



A Robust **P**ush-**T**o-**T**alk Service for Wireless Mesh Networks

(Amir, Y., Musaloiu-Elefteri R., Rivera N.)

High Performance Computer Networks

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Instructor: Professor Uyen Trang Nguyen

Outline

- ▶ **Push-To-Talk (PTT)**
 - ▶ What is PTT?
 - ▶ Motivation behind PTT in WMNs
 - ▶ Challenges
 - ▶ System Overview

- ▶ **Push-To-Talk Protocol**
 - ▶ Architecture
 - ▶ User Interaction
 - ▶ Session Controller
 - ▶ Session Management
 - ▶ Monitoring

- ▶ **Experimental Results**
 - ▶ Testbed
 - ▶ Scenarios

- ▶ **Conclusion**

What is PTT?

- ▶ Several users can speak over a single, half-duplex, communication channel
- ▶ One user can speak at a time (**Permission-to-speak**)
- ▶ Other users listens, while one is speaking
- ▶ Often used in law enforcement and public safety communities (i.e. disaster site)

Motivation behind PTT in WMNs

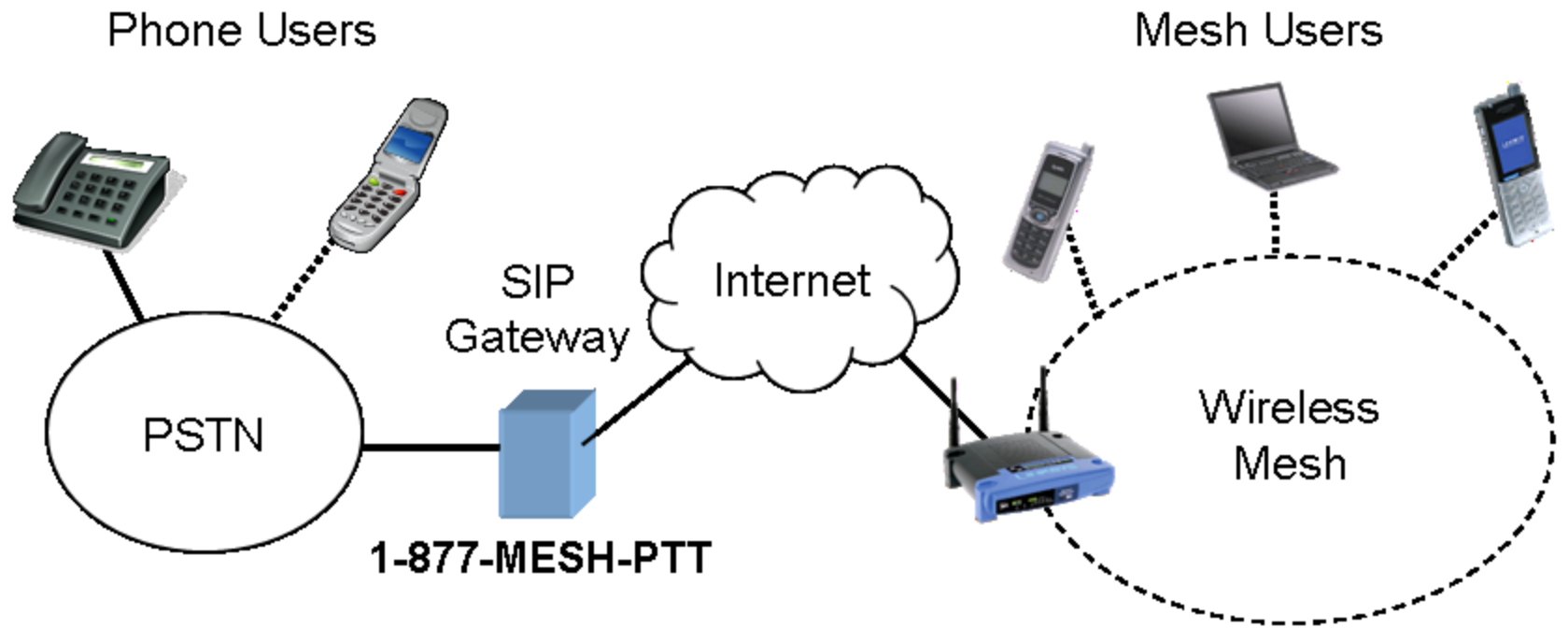
- ▶ PTT is primary usefull for **first responders**
- ▶ First responders **cannot** always rely on pre-existing ground communication infrastructure
- ▶ Wireless mesh networks allows **rapid deployment** of an instant infrastructure
- ▶ Known PTT solutions like **POC not sufficient** for more dynamic environments

Challenges

- ▶ 1. Infrastructure challenges:
 - ▶ Unavailability of infrastructure (**node crashes, i.e. centralized point**)
 - ▶ Interrupted connection between nodes (**network partitions and merges**)

- ▶ 2. Medium challenges:
 - ▶ **Efficient** use of the wireless medium
 - ▶ **Low transfer times** between users' request

System Overview



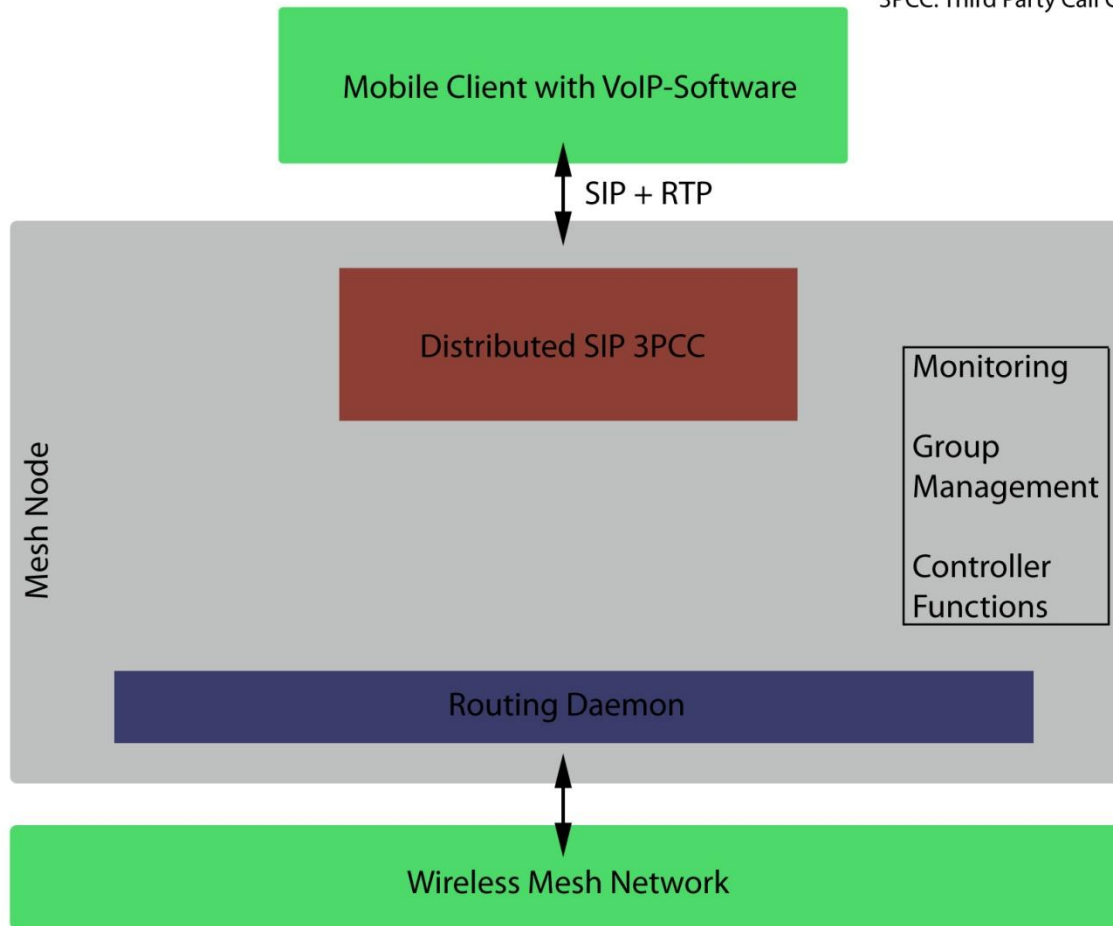
Source: [1]

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PTT Architecture

SIP: Session Initiation Protocol
RTP: Real Time Transmission Protocol
3PCC: Third Party Call Control



User Interaction

How to connect	Sip: ptt@192.168.100.1 PSTN: 1-877-MESH-PTT
How to join a group	Type #12#
How to request to speak	Type 5
Permission-to-speak Notification	„ beep-beep “ audio signal

Session Controller

- ▶ Each Group is managed by **one** controller
- ▶ **Main Task:** Floor Management
- ▶ **Initiation of a controller:**
 - ▶ First step: Node with the lowest IP address
 - ▶ Second step: select a mesh node in the center of a group (according to the PTT group members location)
 - ▶ Increased Performance
 - ▶ Increased Availability

Session Management

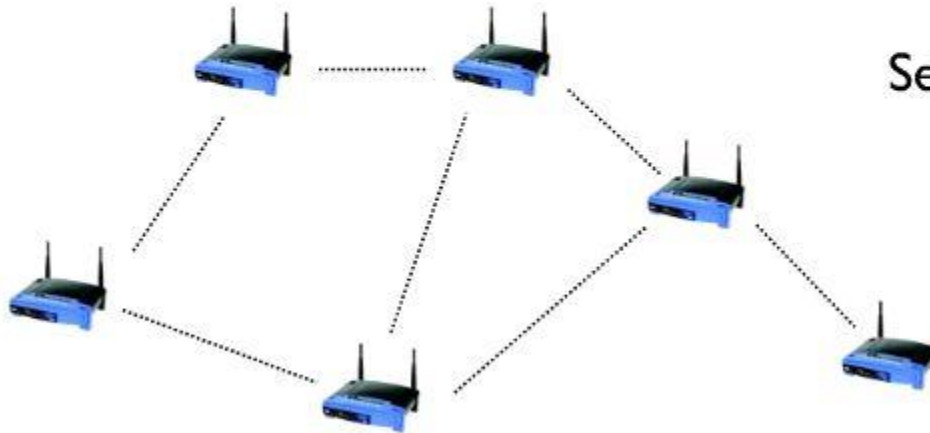
- ▶ Usage of multicast groups to manage the client and the PTT sessions (overlay multicast groups)
- ▶ Types of Groups:
 - ▶ **Control Group**: Share client state information
 - ▶ **Controller Group**: Managing the floor
 - ▶ **Monitoring Group**: Monitoring the Controller
 - ▶ **Data Group**: Deliver actual voice data to clients

Session Management

Client management



Session management



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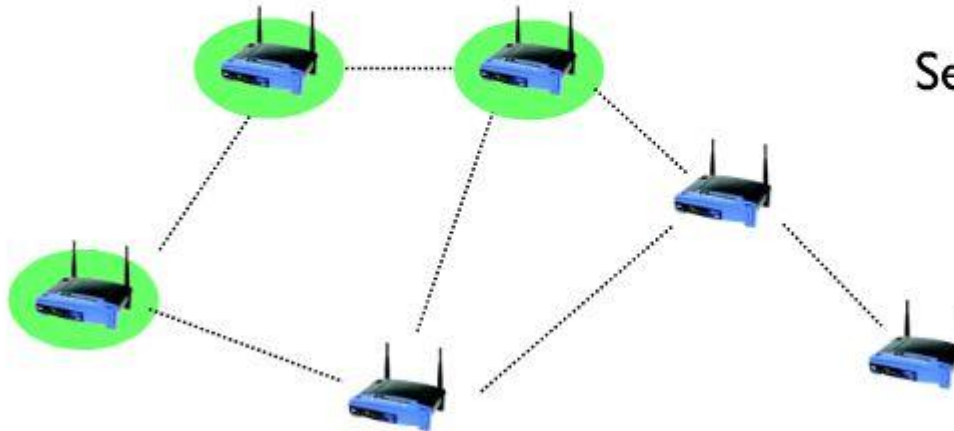
Session Management



Client management

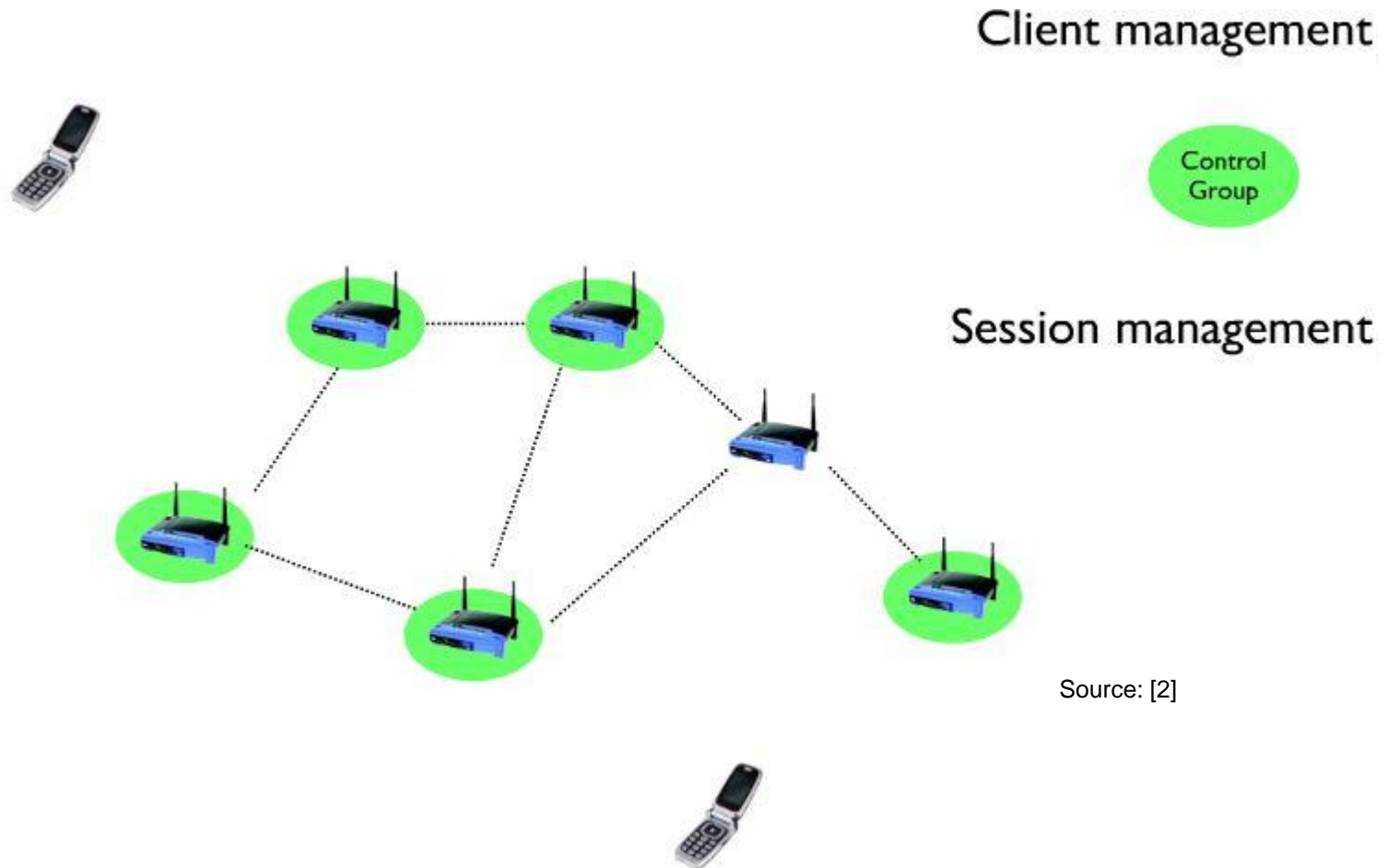


Session management

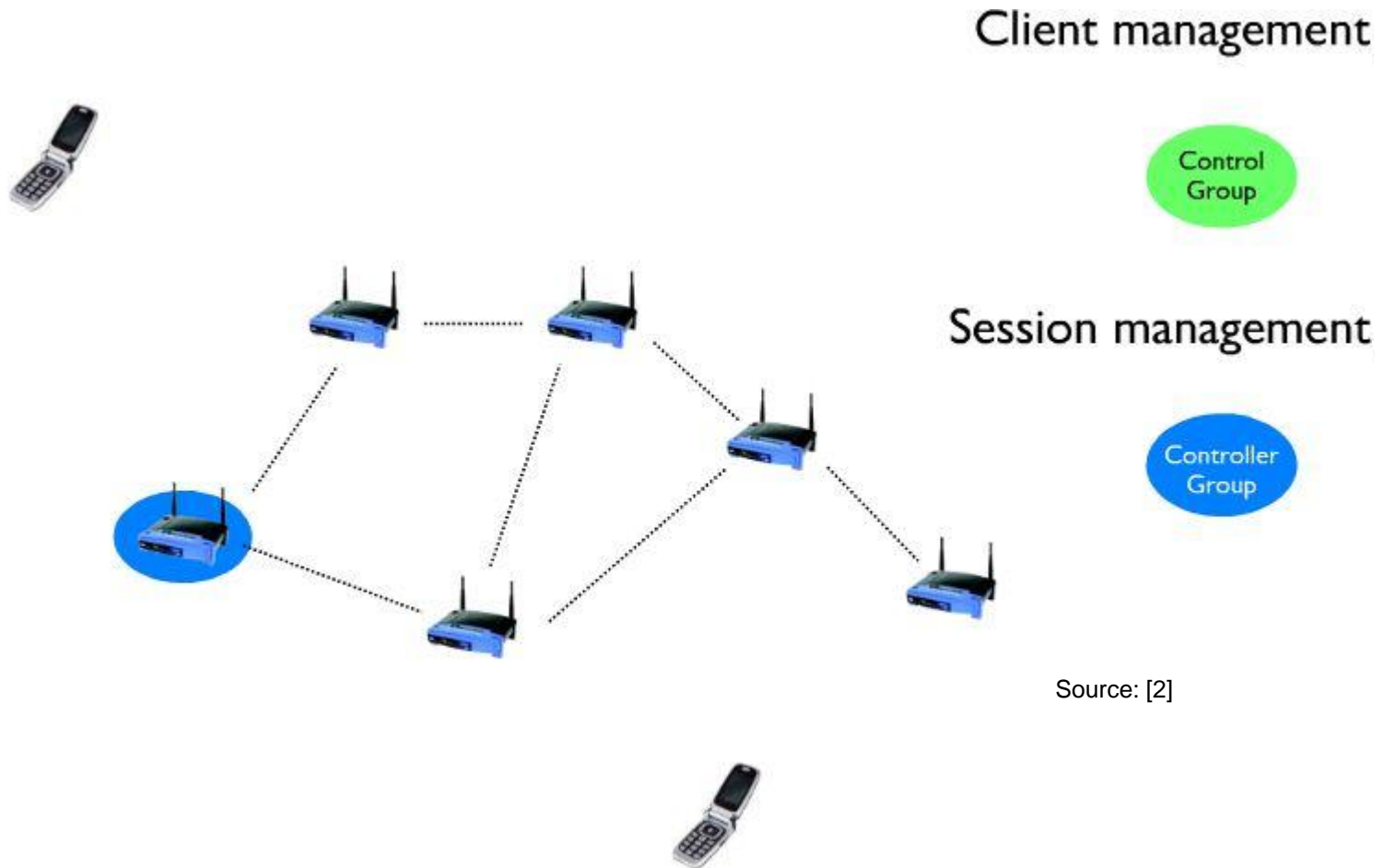


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Session Management

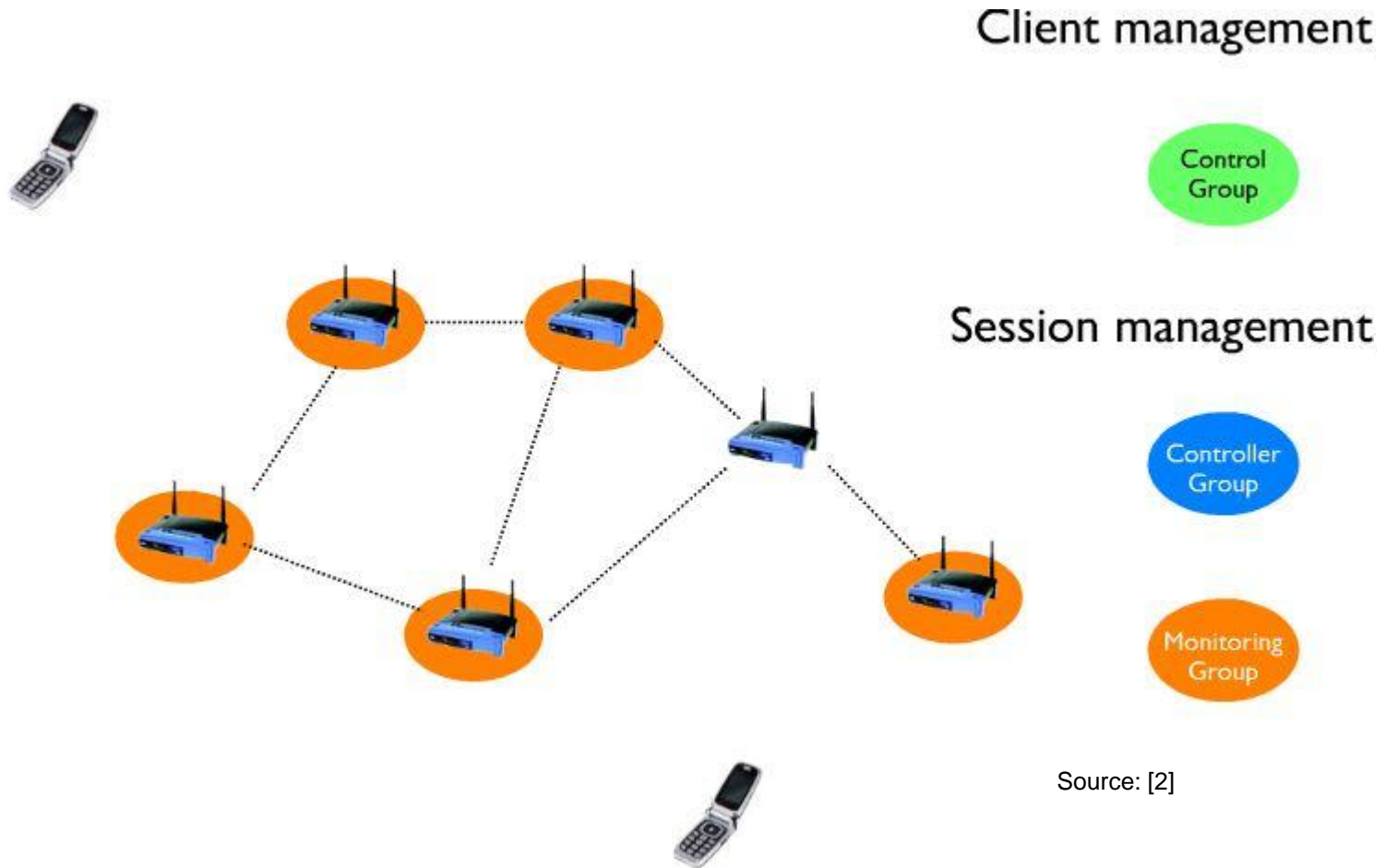


Session Management

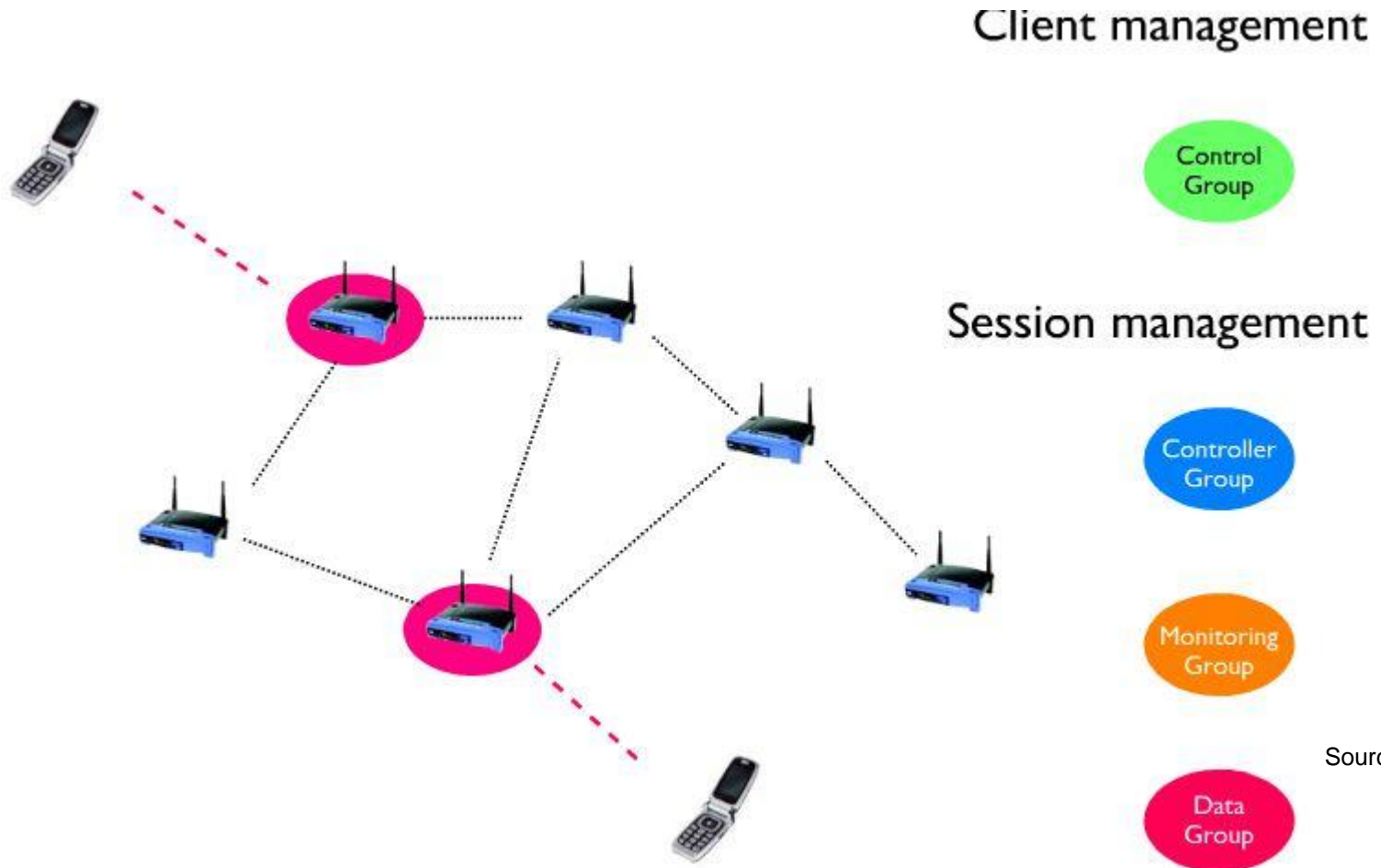


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Session Management

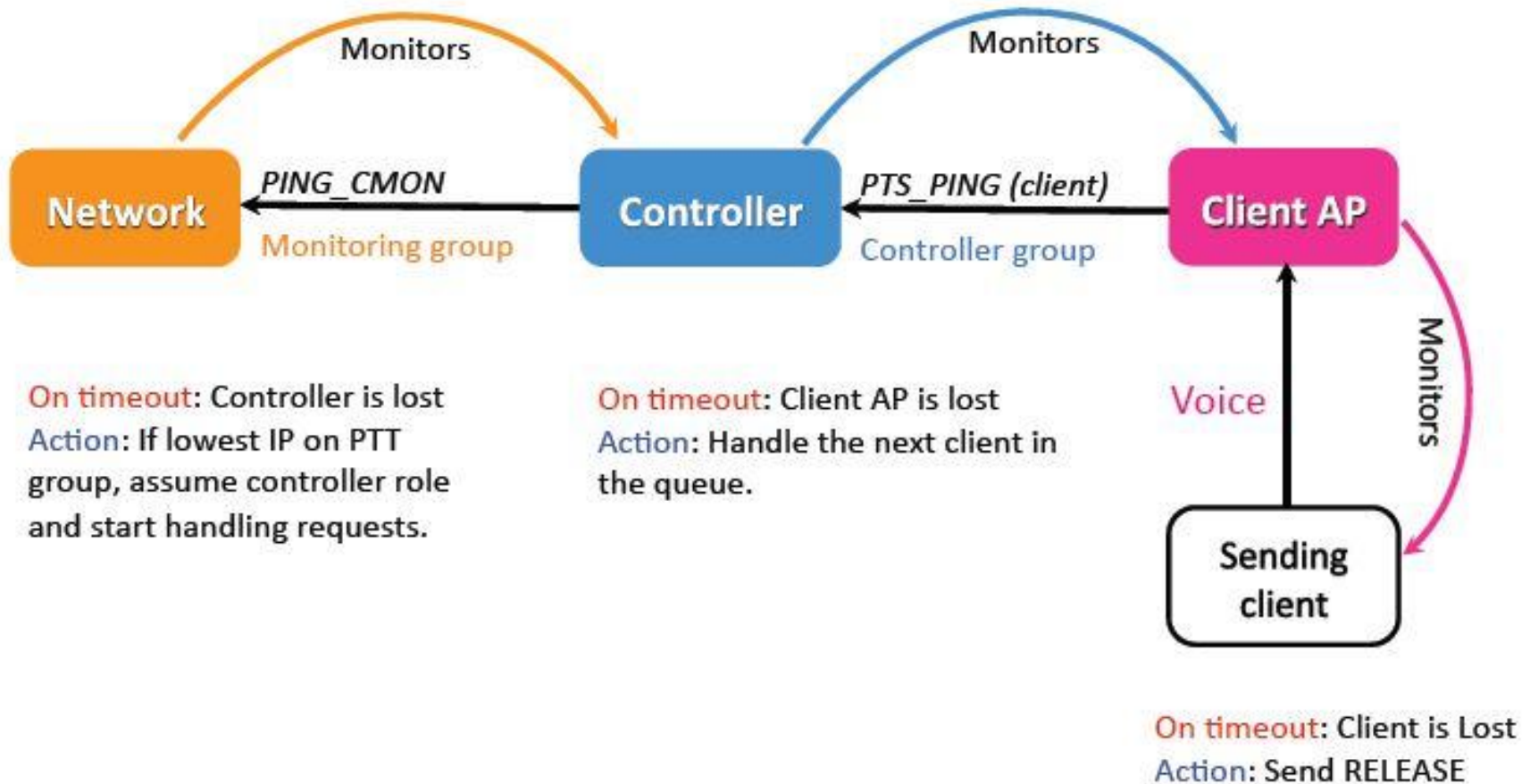


Session Management



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Monitoring

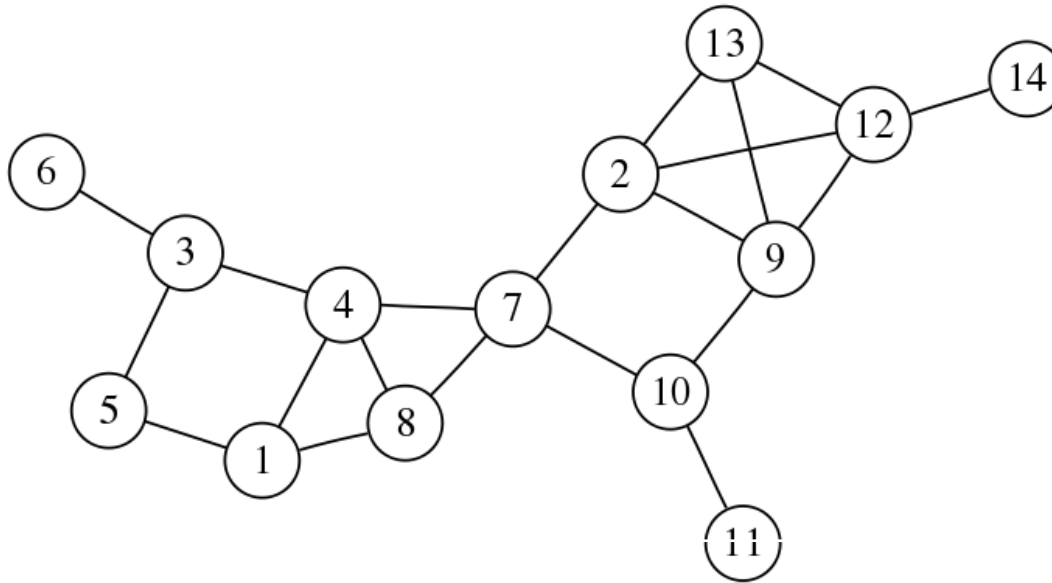


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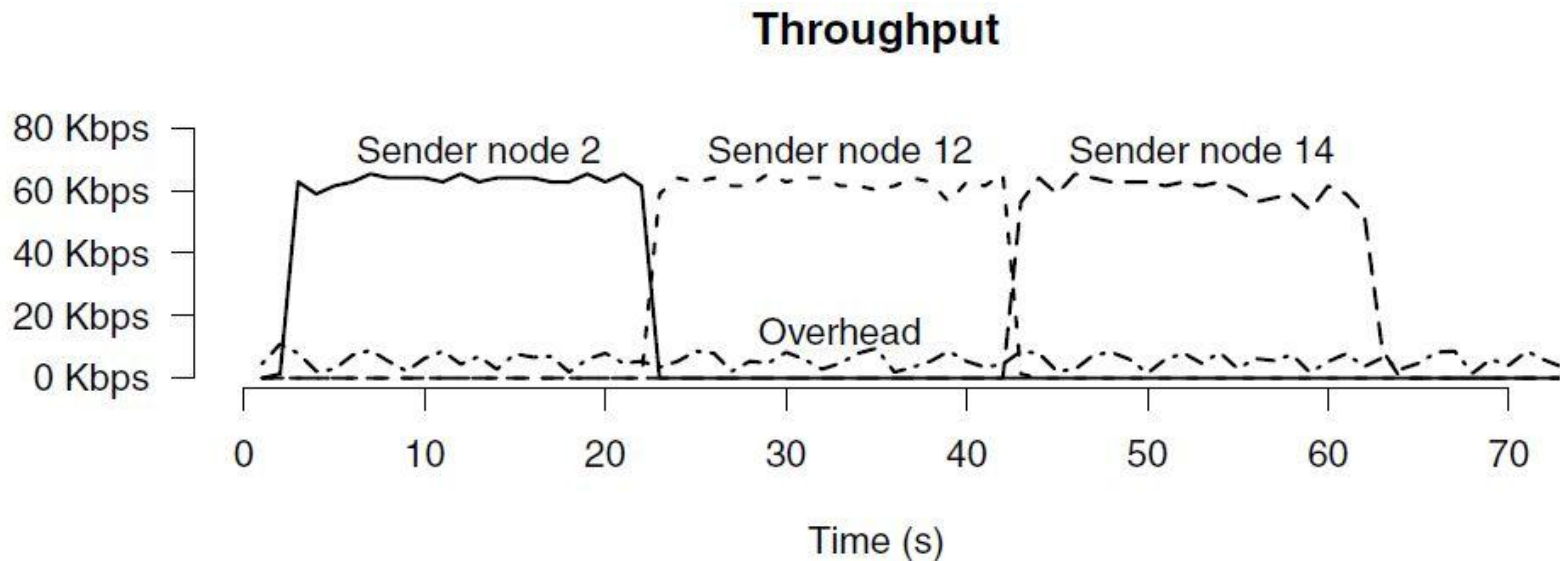
Testbed



Source: [1]

Rate	18Mbps
Transmission Power	50mW
VoIP Stream	64Kbps
Nodes	14
Router	WRT54G

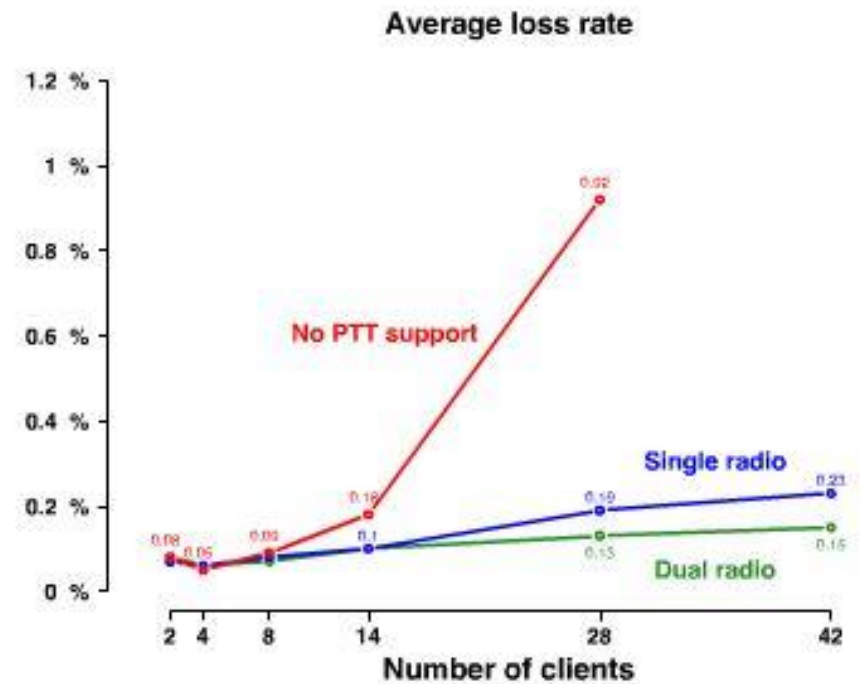
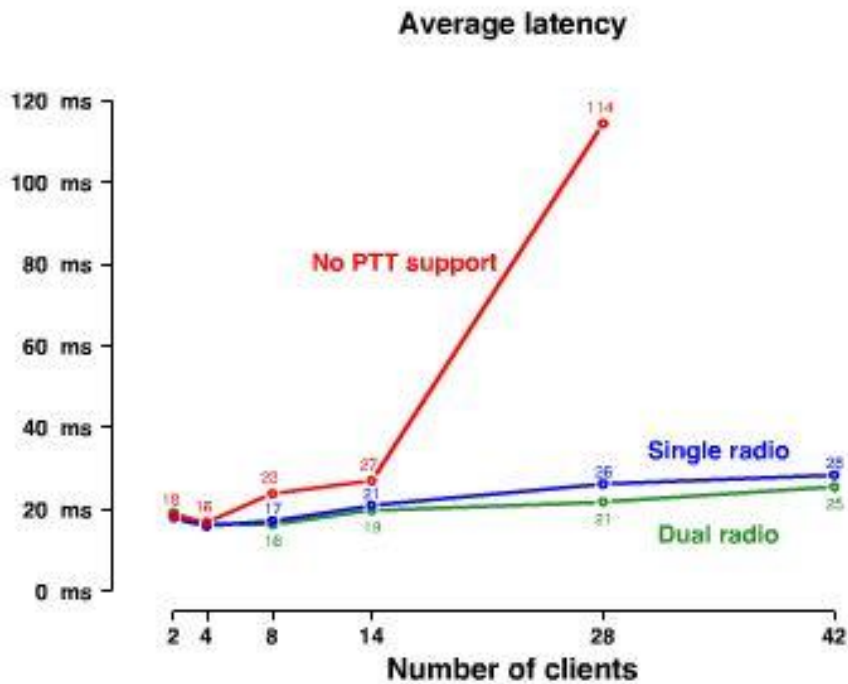
Normal Operation Scenario



Source: [1]

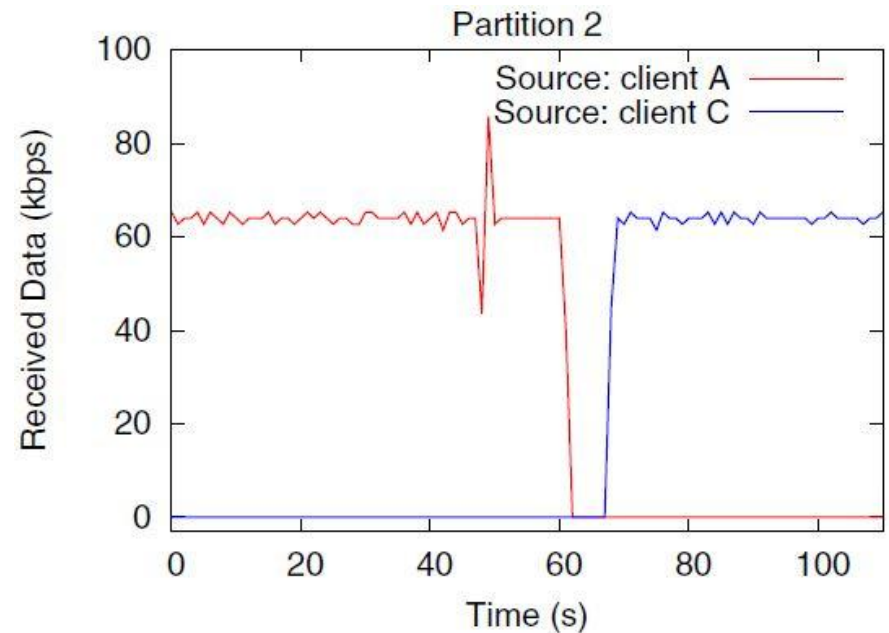
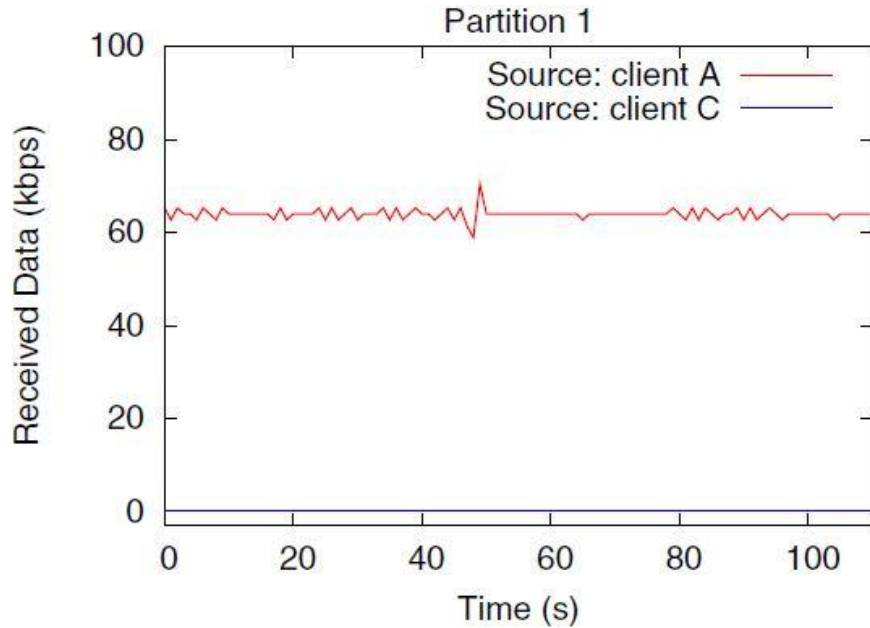
- ▶ Normal Operation
 - ▶ 4 Clients on one PTT Group
 - ▶ Switch Latency: ~ 140ms
 - ▶ Average Overhead: 3,4 Kbps

Scalability Scenario(# of Clients)



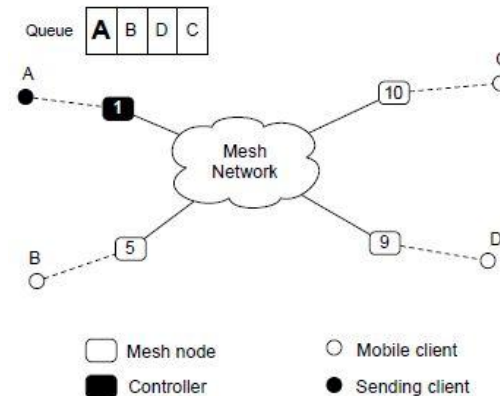
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Partition Recovering Scenario

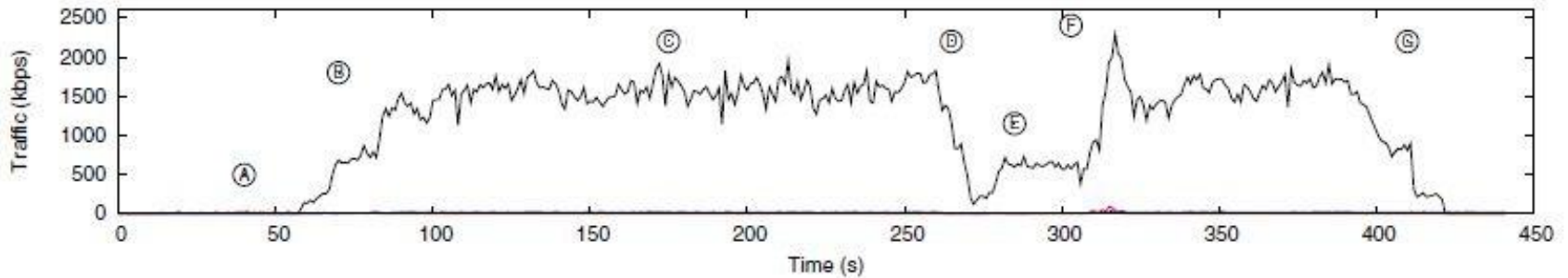


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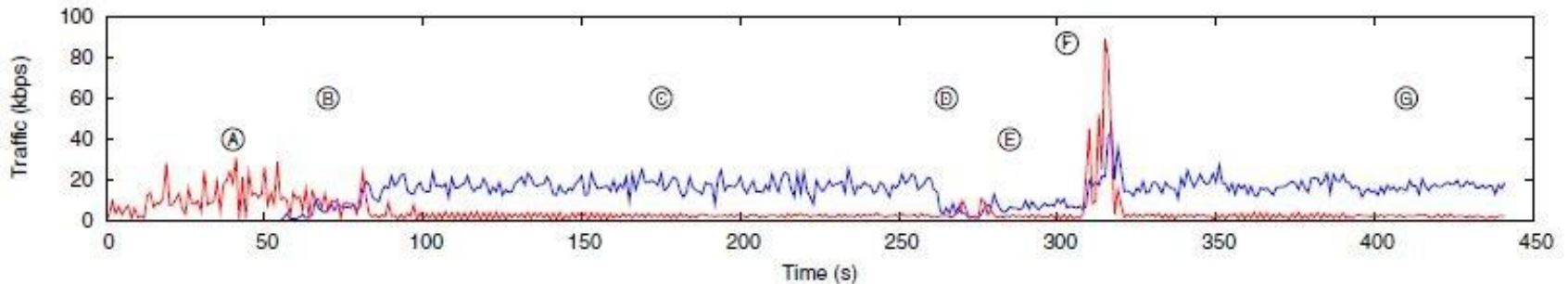
- ▶ Network Partitioning
 - ▶ 4 Clients on one PTT Group
 - ▶ Recovery: **~ 7s**



Large Case Scenario



(a) Data and overhead traffic.



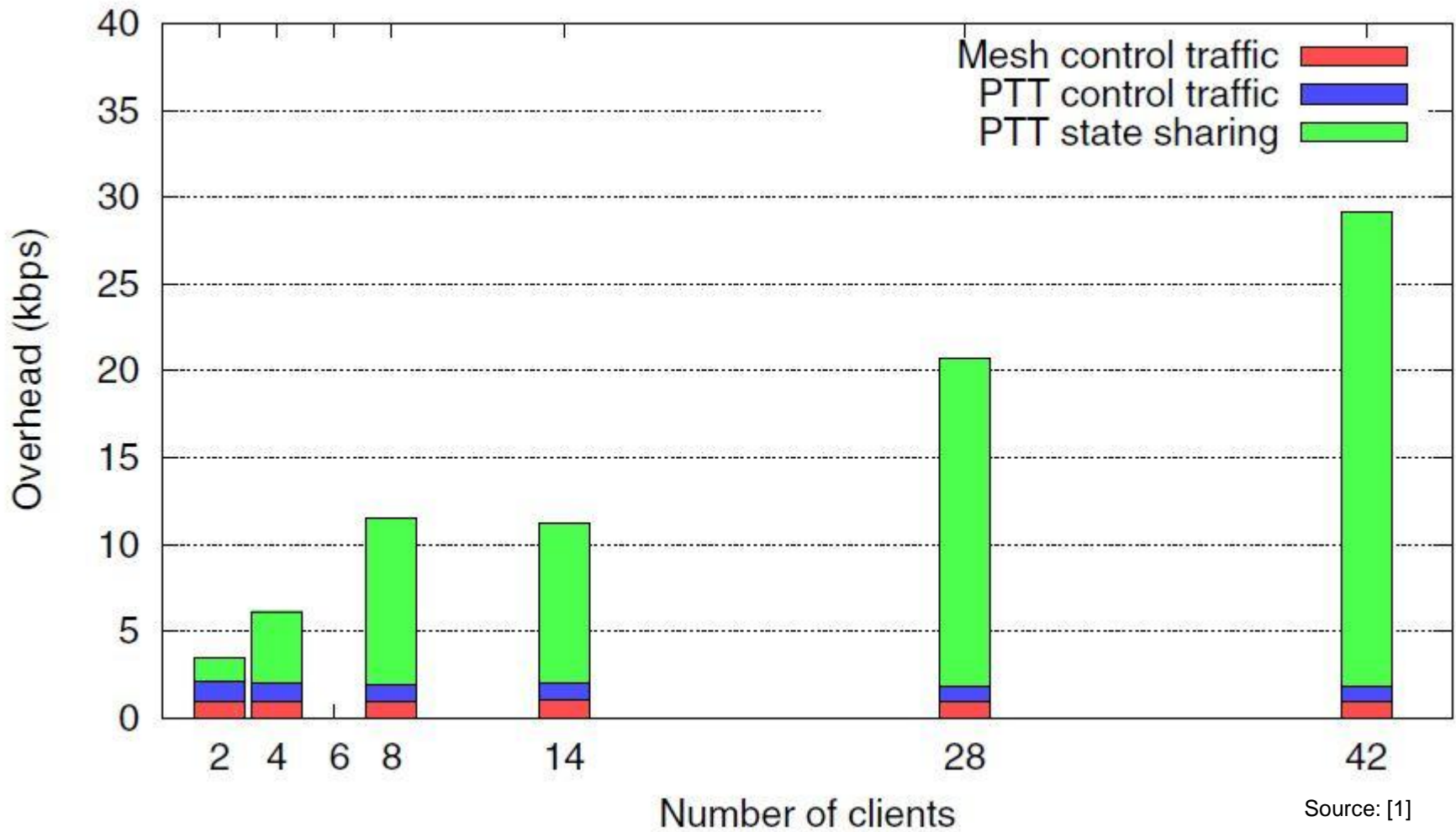
(b) Overhead traffic.

Source: [1]

Data —
 PTT control traffic —
 Routing control traffic —

Clients	40
Nodes	14
PTT Groups	10

Protocol Overhead



Conclusion

- ▶ **High-throughput** and **fast handoff** PTT Service for wireless mesh networks
- ▶ A **robust** PTT Service in WMNs against node failure, network merges and network partitioning
- ▶ Based on **off-the-shelf** routers
- ▶ **Seamless** architecture

Thank you for your attention.



References

- ▶ [1] Amir, Y., Musaloiu-Elefteri R., Rivera N., *A Robust Push-To-Talk Service for Wireless Mesh Networks*, IEEE, 2010
- ▶ [2] *Practical Wireless Mesh Networks and Their Applications*