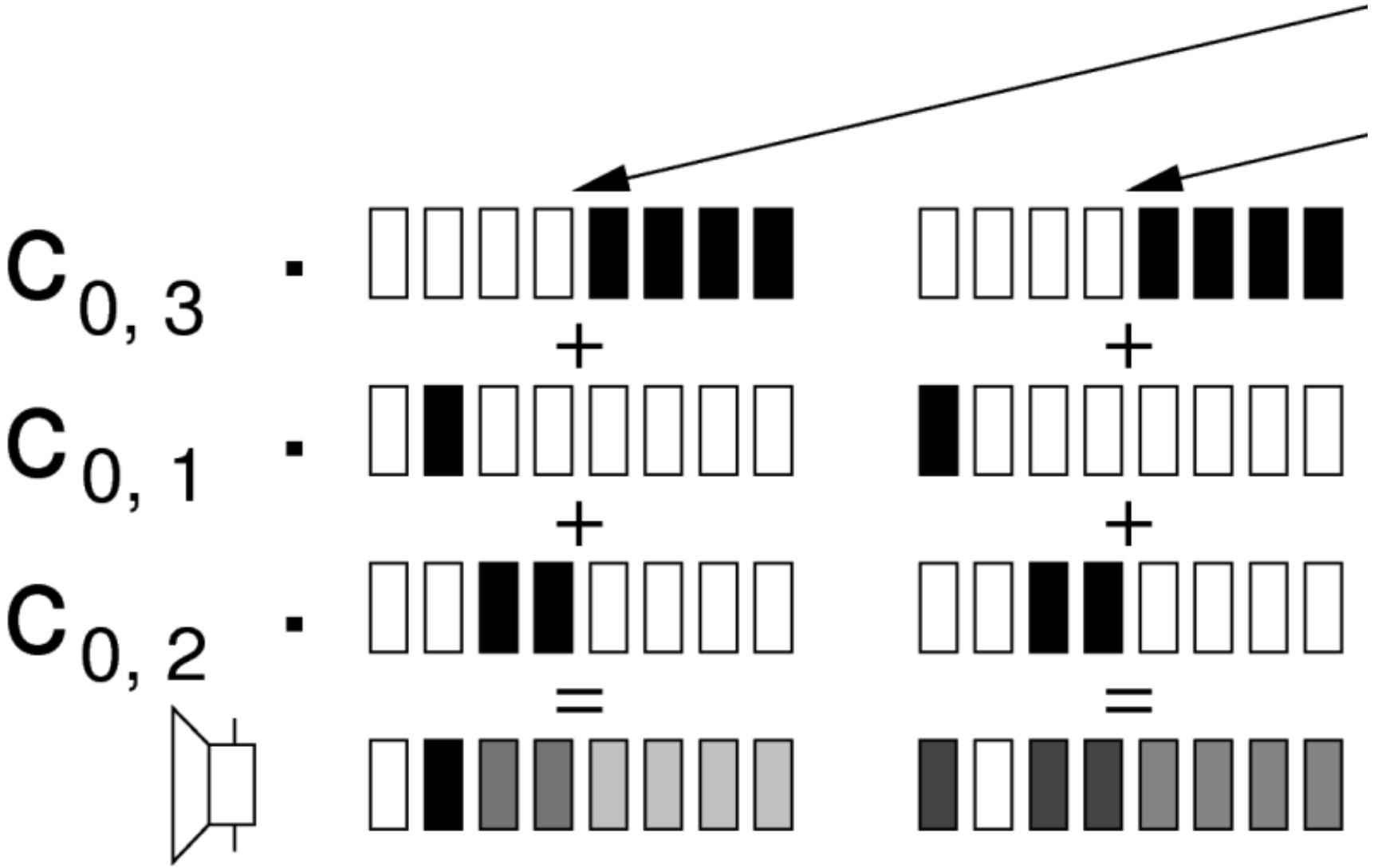


Resources	Provider	User
Traffic	 constant	 logarithmic
Effort	 constant	 logarithmic

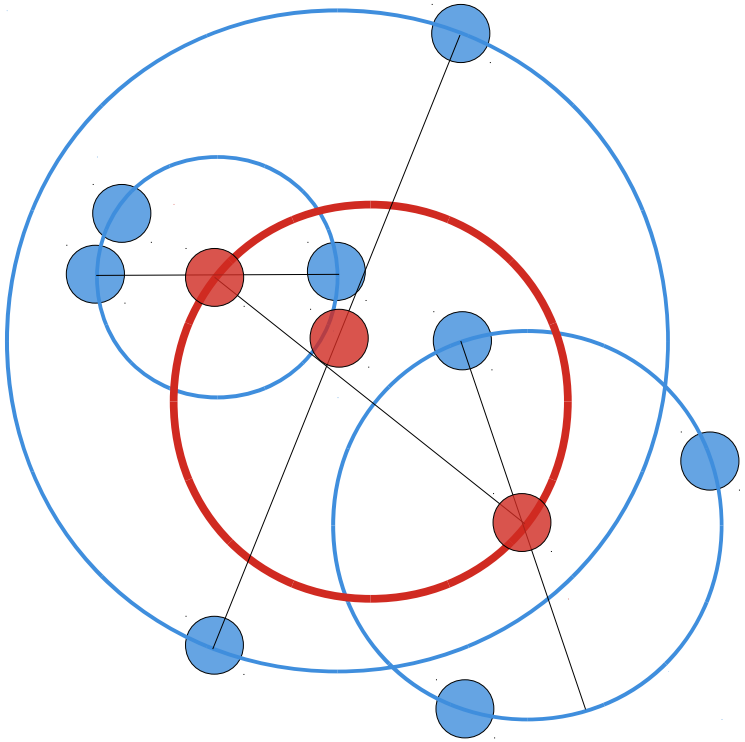
HYPERCUBE TOPOLOGY: Mixing with coefficients



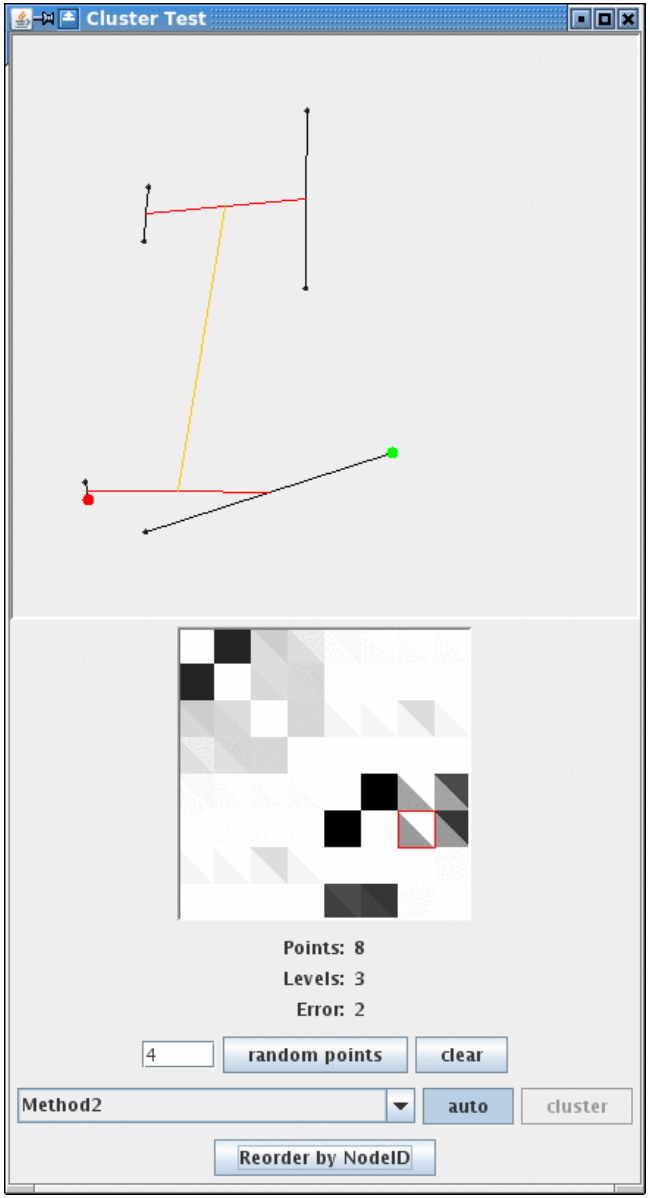
Dim. 3



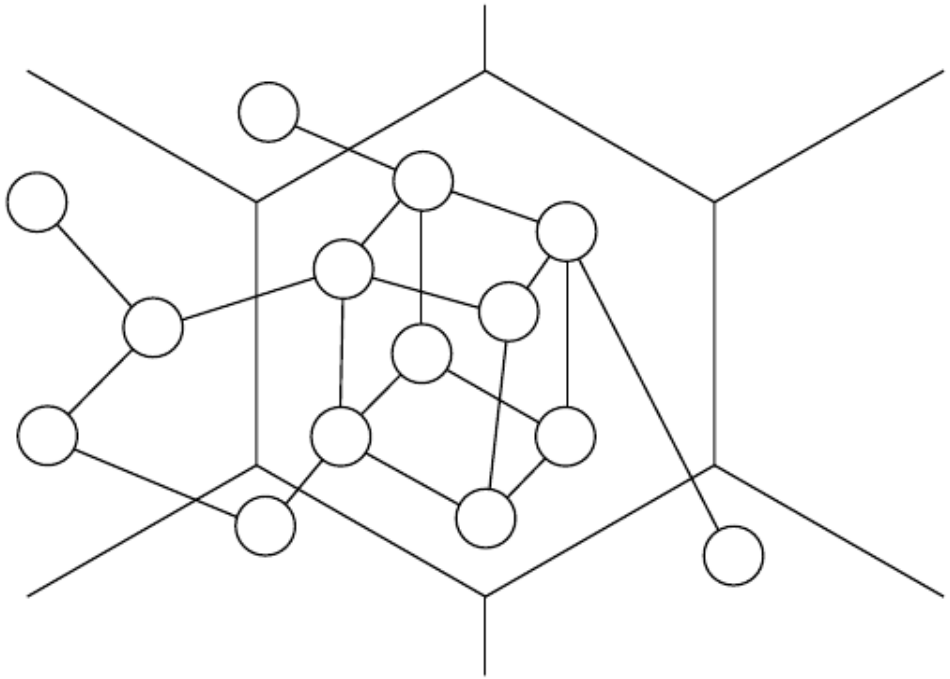
CLUSTERING: How users are assigned their network positions

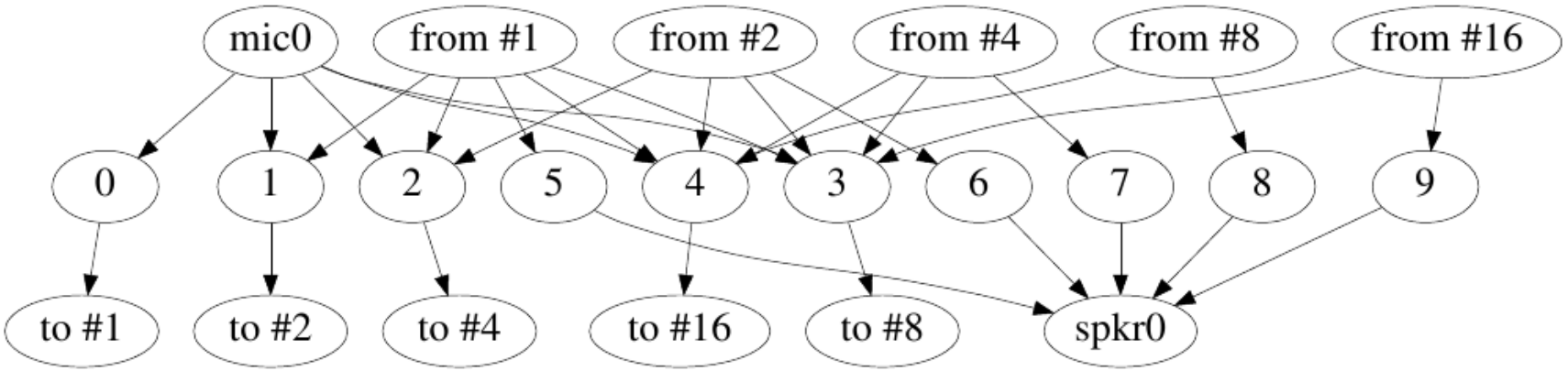


CLUSTERING: Evaluation

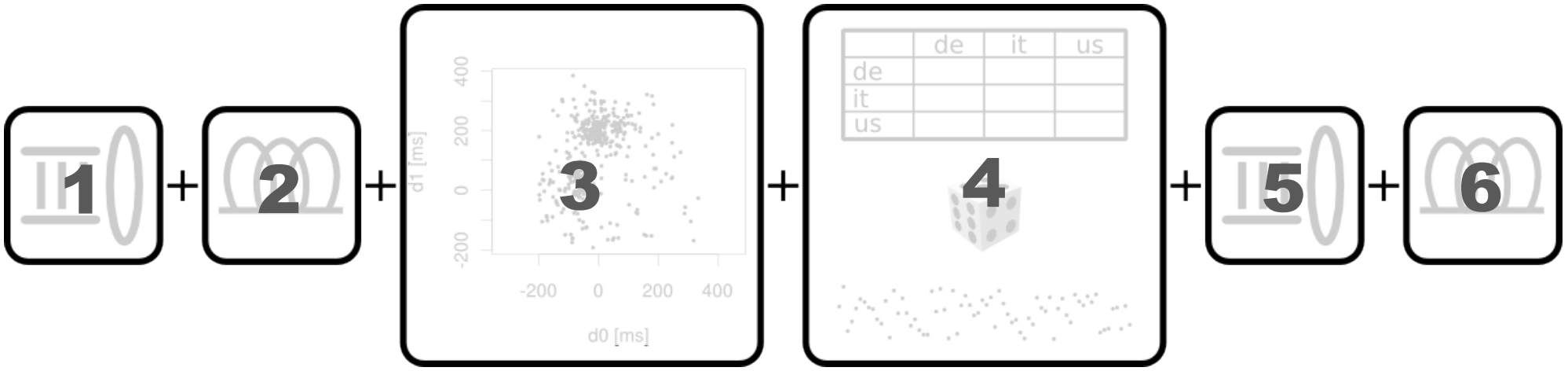


PARTITIONING: Hexagonal Grid



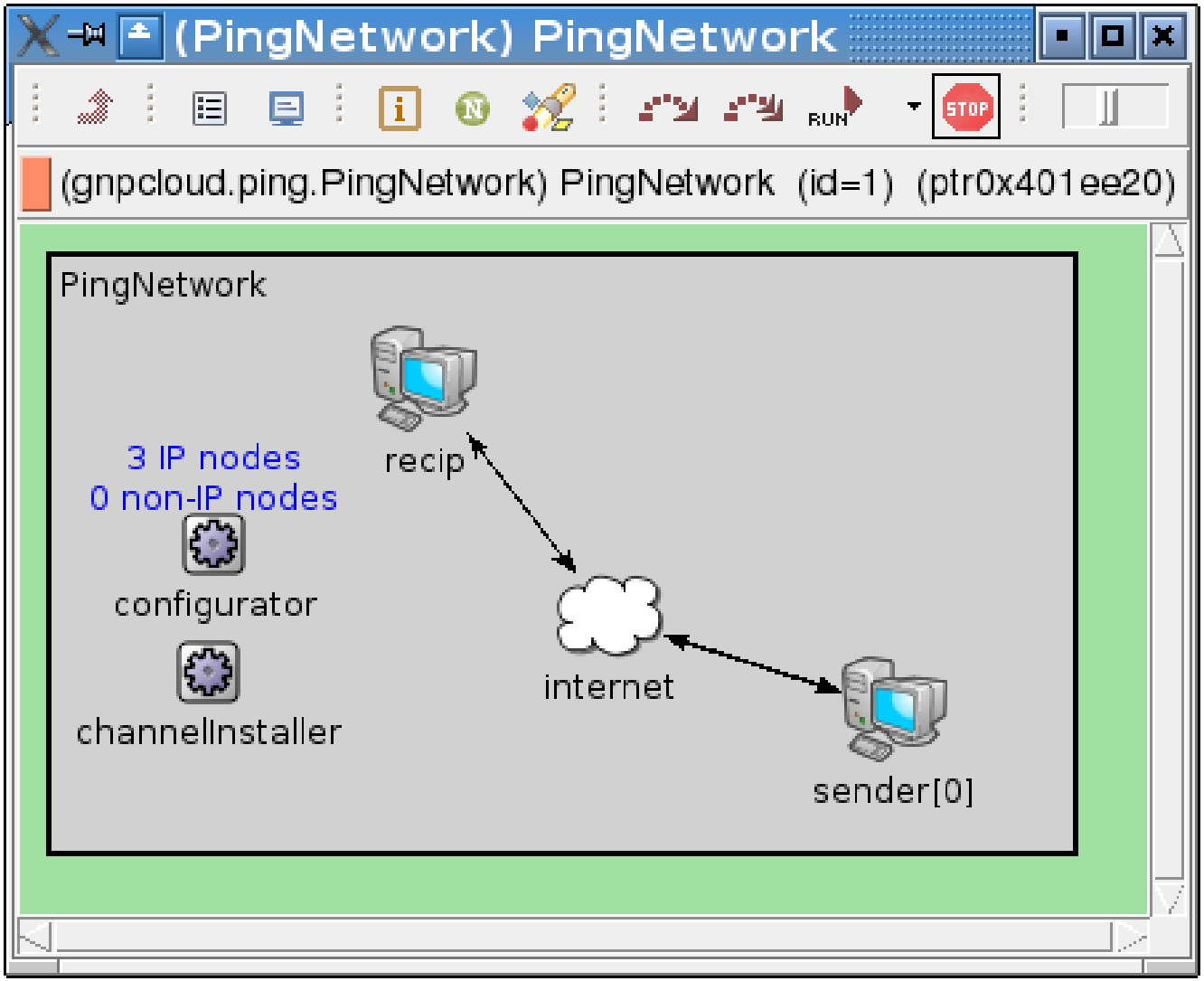

mic0
from #1
from #2
from #4
from #8
from #16
0
1
2
5
4
3
6
7
8
9
to #1
to #2
to #4
to #16
to #8
spkr0

THE DELFOI MODEL: One Way End-to-End Latency

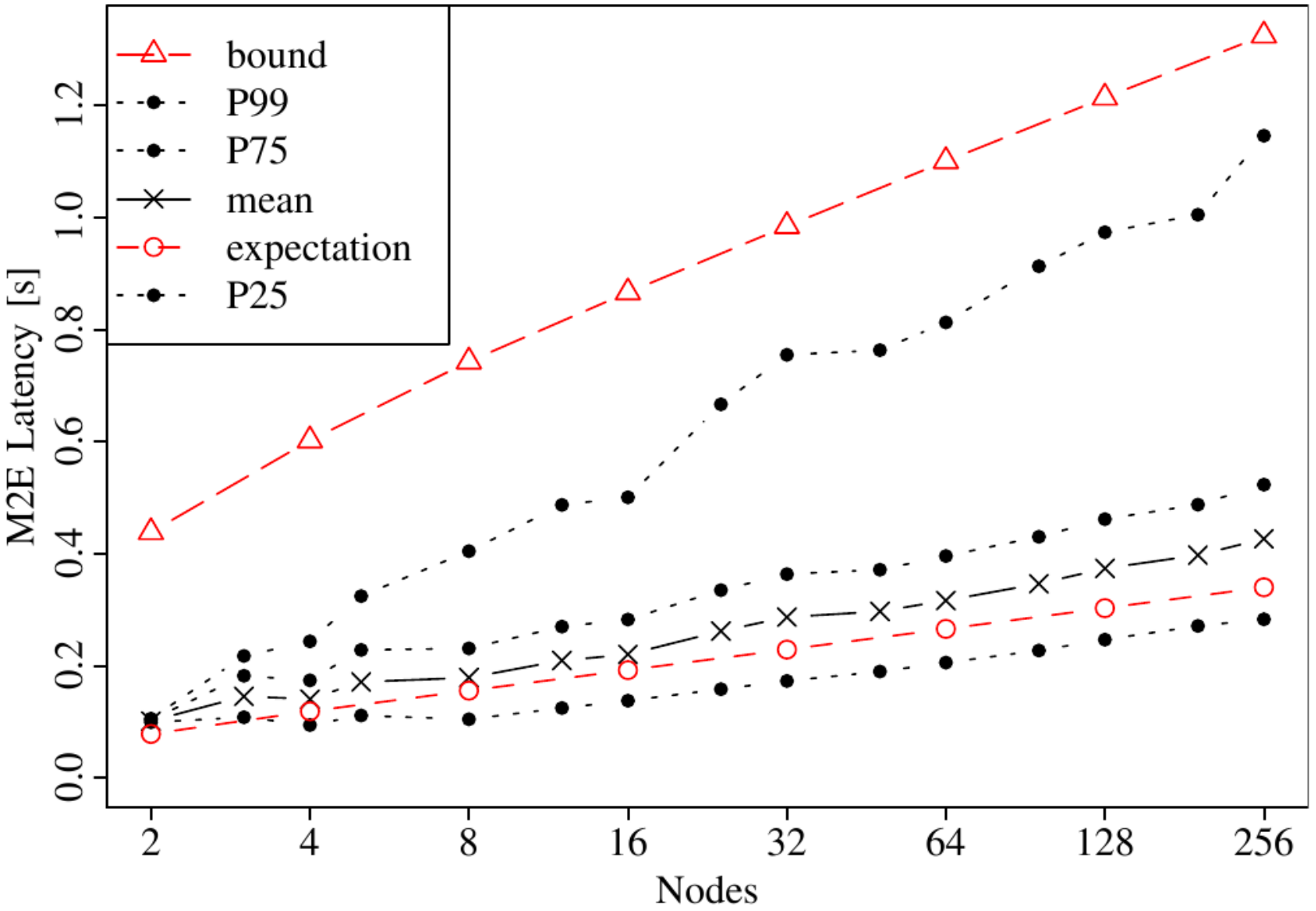


$$\text{delay}(H_1, H_2, l_P, S) := \sum \ldots$$

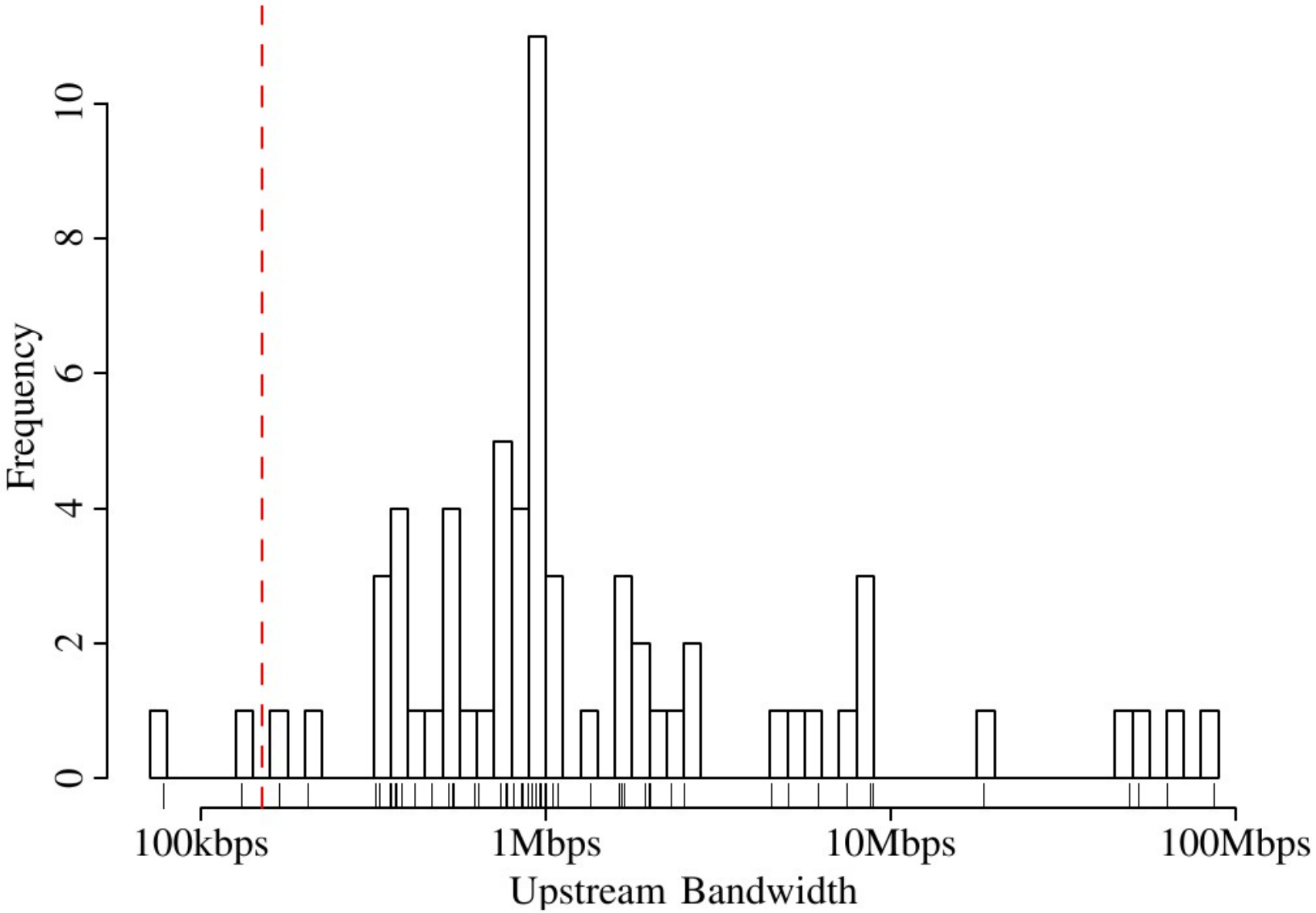
1. $\dfrac{\text{queuelevel}\left(S_{H_1,up}\right) + l_P}{bandwidth_{H_1,up}}$
2. $wiredelay_{H_1,up}$
3. $\sqrt{\sum_{i=1}^{D}\left(c_{H_1,i} - c_{H_2,i}\right)^2}$
4. $\text{rlnorm}\left(\mu_{H_1,H_2}, \sigma_{H_1,H_2}\right)$
5. $\dfrac{\text{queuelevel}\left(S_{H_2,down}\right) + l_P}{bandwidth_{H_2,down}}$
6. $wiredelay_{H_2,down}$


(PingNetwork) PingNetwork
RUN
STOP
(gnpcloud.ping.PingNetwork) PingNetwork (id=1) (ptr0x401ee20)
PingNetwork
3 IP nodes
0 non-IP nodes
recip
configurator
channelInstaller
internet
sender[0]

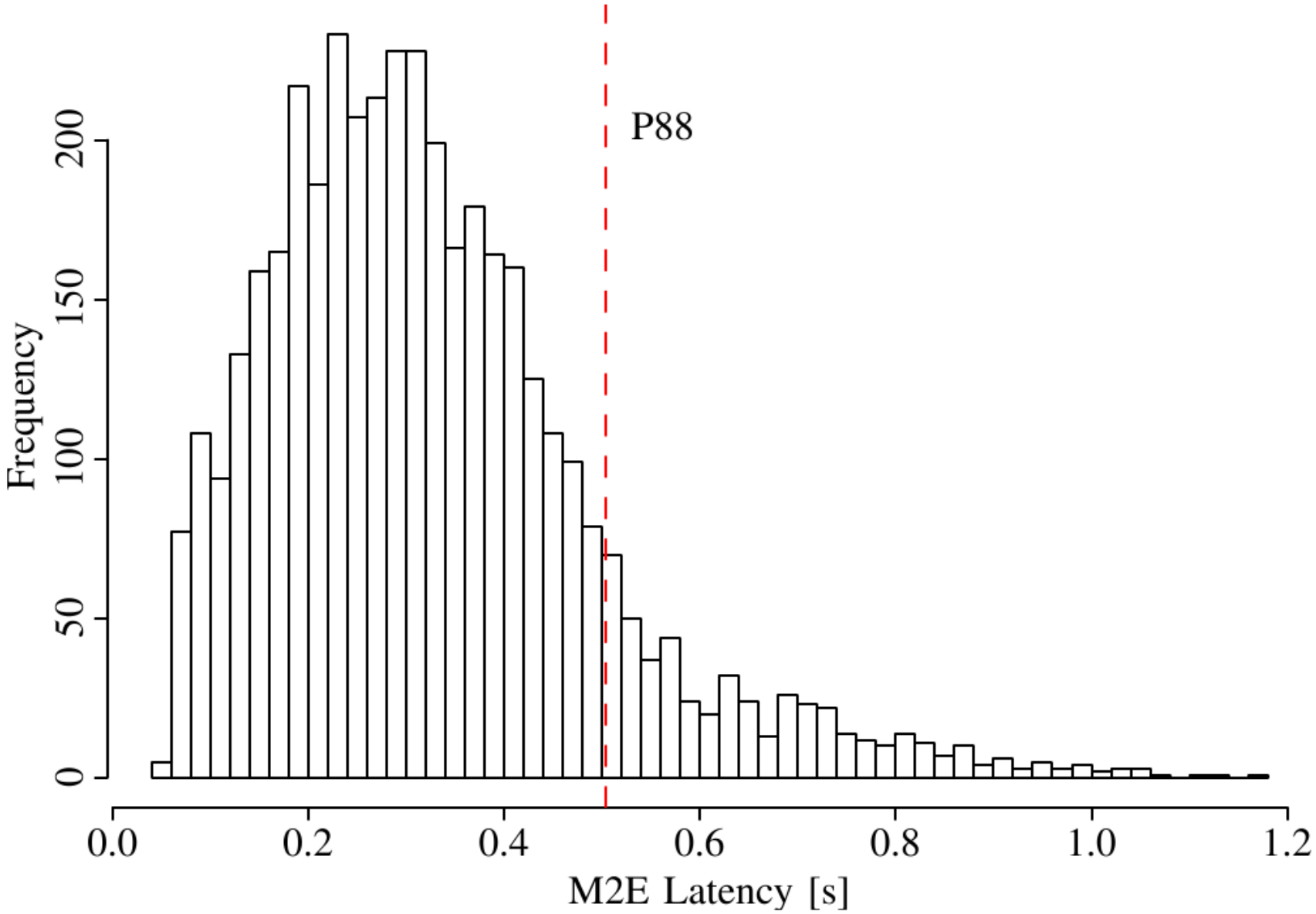
EVALUATION: Simulated Mouth to Ear Latency



DETAIL 64: Available Bandwidth



DETAIL 64: Latency Distribution



FUTURE WORK: What is missing

- Improve user clustering algorithm
- Work out node dynamics
- Verify simulation results with prototypes and field tests

- MMVEs provide a new form of communication & entertainment
- Scaling Audio Communications for MMVEs without P2P is expensive
- Hypercube Gossiping scales well with respect to latency and bandwidth requirements
- Intelligent Stable Clustering is required to map avatar positions to network positions

---

DISCUSSION