

***A Self-Balanced Receiver-Oriented MAC
Protocol for Multiple channels Multihop
Ad-Hoc Networks***

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Outline

- Introduction
 - MAC protocols for wireless network
- SEBROMA
 - Protocol description
- Delay-Throughput analysis
 - Network model
 - Markov chain model
- Numerical results

MAC protocols for wireless network

- Centralized Vs distributed control
- Single channel vs multi channel system
- Receiver based Vs transmitter based

SEBROMA

- Fully distributed
- Asynchronous
- Receiver based
- code assignment free

SEBROMA

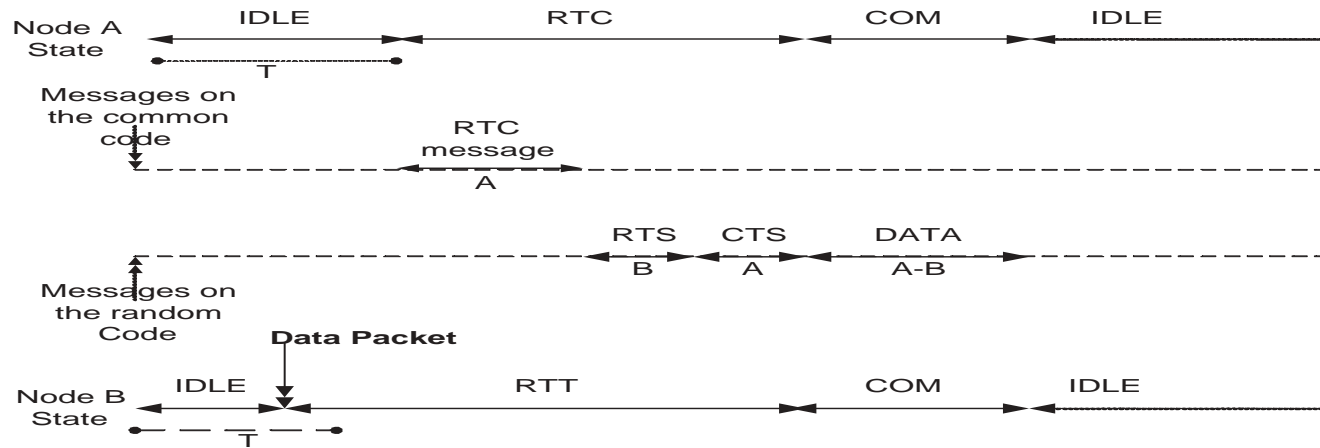
- RTC message format

Synchronization sequence	Node ID	Code ID
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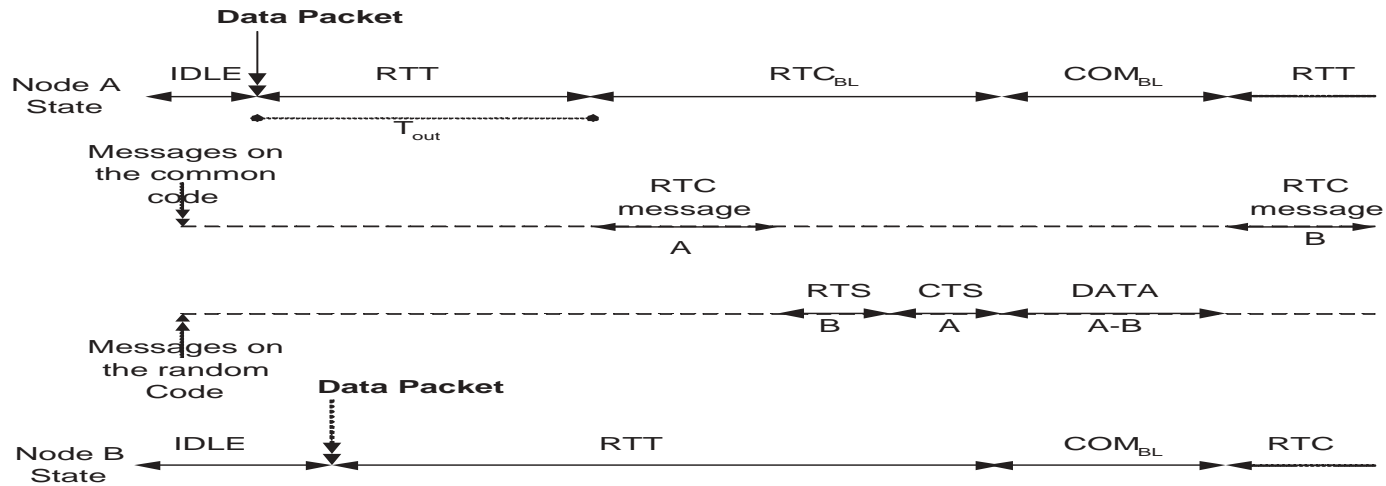
- Contention phase

Contention Window				Decision period	Contention Result
RTS	RTS	RTS	RTS		CTS

Case of not blocked transmitter

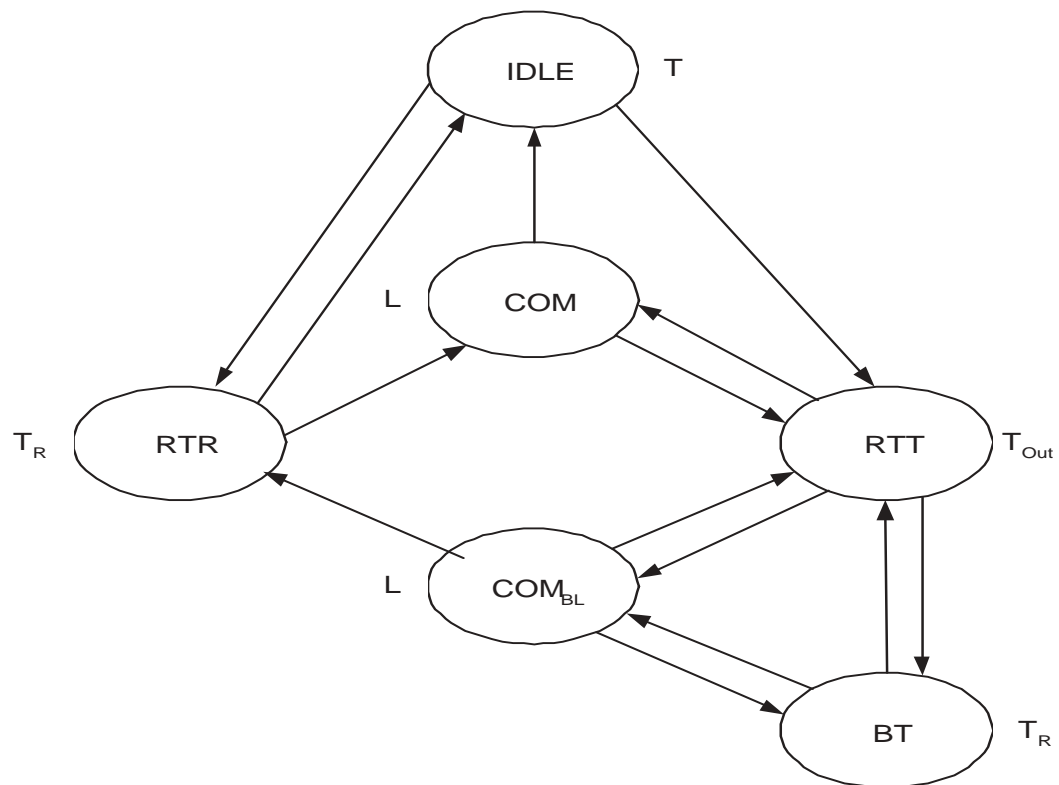


Case of blocked transmitter



SEBROMA

- States Diagram



Delay-Throughput Analysis

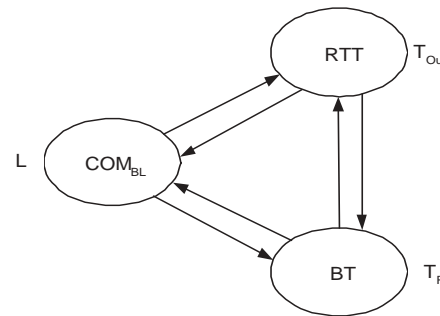
Network Model

- Nodes are bi-dimensional poisson distributed with density λ over an infinite area
- All nodes have the same circular transmitting and receiving range of radius r (MAC range)
- Nodes traffic is uniform over a circular range of radius R (Routing range $R \geq r$)
- Routing protocol guarantees that the final destination of a packet is in the routing range of the next hop

Delay-Throughput Analysis

Markov Chain Model

- we analyse the system behavior in the range of some node in saturation conditions



- Only one communication at time is allowed on every channel
- The physical layer offers $(D + 1)$ orthogonal and identical channels
- L contention sub-windows for the reception of RTS message
- Packet length is exponentially distributed with mean l

Delay-Throughput Analysis

Markov Chain Model

- Three-dimensional Markov chain to model the considered system \iff Closed Network of queues with network's state dependent routing probabilities
- Towsley showed that this type of network has an equivalent product-form network
- Node's states are only logical states \Rightarrow There is no queueing
- Applying Mean Value analysis gives us:

$$Q_N(i) = N.Q_1(i)$$

- Equilibrium point analysis to provide the 1-customer system with mean routing probabilities

Numerical Results

Channel Utilization with general T_o

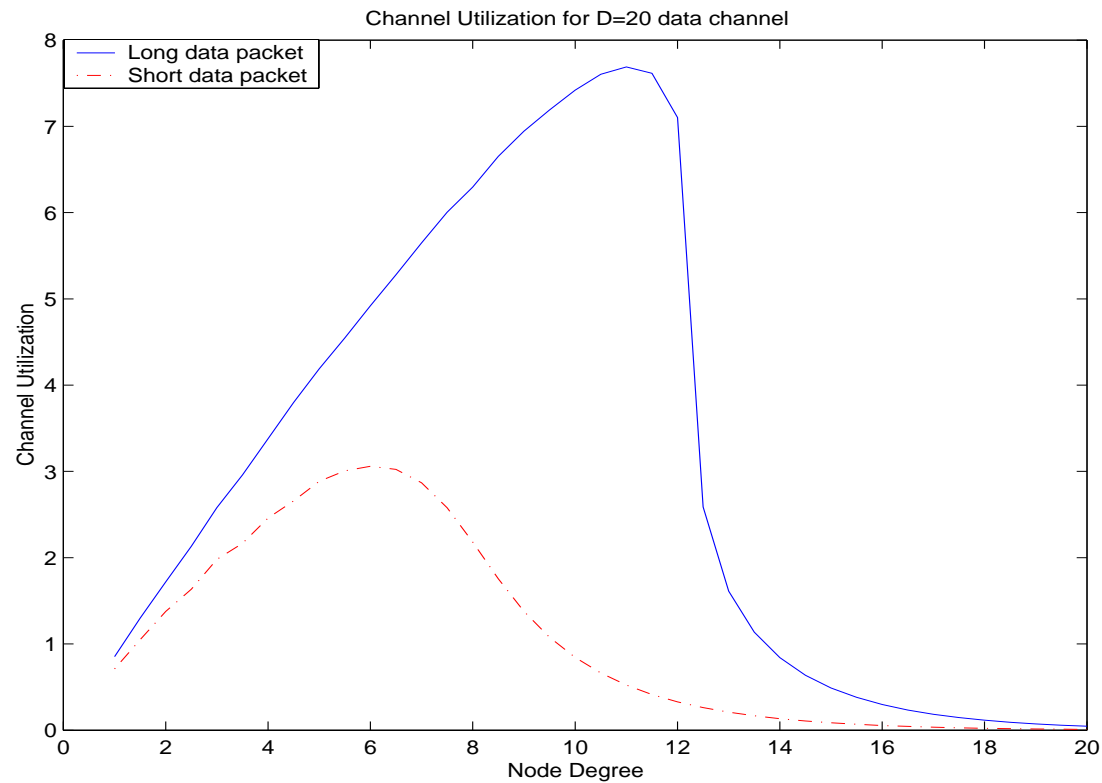


Figure 1: Agregate Channel Utilization Vs Node degree

Numerical Results

Channel Utilization with optimized T_o

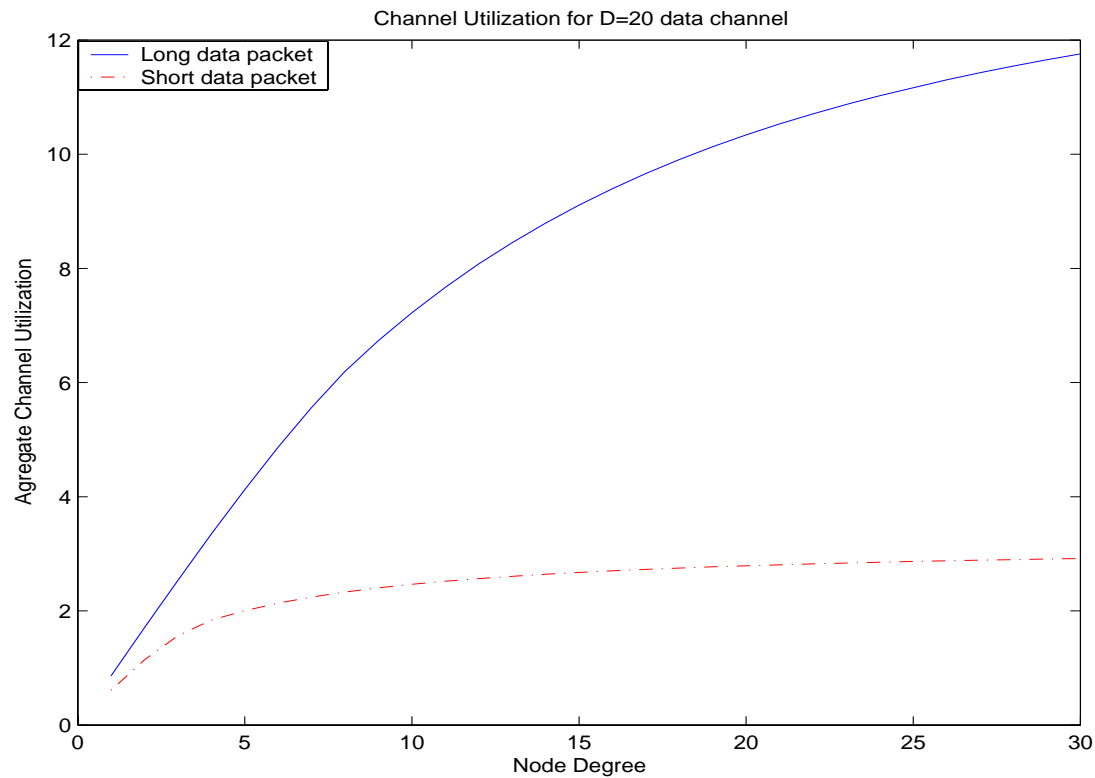


Figure 2: Agregate Channel Utilization Vs Node degree

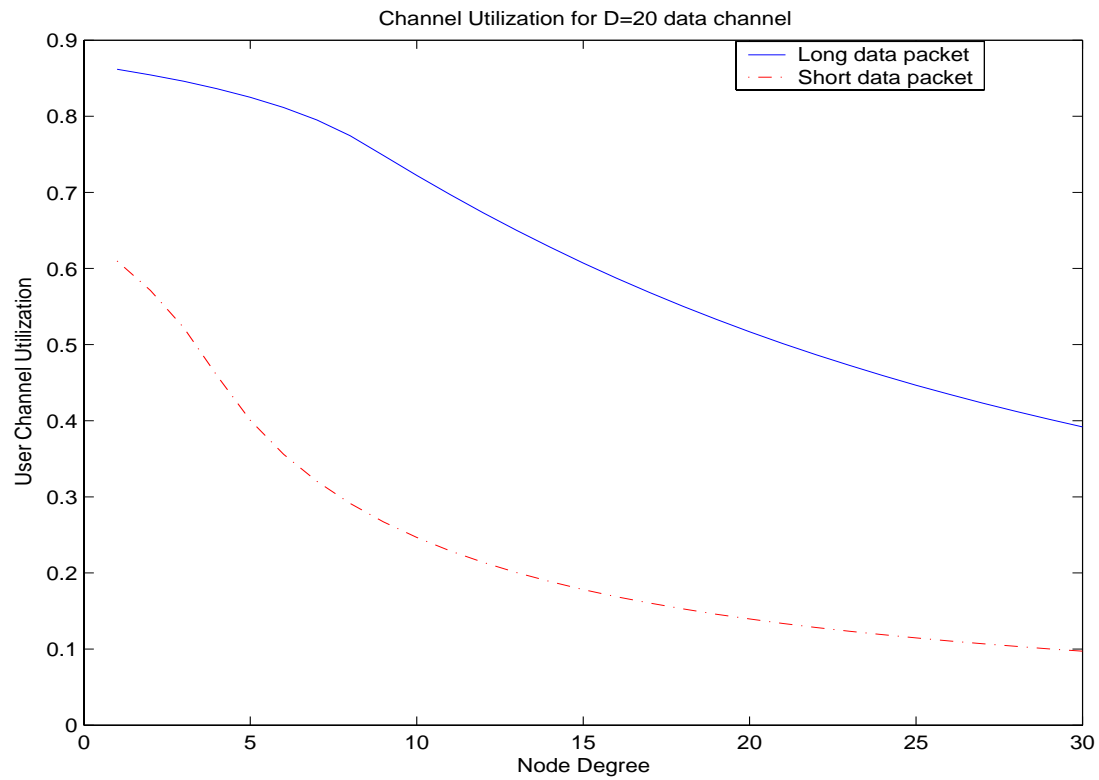


Figure 3: User Channel Utilization Vs Node degree

Numerical Results

End-to-End Performances

- Traffic is uniform over the routing area of radius R
- Routing protocol guarantees that the final destination of a packet is in the routing range of the next hop
- The mean number of forwarding operation is then $\frac{R^2}{r^2}$

Numerical Results

End-to-End CU

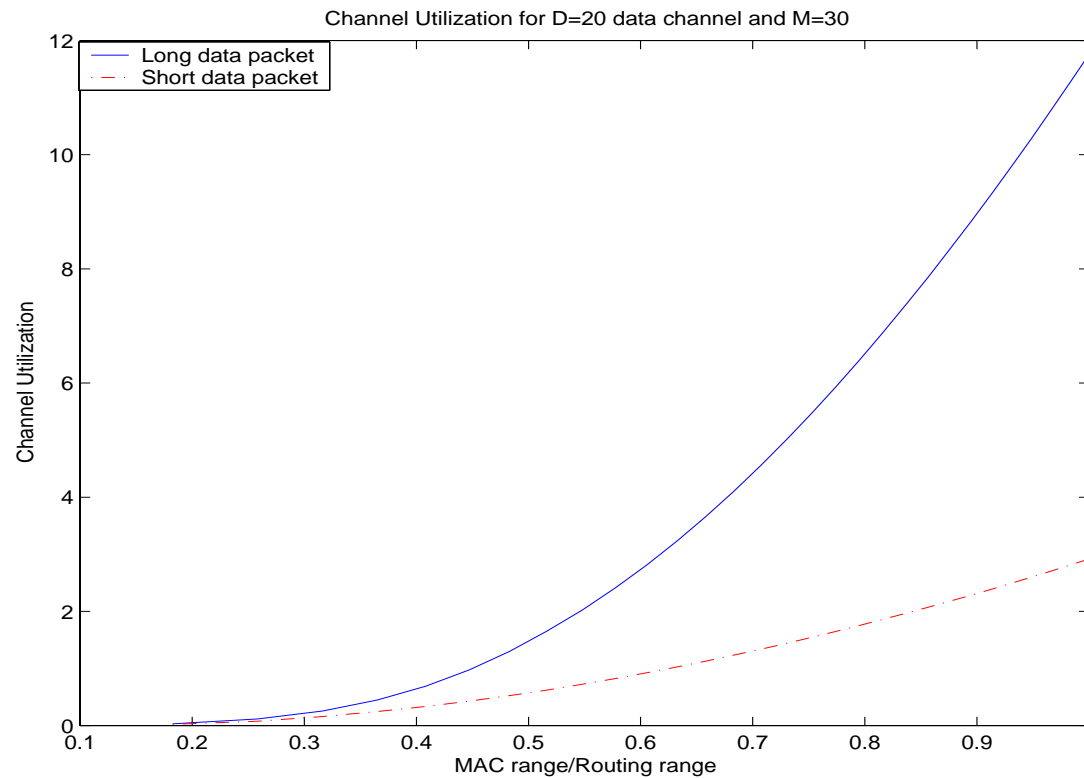


Figure 4: Channel Utilization Vs Mac/Routing ranges ratio

Numerical Results

End-to-End CU

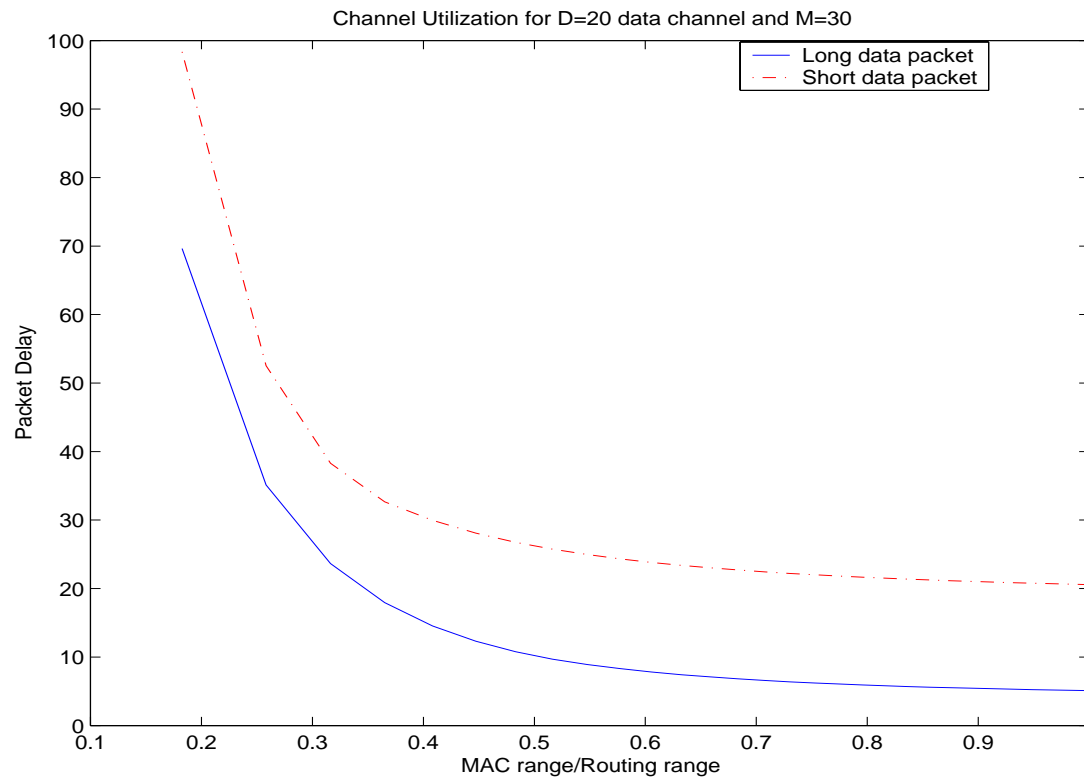


Figure 5: Packet delay Vs Mac/Routing ranges ratio

Conclusion

- Sebroma
 - Realistic
 - provide stable and good performance
- Future works
 - general load performance
 - Transmitter based version
 - Single channel version