The MAC Protocols for Wireless Sensor Networks

Speaker: Cheng-Han Wu

Outline

- S-MAC
- D-MAC
- Performance Evaluation
- Conclusion
- Discussion

S-MAC

- 2002

1. Periodic Listen and Sleep
2. Collision and overhearding Avoidance
3. Message Passing

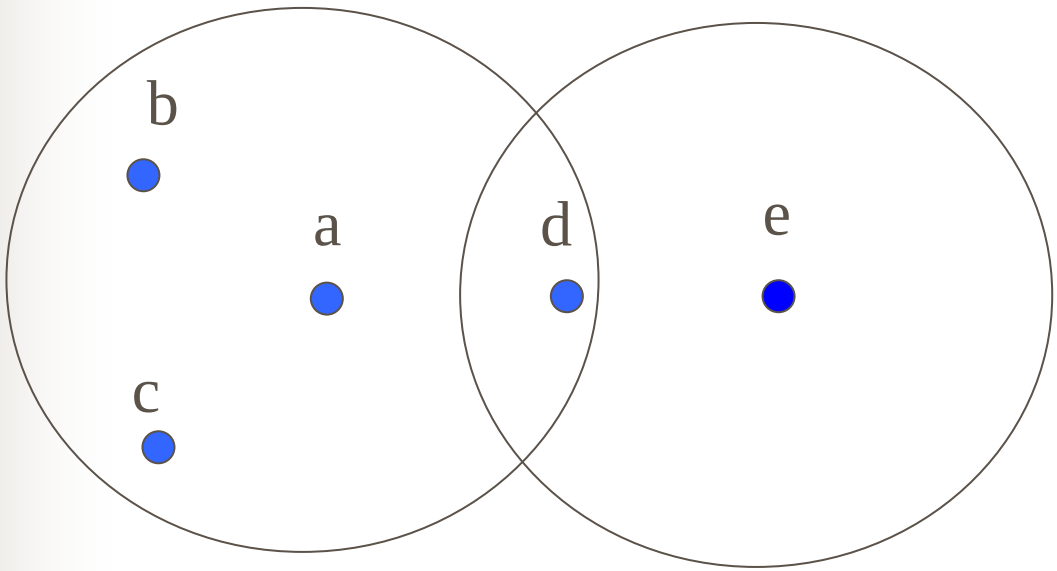
- 2004

1. Periodic Listen and Sleep
2. Collision and overhearding Avoidance
3. Message Passing
4. Periodic neighbor discovery
5. Adaptive listening

Why do we need periodic neighbor discovery?

Periodic Listen and Sleep

- Step1:synchronizer
- Step2:follower
- Step3:border

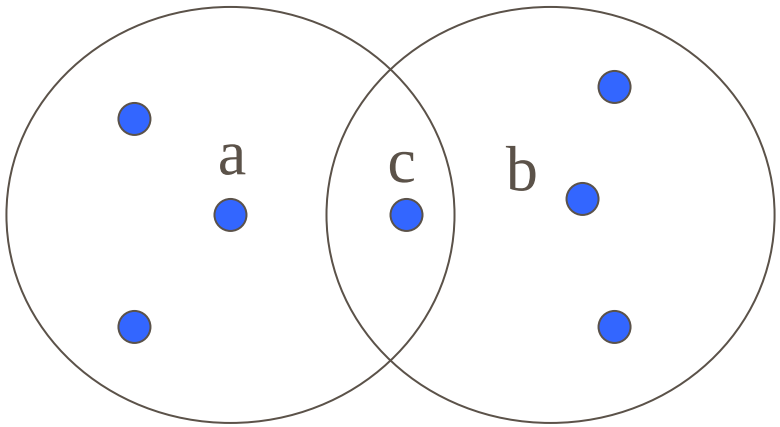


a: synchronizer

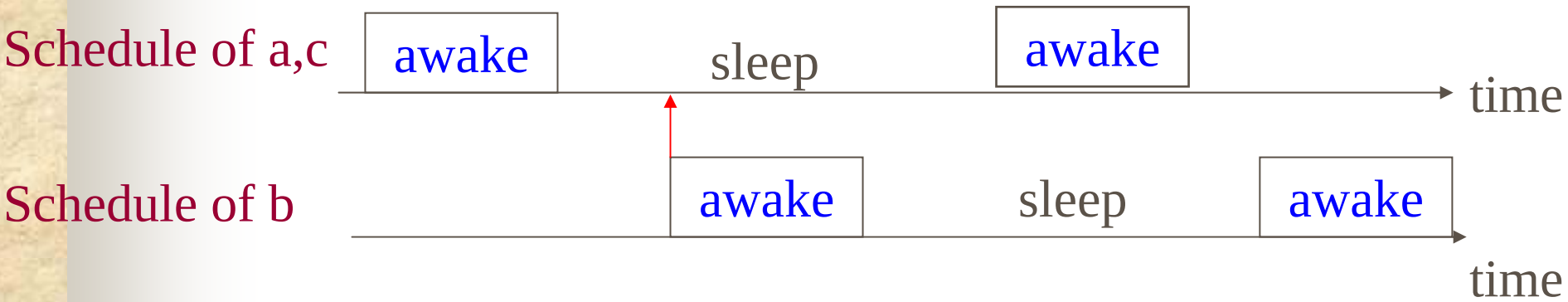
b,c,d: follower

d: border

The problem results from the above three steps



a,b:synchronizer

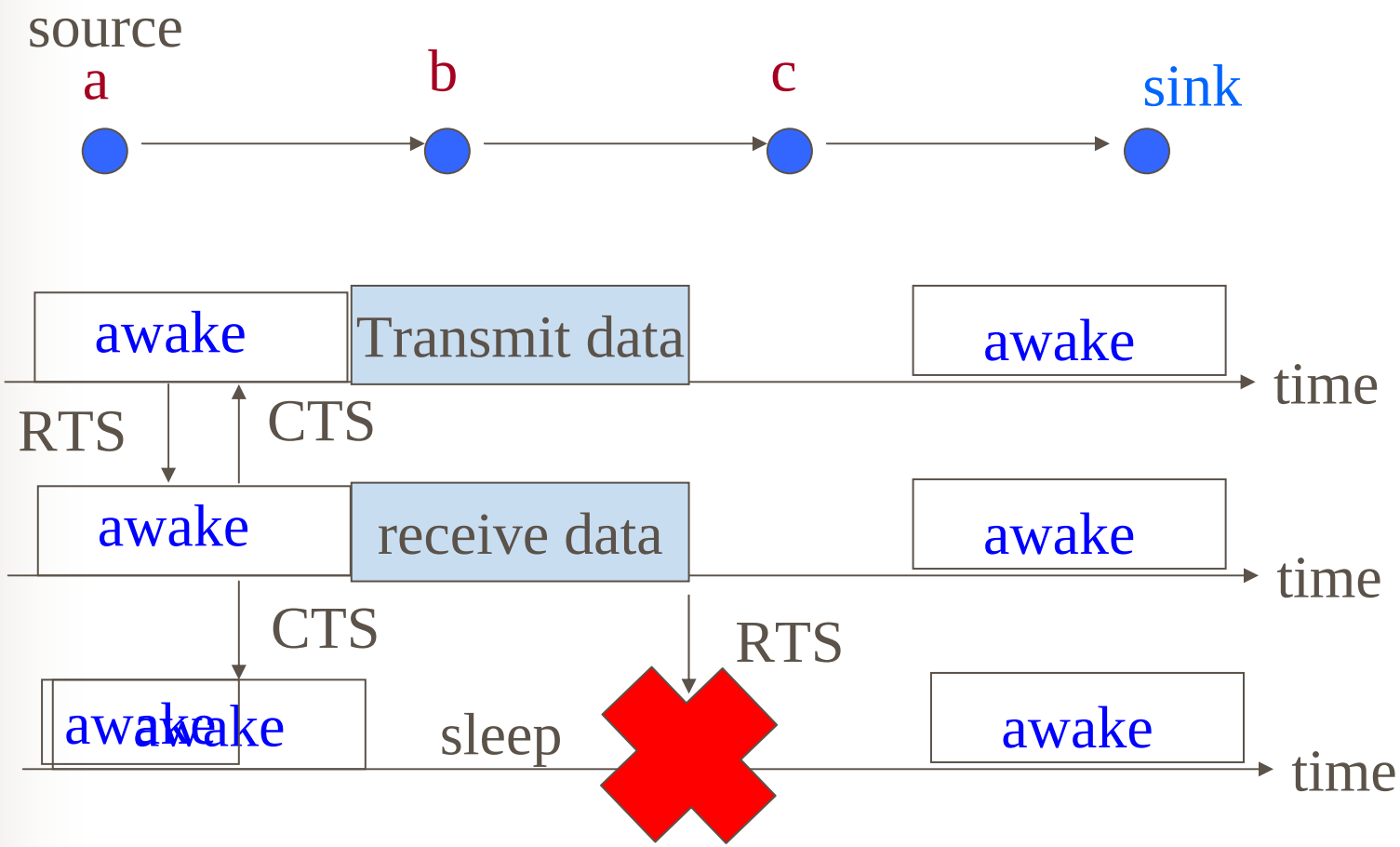


Periodic Neighbor Discovery

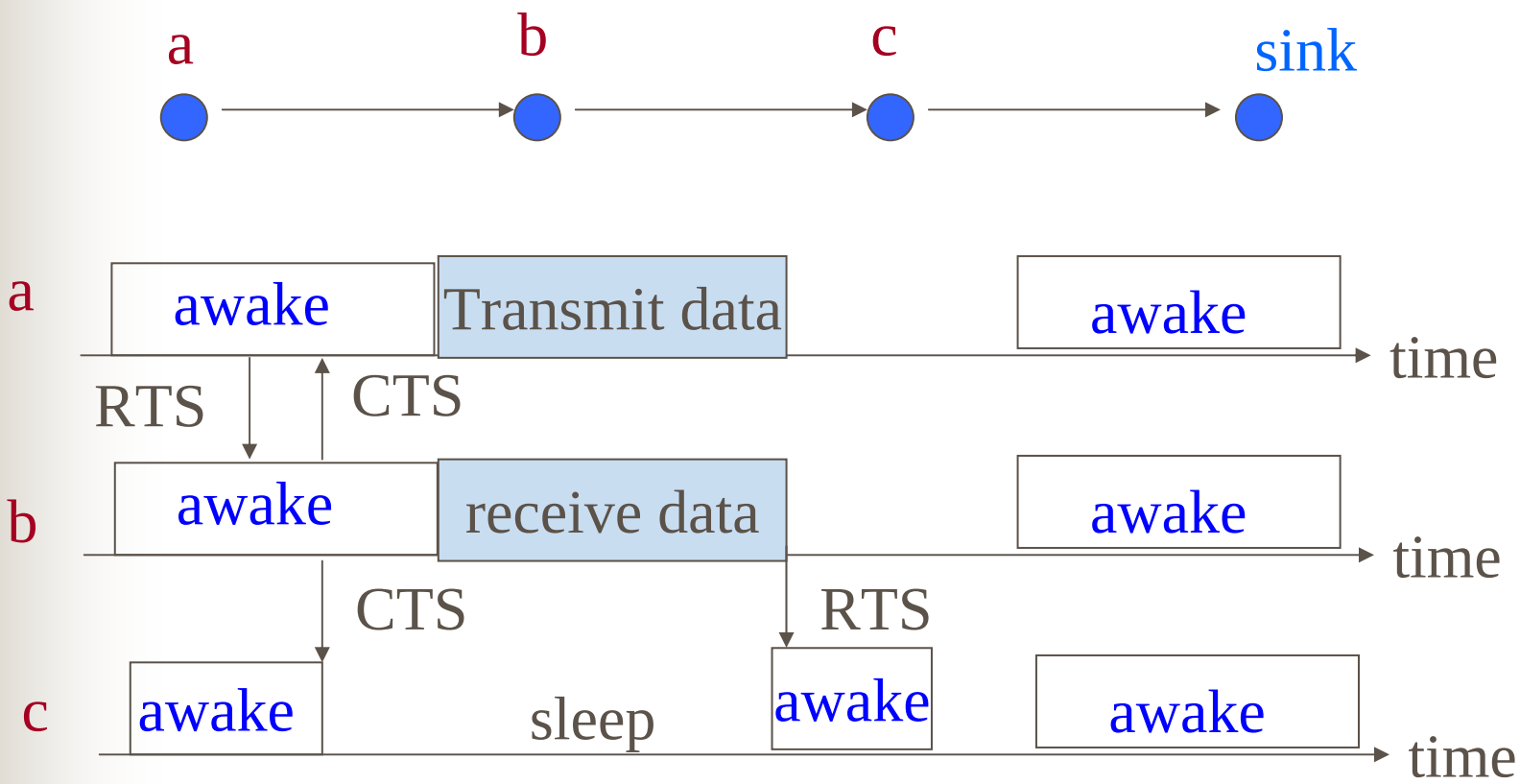
- Each node will periodically listen for the whole period that is 10s.
- In our current implementation, a node performs neighbor discovery every 2 min if it has at least one neighbor.(the frame length is 1.15s and listen interval is 0.115s)
- The frequency with which a node performs neighbor discovery depends on the number of neighbors it has.

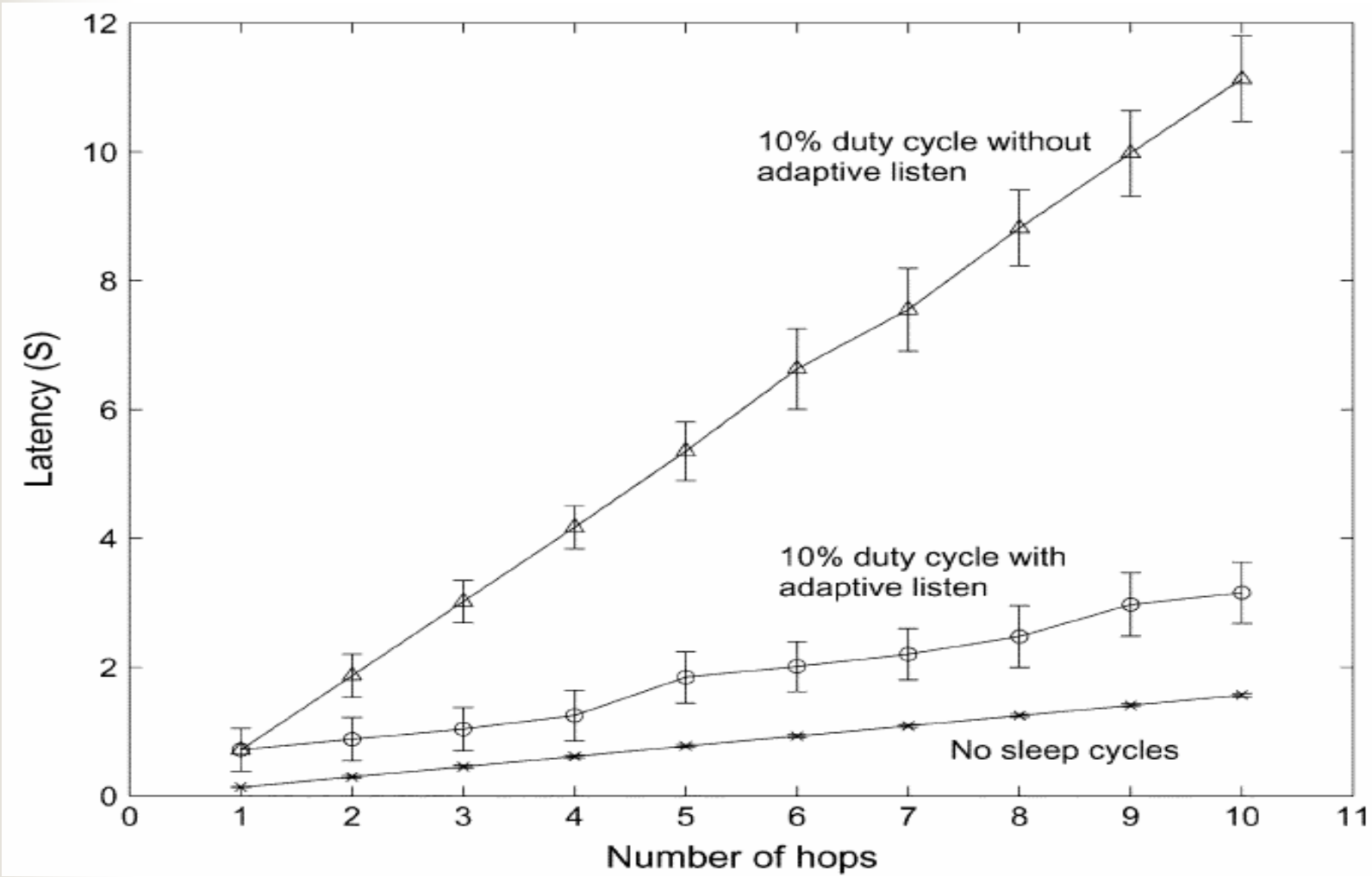
Adaptive Listening

Why do we need adaptive listening?



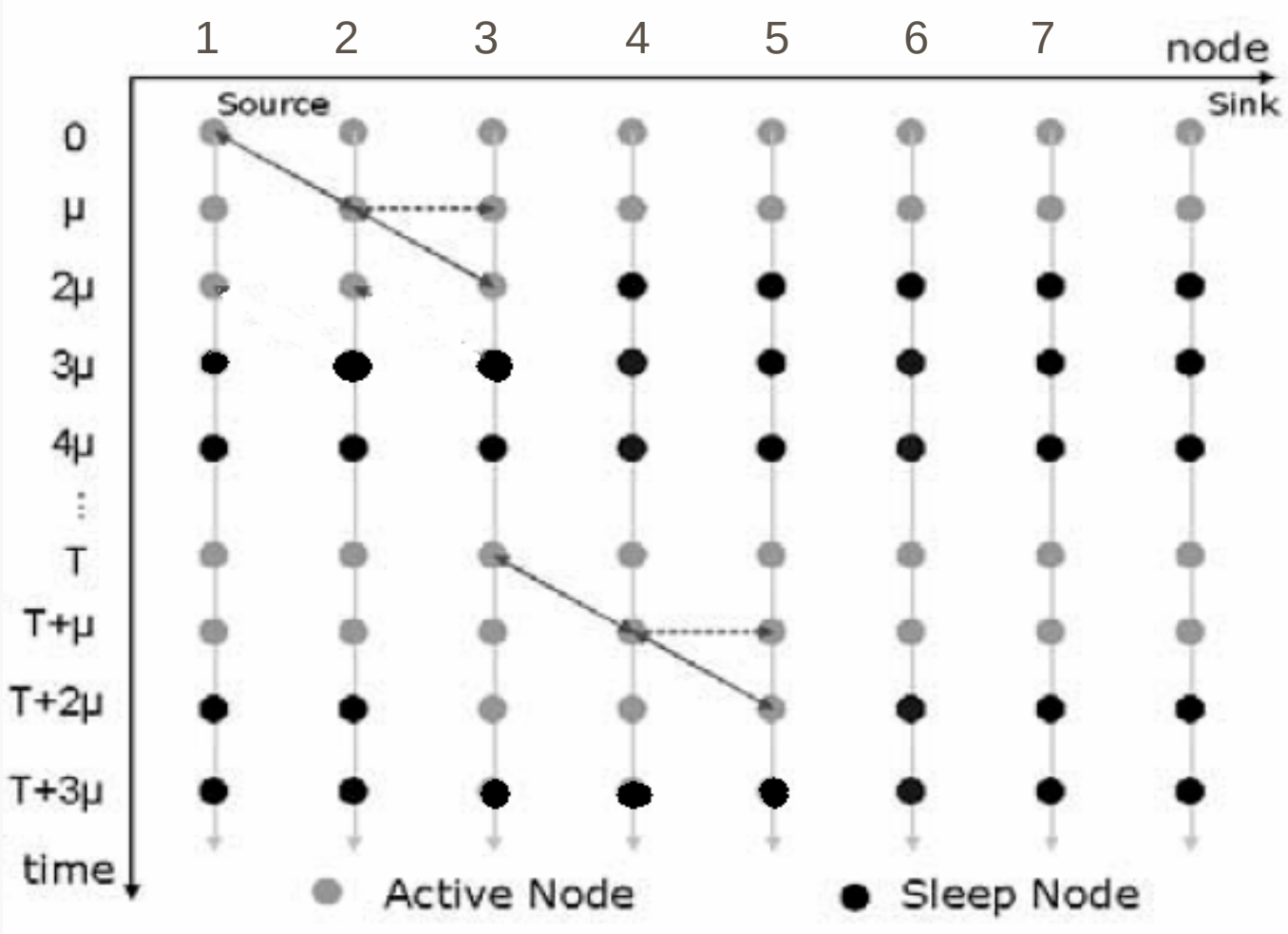
Adaptive Listening




Latency (S)
Number of hops
10% duty cycle without adaptive listen
10% duty cycle with adaptive listen
No sleep cycles
0
2
4
6
8
10
12
0
1
2
3
4
5
6
7
8
9
10
11

D-MAC

The problem of S-MAC is latency



D-MAC

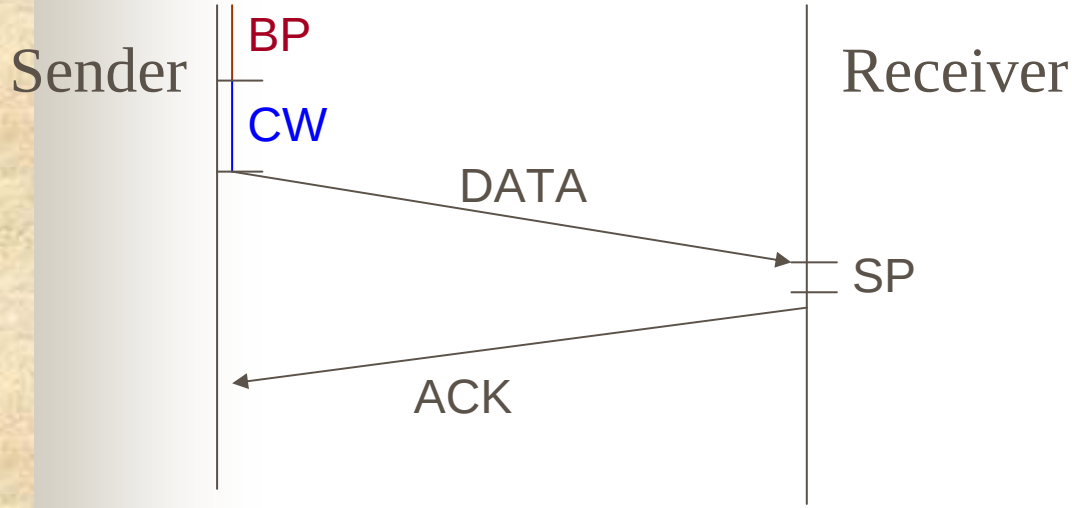
- Staggered Wakeup Schedule
- Duty cycle adaptation in multihop chain
- Data Prediction
- More-to-send packet

Assumption

- We assume that sensor nodes are fixed without mobility and that a route to the sink is fairly durable.

Message Passing

- We don’t use the RTS/CTS control packets.



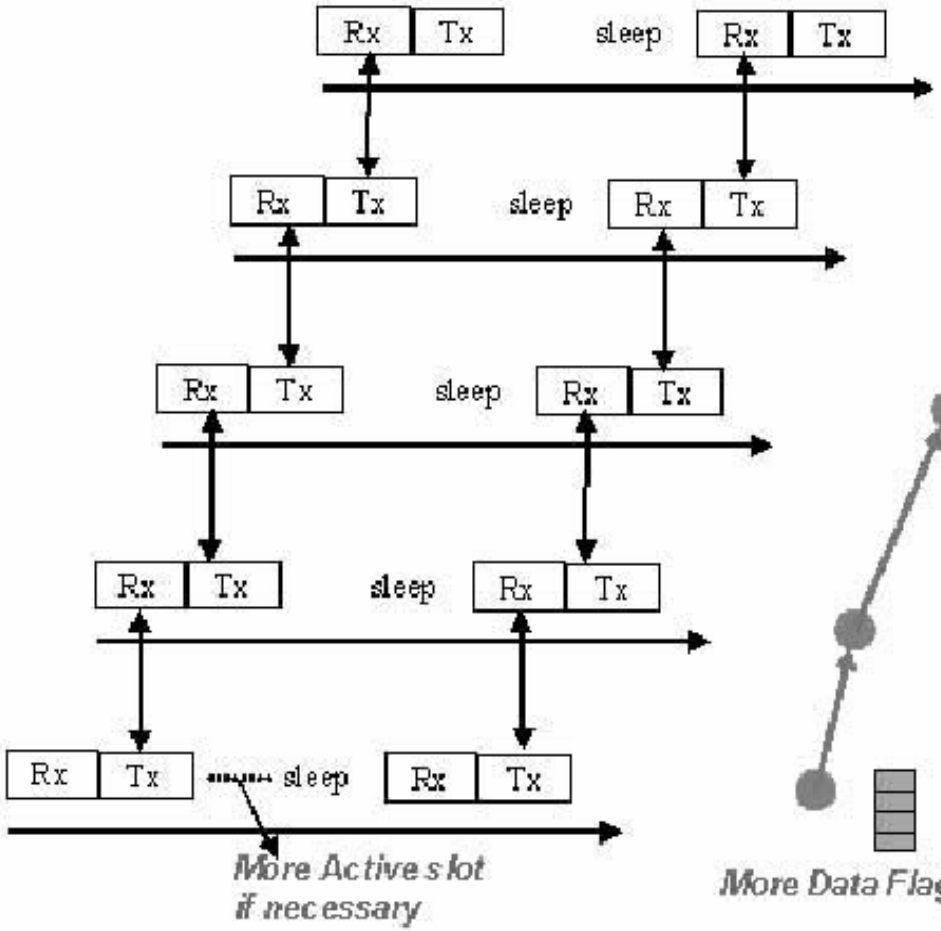
BP:like DIFS
CW:Contention Window
SP:like SIFS

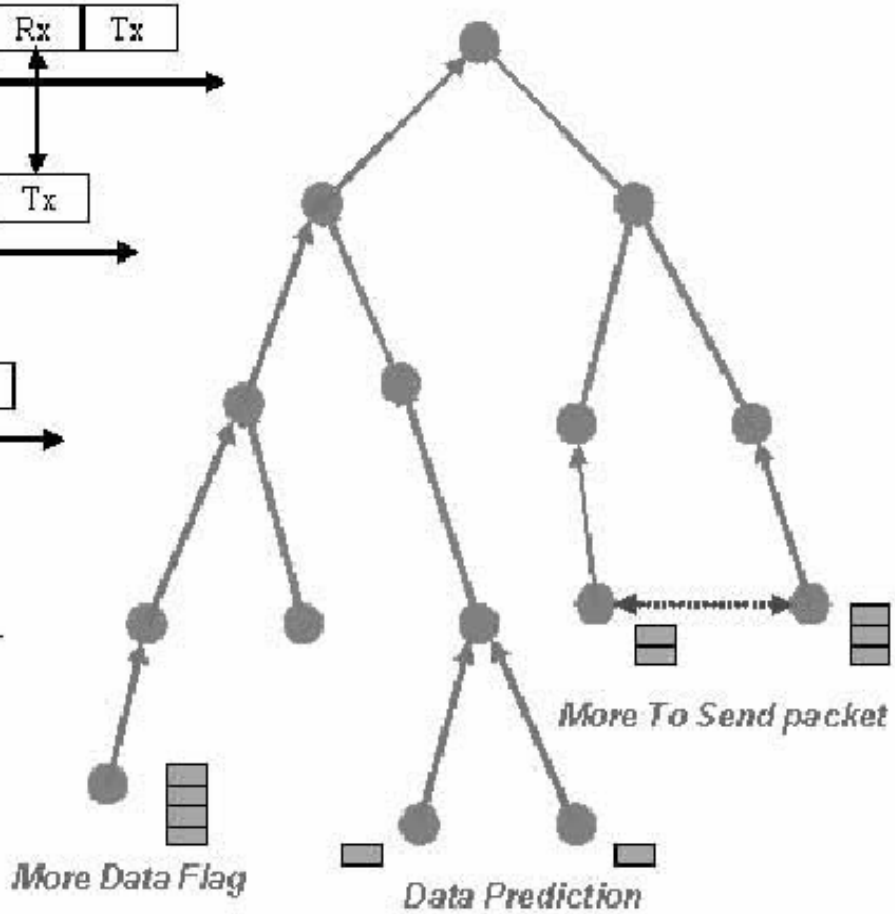
- We define the slot μ

$$\mu = BP + CW + DATA + SP + ACK$$

- In our implementation,slot μ is set to 10 ms.

Staggered Wakeup Schedule

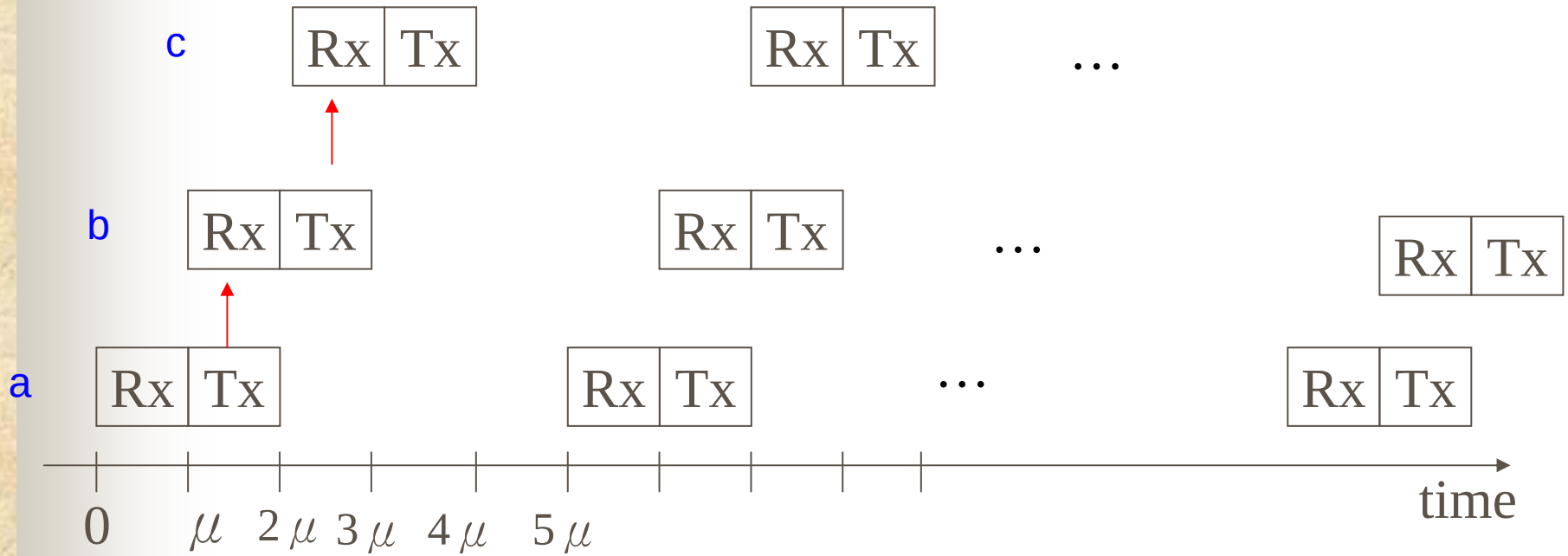




Data gathering tree

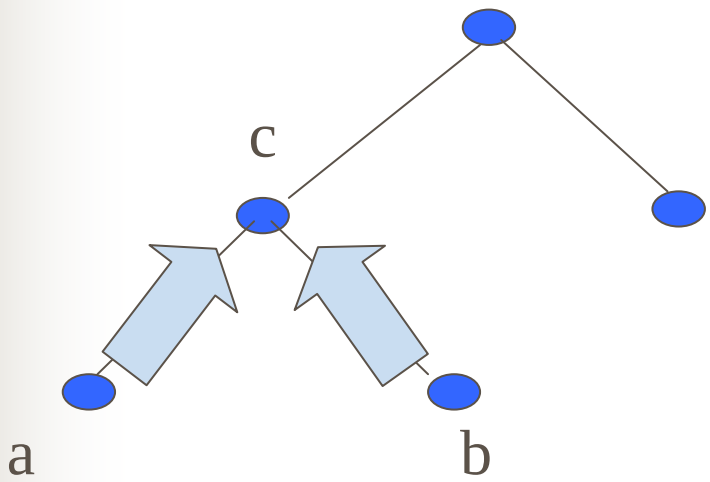
Duty cycle adaptation in multihop chain

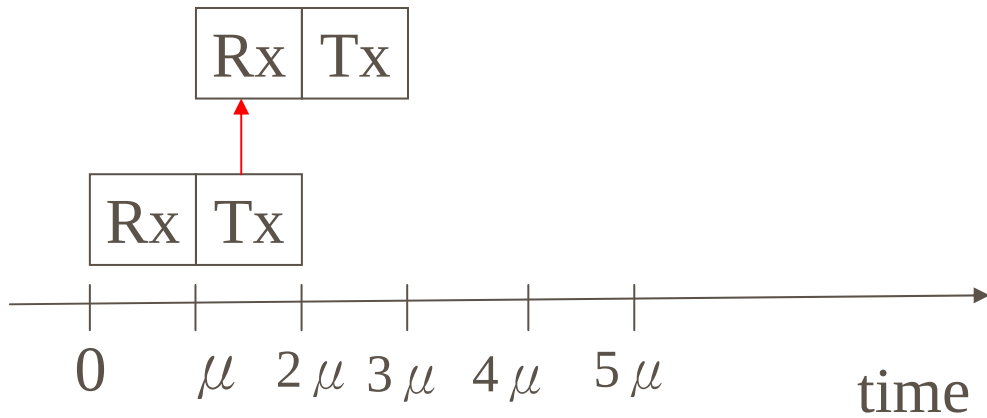
- We add a *more data* flag in the MAC header.



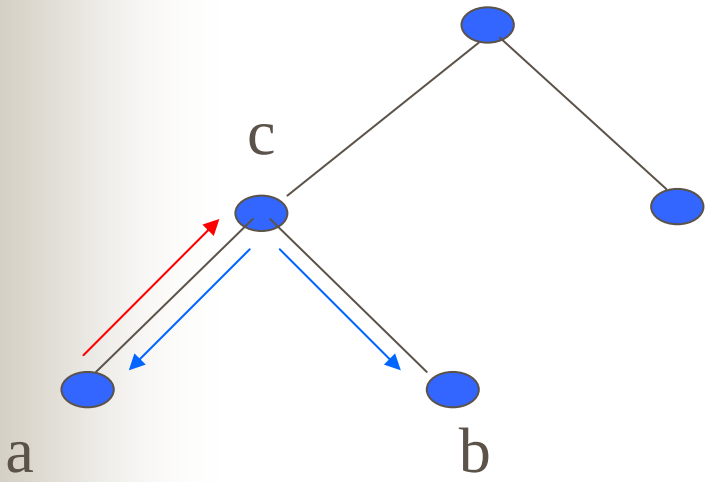
Data Prediction

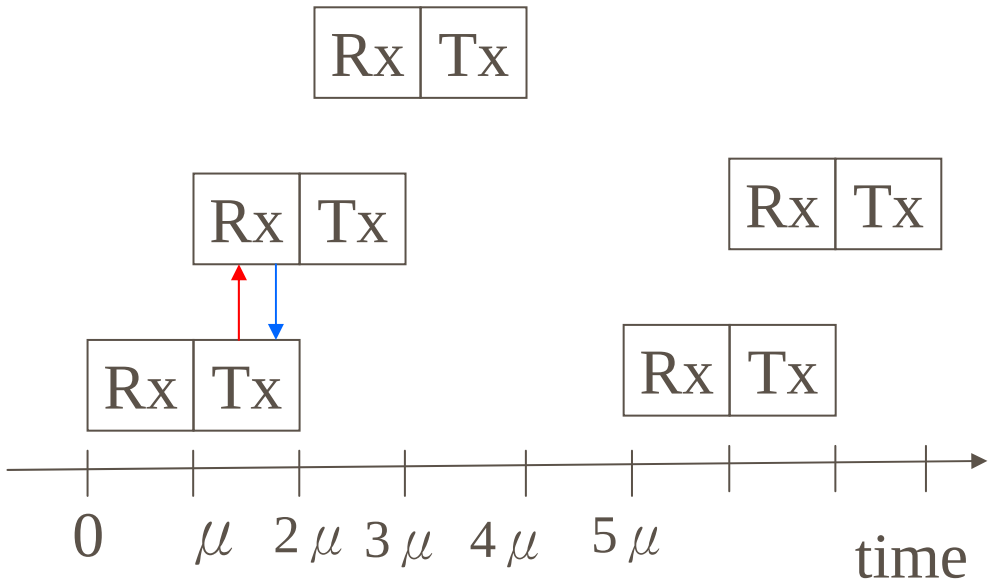
Why do we need data prediction?





Data Prediction

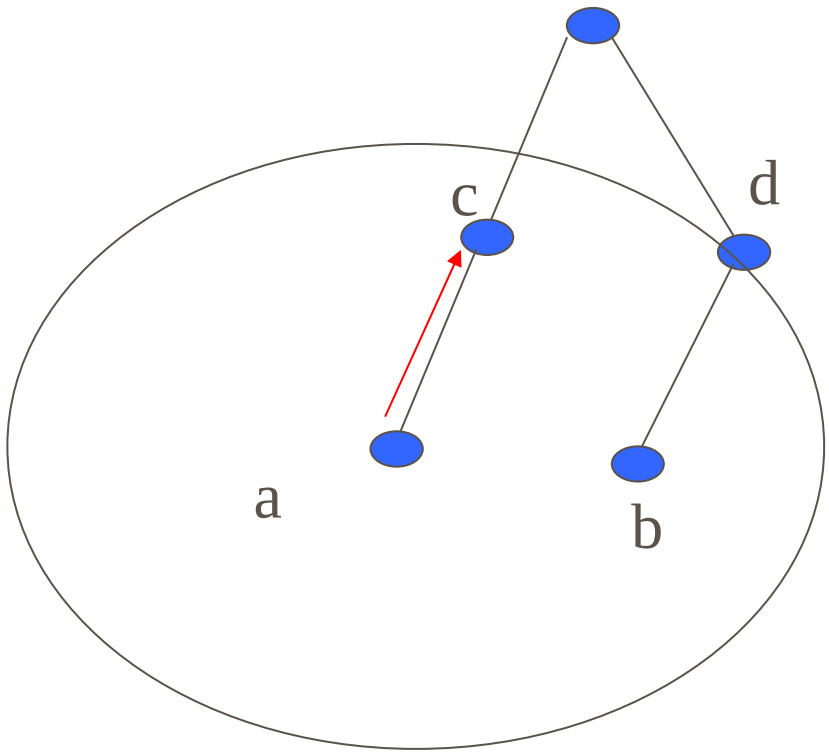




ACK

More-To-Send Packet

Why do we need more-to-send packet?

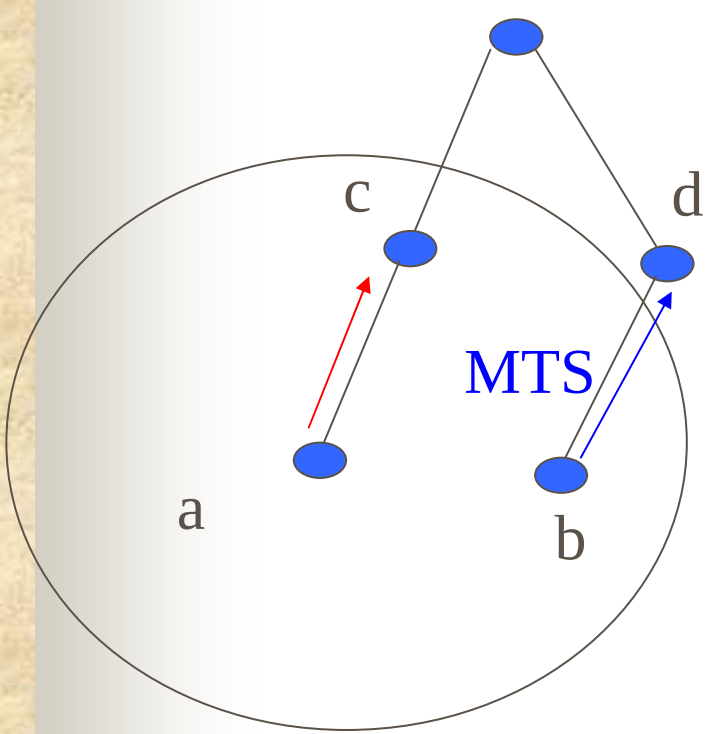


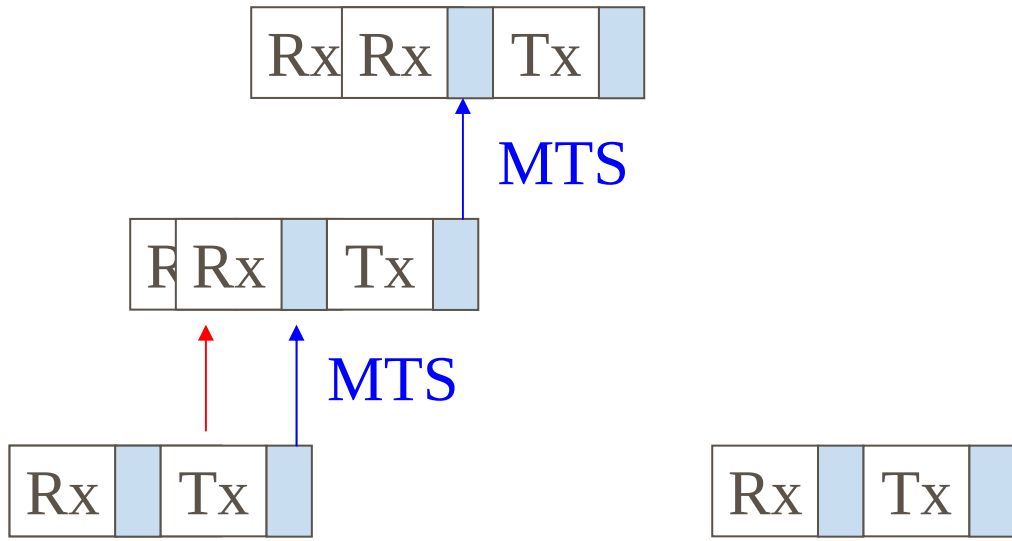
More-To-Send Packet

- MTS(More-To-Send) packet is very short with destination's local ID and a flag.
- A MTS packet with flag set to 1 is called a request MTS.A MTS with flag set to 0 is called a clear MTS.
- A node which sends or receives a request MTS will keep waking up periodically every 3 μ .

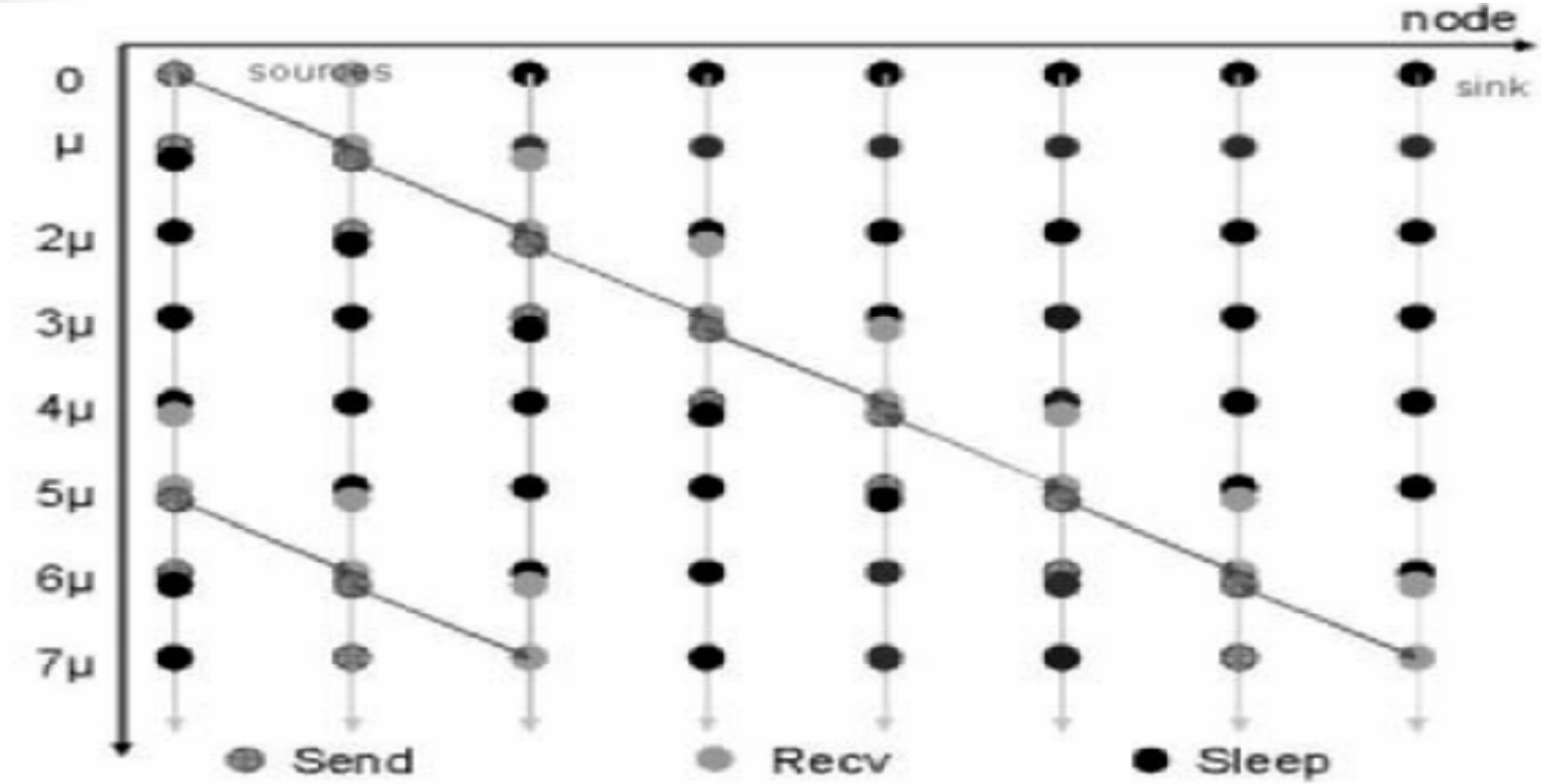
More-To-Send Packet

- We use the new slot μ that is bigger than normal.





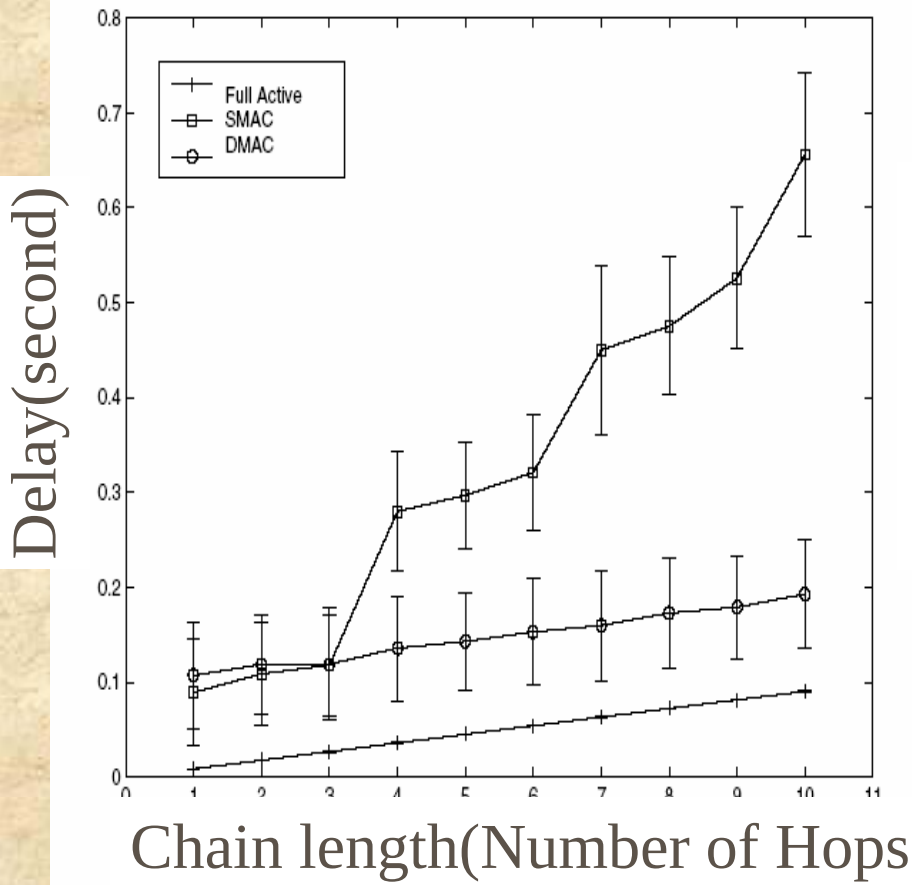
D-MAC

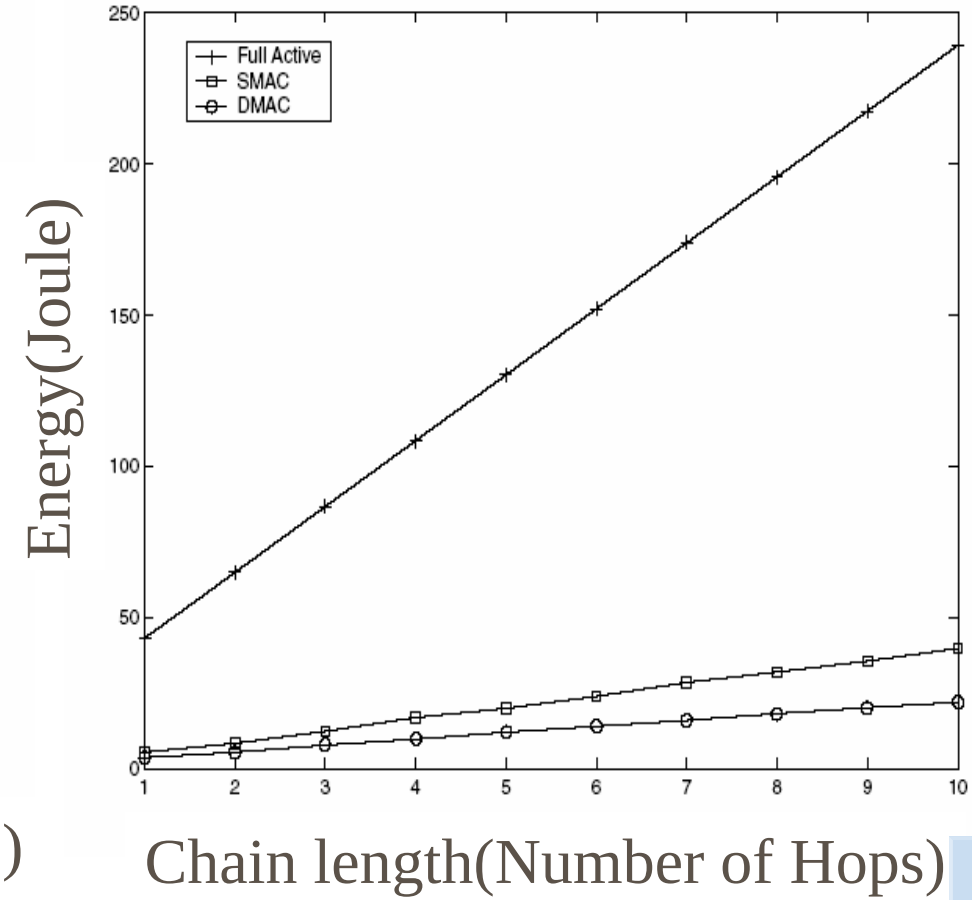


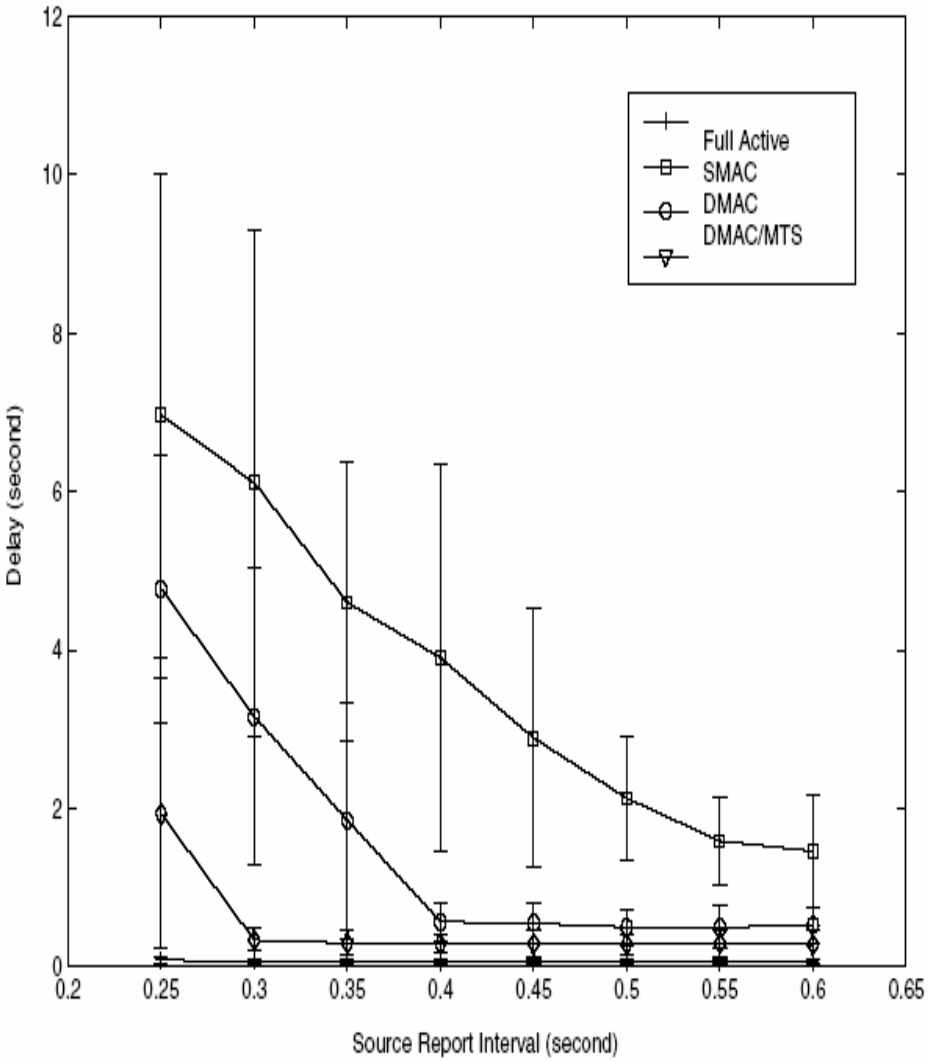
(b) DMAC

Performance Evaluation

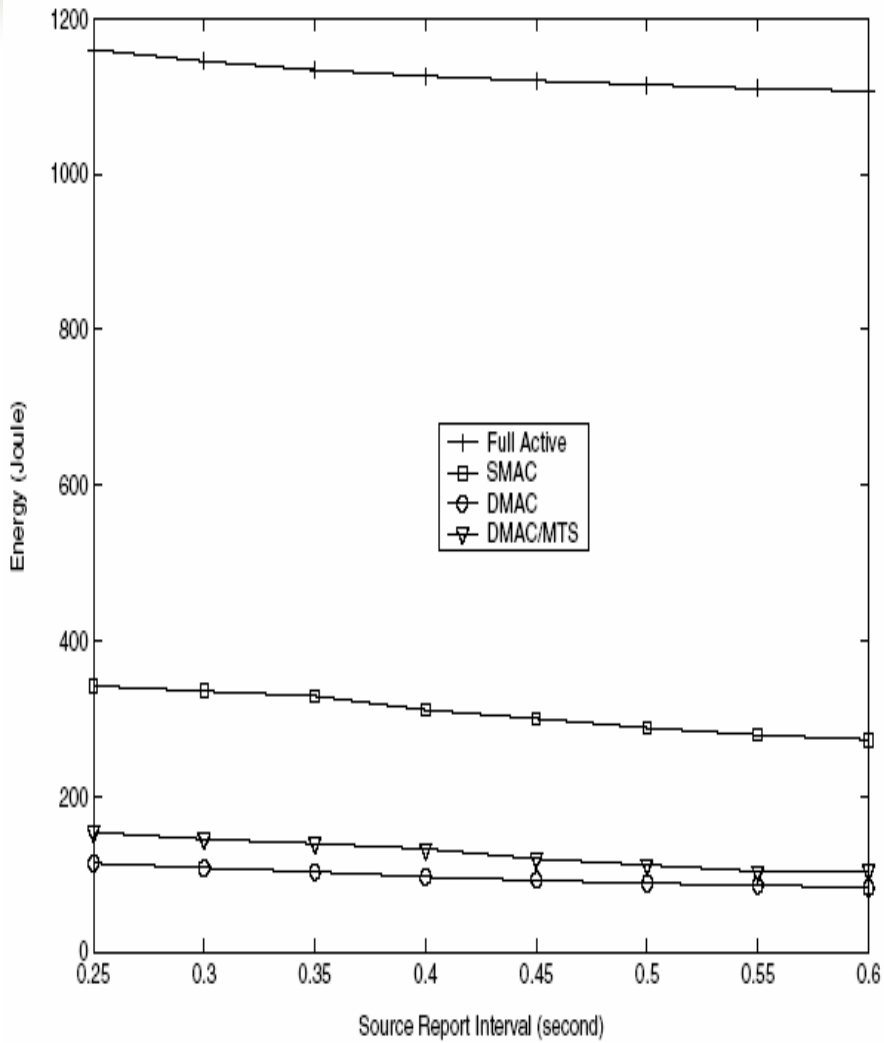
- We assume that sensor nodes are fixed and a route to the sink is fairly durable



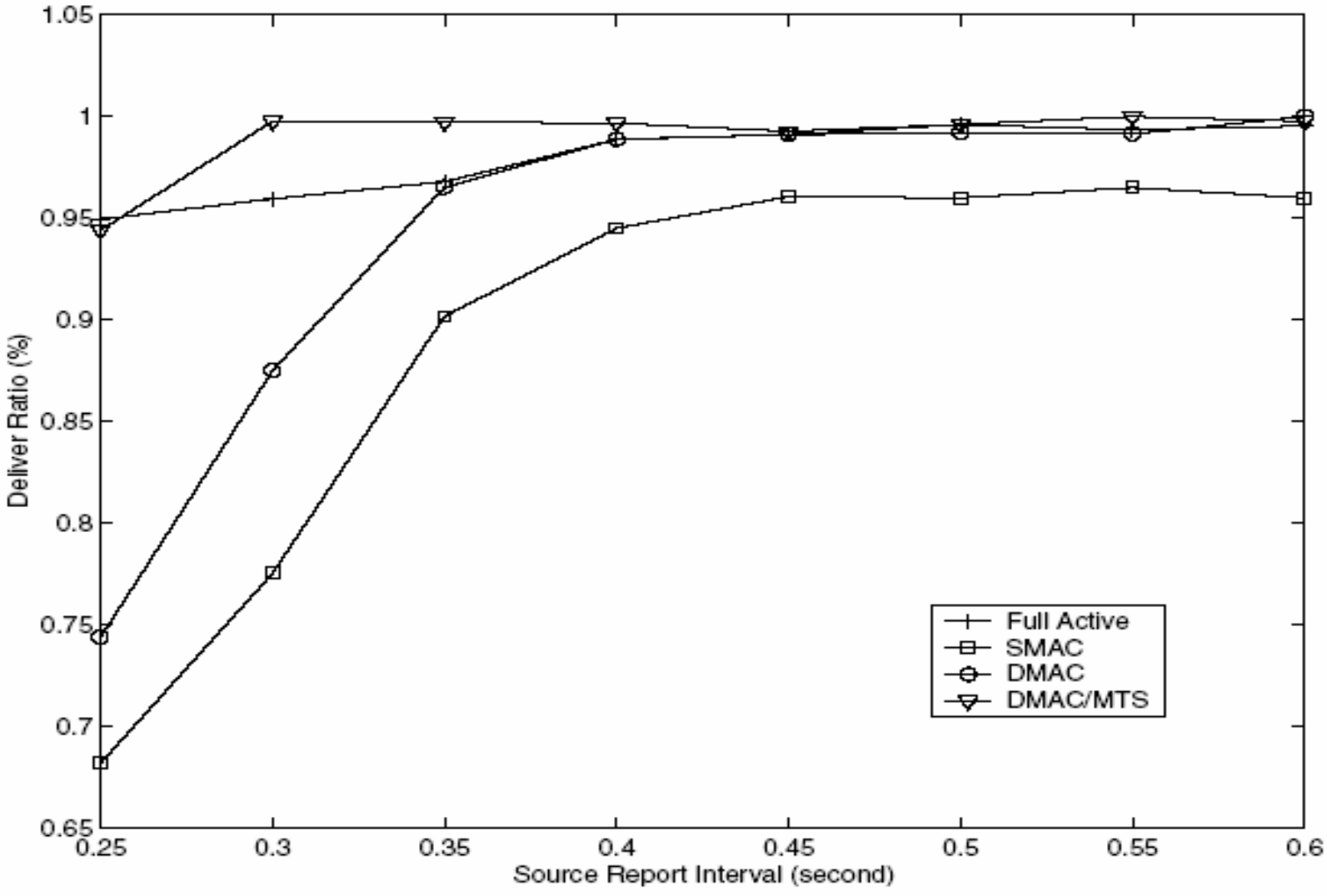




(a)latency

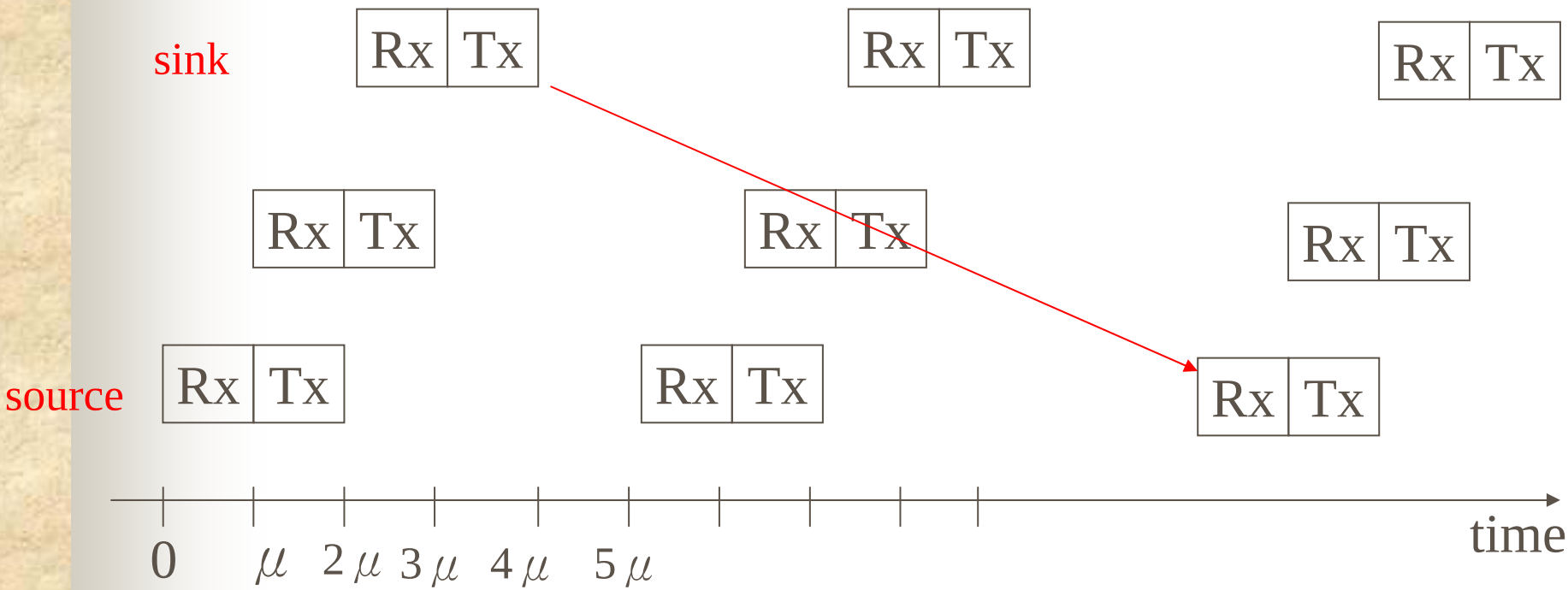


(b)energy



(c)Delivery ratio

The problem of D-MAC



Conclusion

	Fixed sensor and the route is fairly durable.			Other circumstance	
	latency	Energy-efficient	reliability	flexibility	bidirectional communication
S-MAC					is bidirectional but is slower than D-MAC
D-MAC					is only one direction but is faster than S-MAC

Discussion

- We can design a mechanism that can make D-MAC bidirectional.
- We can think how to enhance the reliability of D-MAC.

.