



rDCF: A Relay-enabled Medium Access Control Protocol for Wireless Ad Hoc Networks

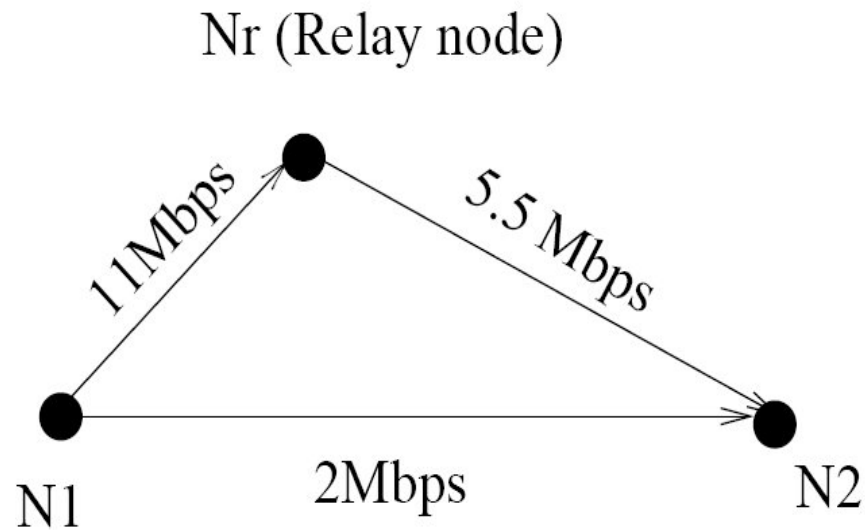
Hao Zhu and Guohong Cao
INFOCOM 2005

Speaker: J. C. Liu

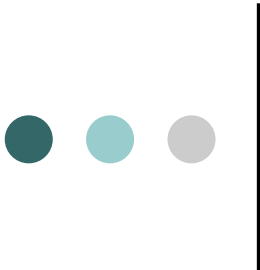


Motivations

- Advantage of two-hop relay



- MAC layer relay vs. Network layer forwarding

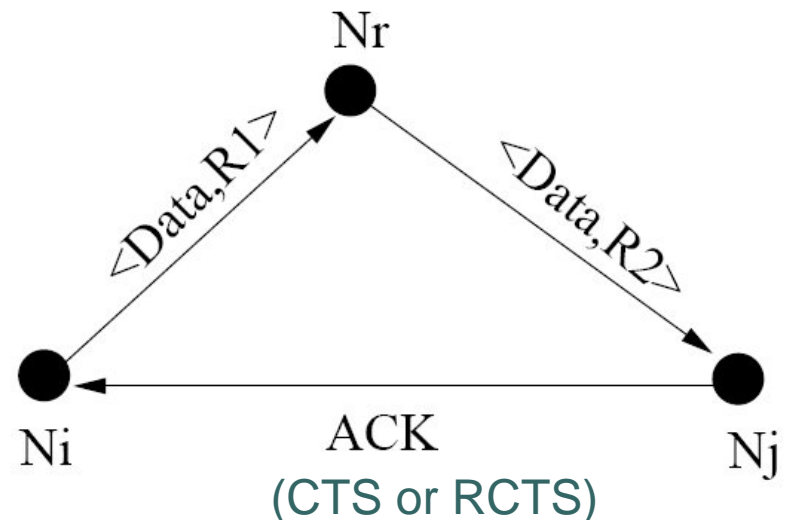
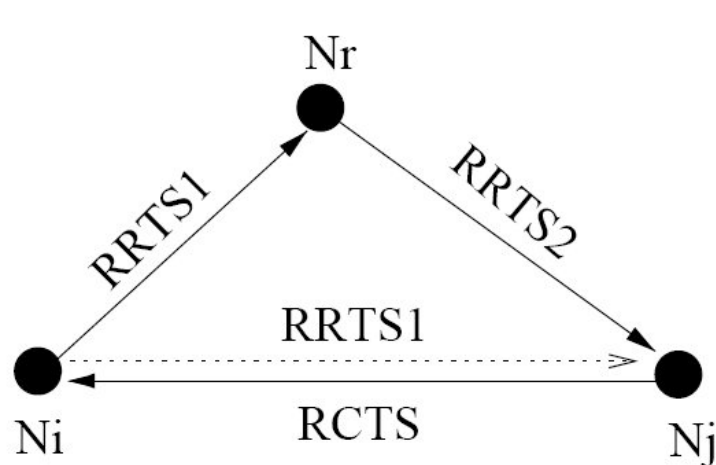


The Relay-enabled DCF (rDCF)

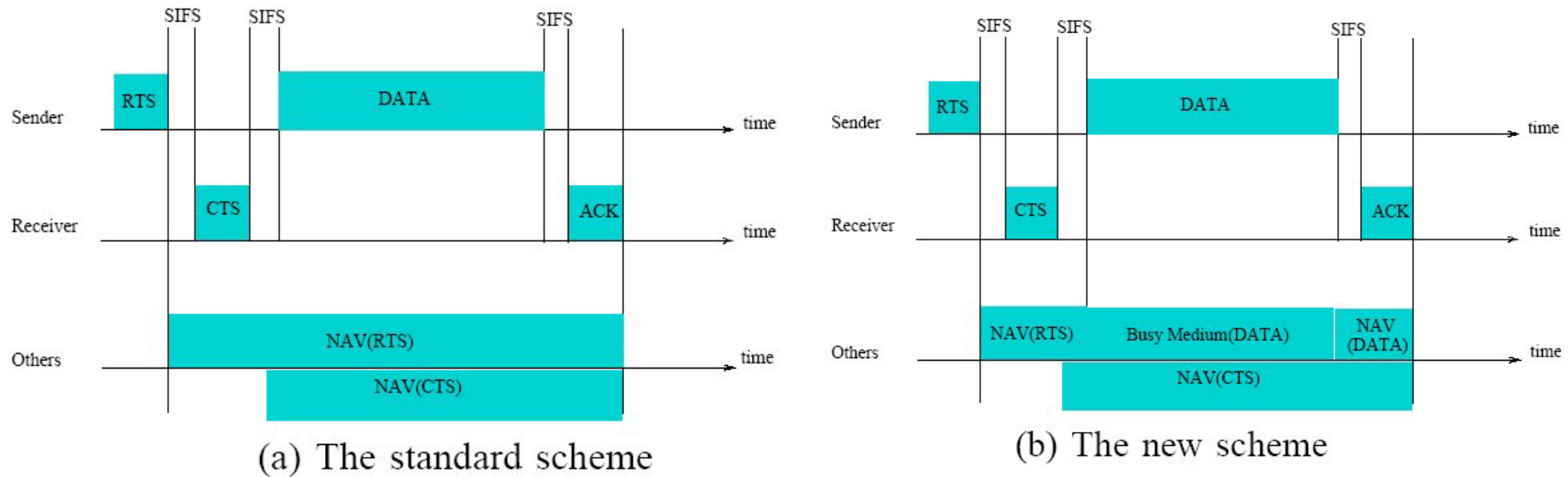
- Receiver-initiated channel condition measurement
 - The receiver notify the sender of the transmission rate via CTS.
 - If a node finds that the packets can be transmitted faster with the MAC layer relay, it adds the identity (e.g. MAC address) of the sender and the receiver into its willing list.
 - Periodically, each node advertises its willing list to its one-hop neighbors.

The Relay-enabled DCF (rDCF)

- The triangular handshake
 - If N_i cannot find a relay node, the standard DCF is applied.
 - Otherwise, N_i picks a relay node N_r and starts to coordinate the communication with N_r and N_j .



The Comparison of Two Different Carrier Sensing Schemes



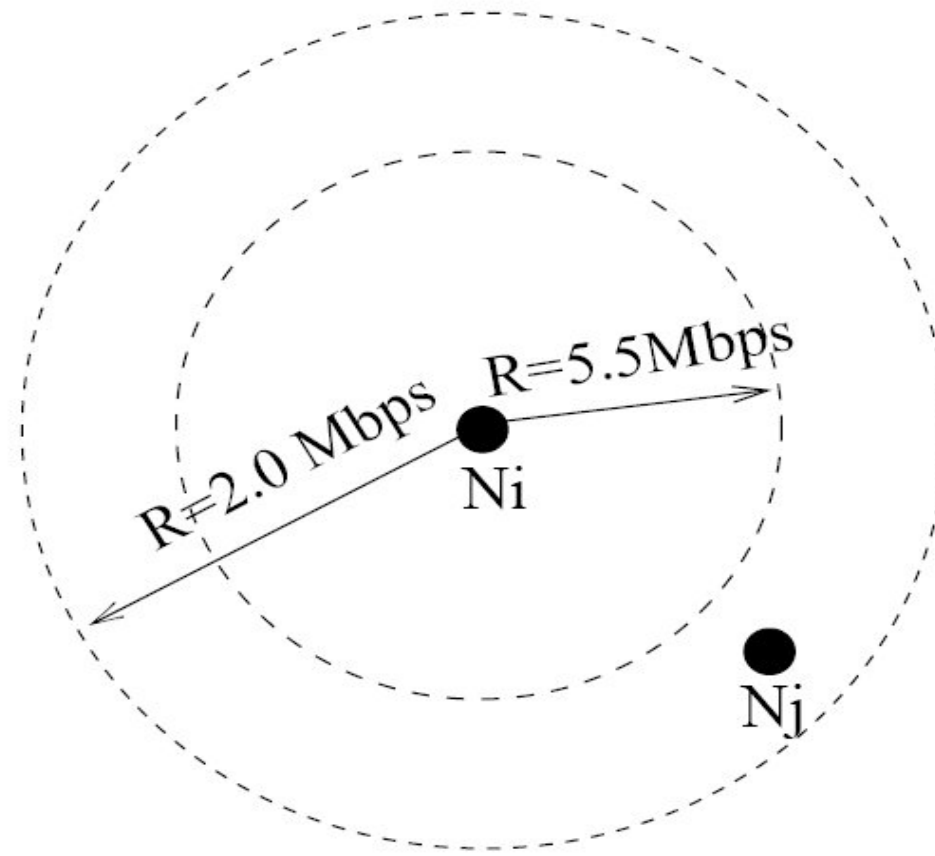
Packet Type	The Duration
RTS	$CTS + \sigma + 2SIFS$
CTS	$DATA(L, R_{dir}) + \sigma + 2SIFS$
RRTS1	$RRTS2 + RCTS + 2\sigma + 3SIFS$
RRTS2	$RCTS + DATA(L, R_1) + 2\sigma + 3SIFS$
RCTS	$DATA(L, R_1) + DATA(L, R_2) + 2\sigma + 3SIFS$
Data _{dir}	$ACK + \sigma + SIFS$
Data ₁	$DATA(L, R_2) + ACK + 2\sigma + 2SIFS$

TABLE I

THE CALCULATIONS OF THE DURATION IN r DCF



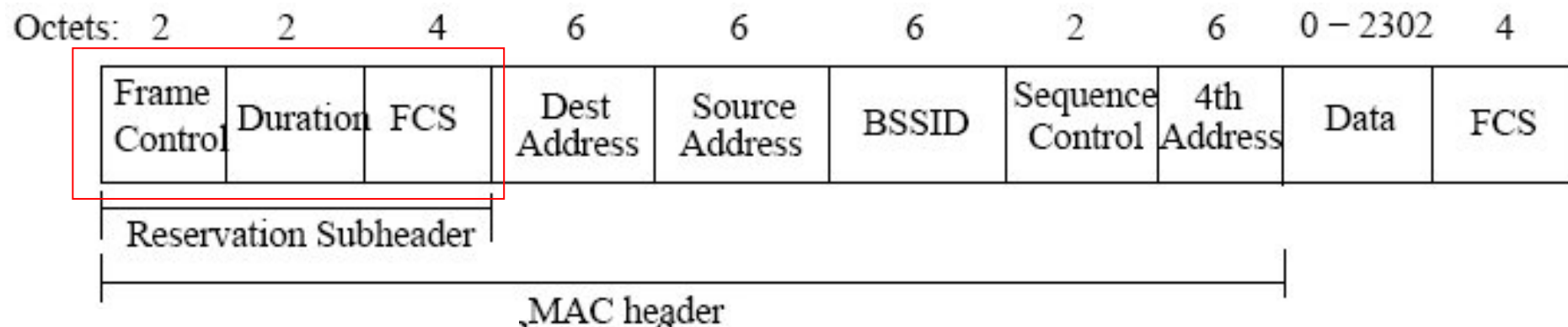
Different Transmission Ranges





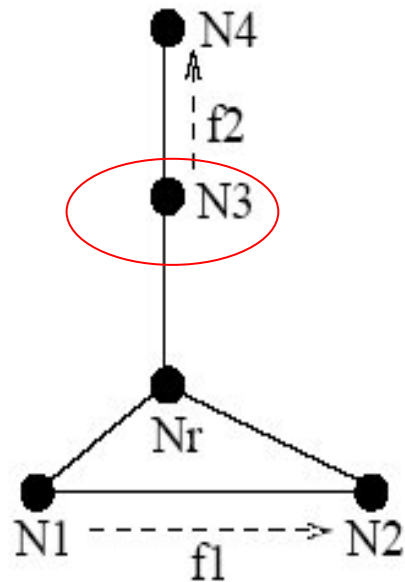
Data Packet Frame Format

- Reservation-sub-header (RSH)
 - A RSH is inserted preceding the data frame and is sent at the same or lower rate compared to RTS.

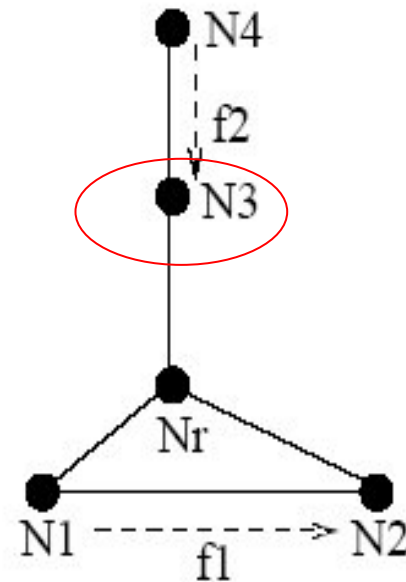




The Impact of rDCF on Spatial Reuse

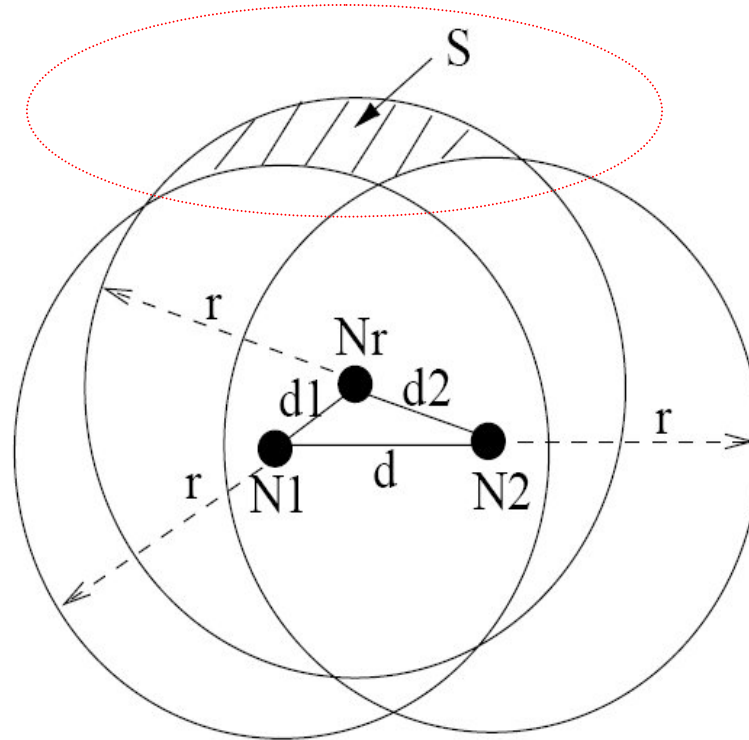


(a) Exposed terminal



(b) Hidden terminal

The Extended Sensing Area



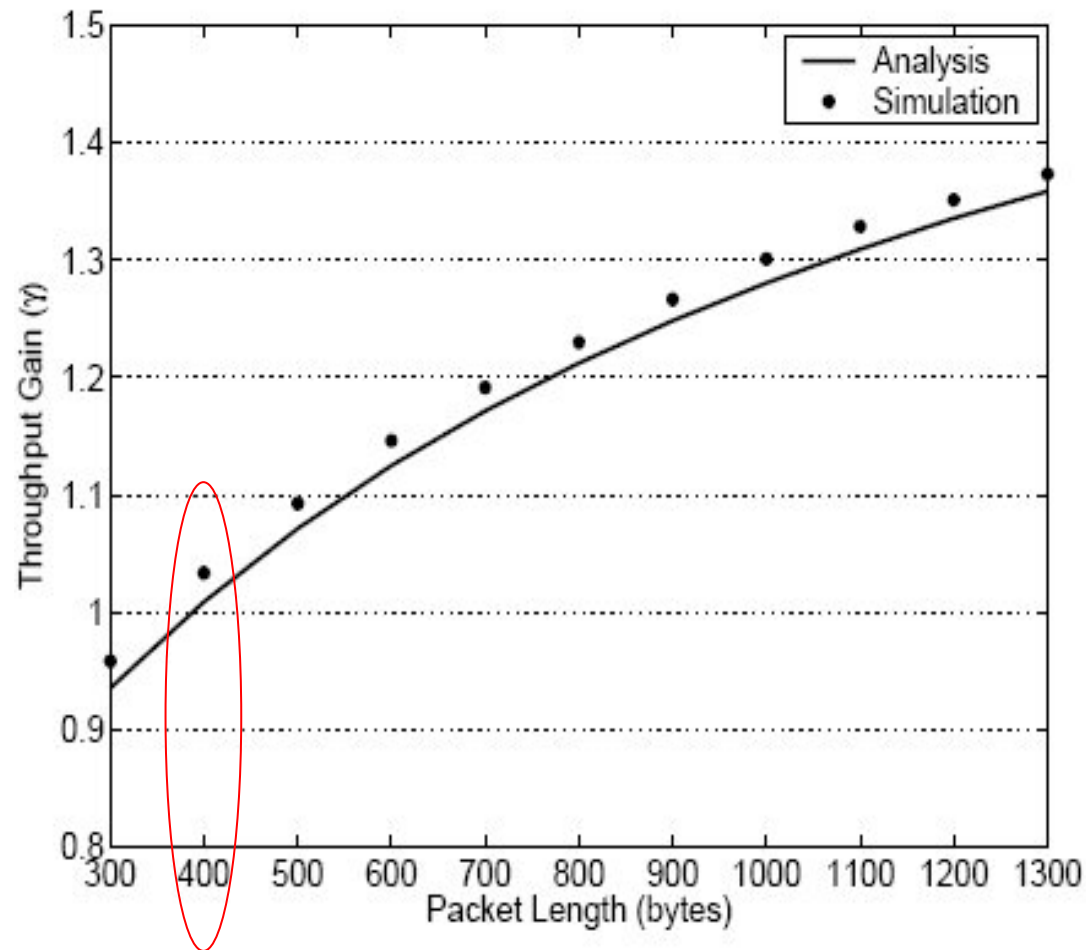
d (meters)	210	220	230	240	250
Upper bound of increased sensing area (%)	11.5	10.5	9.2	8.2	7.2

TABLE II

THE IMPACT OF RELAY ON THE SENSING AREA

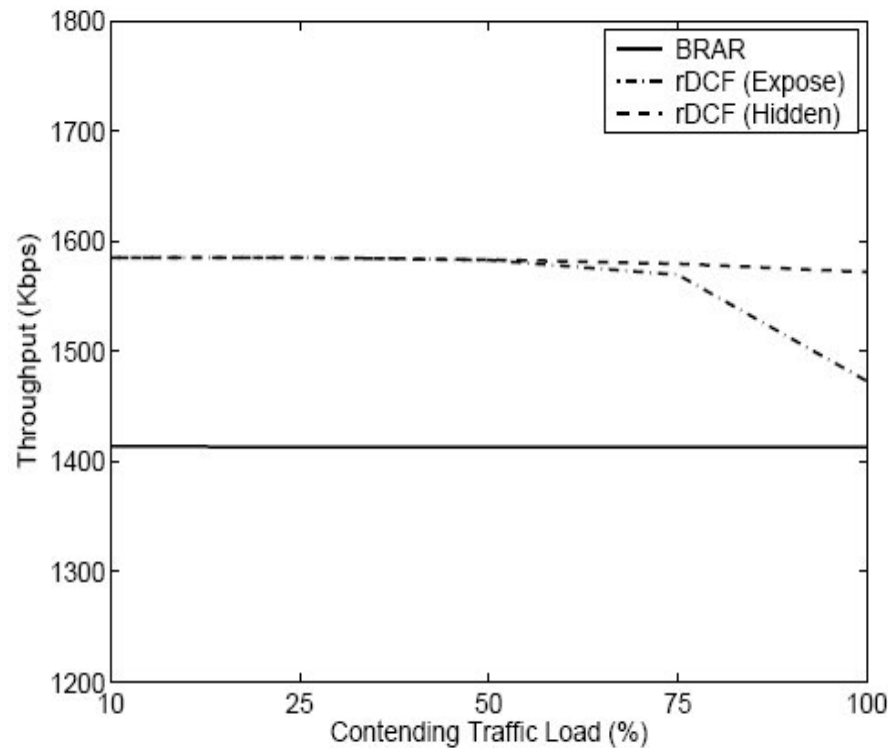


Throughput Gain: Analysis vs. Simulation

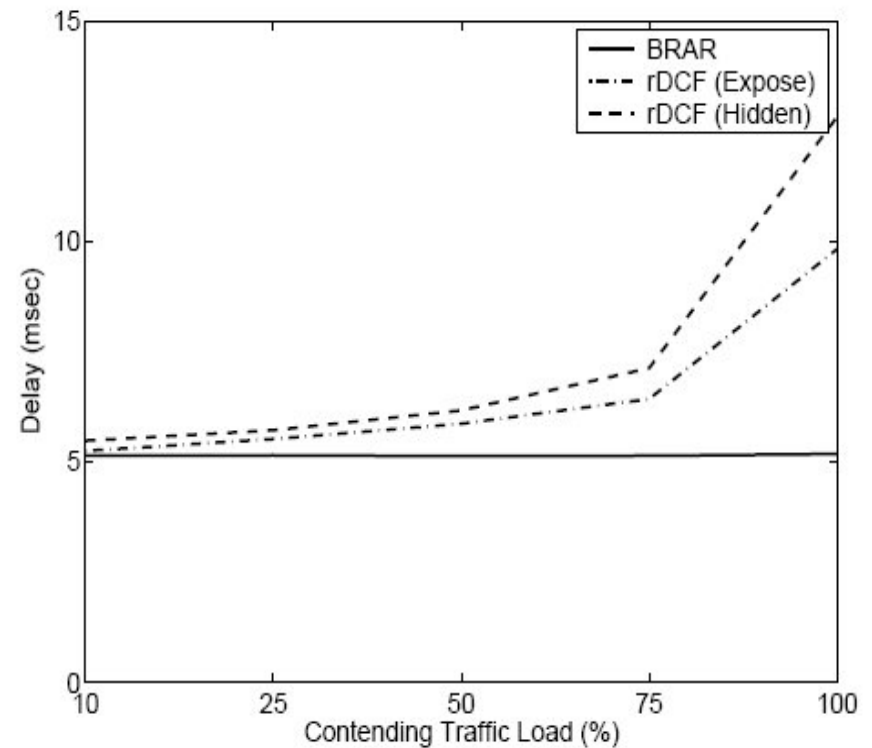




Impacts on Spatial Reuse

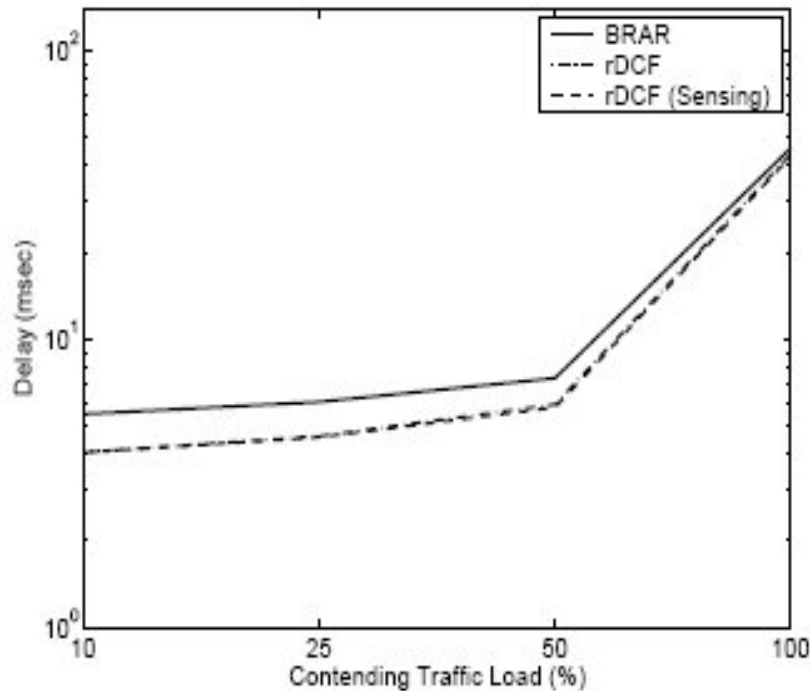


(a) Throughput of Flow 1

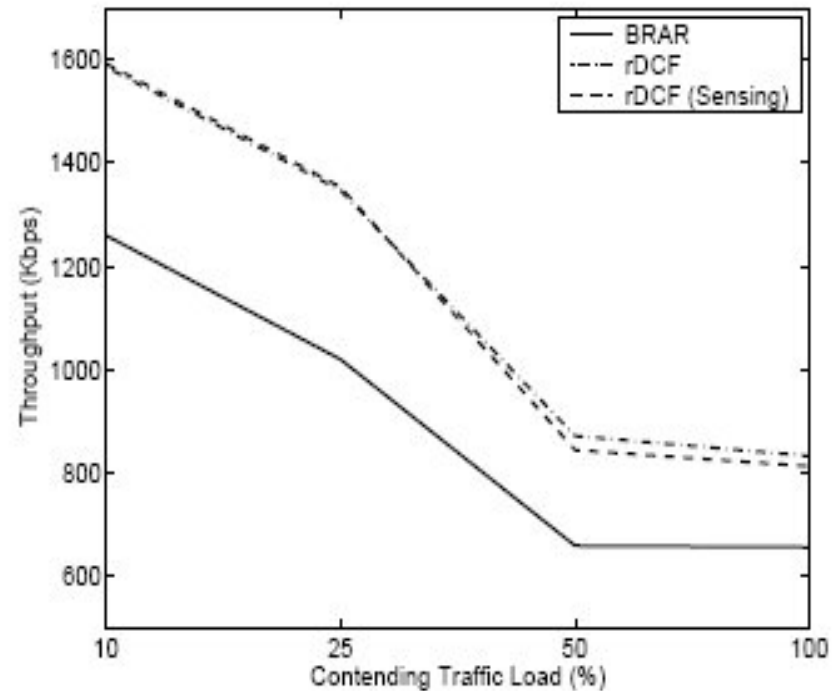


(b) Delay of Flow 2

Impacts of Hidden Relay on rDCF



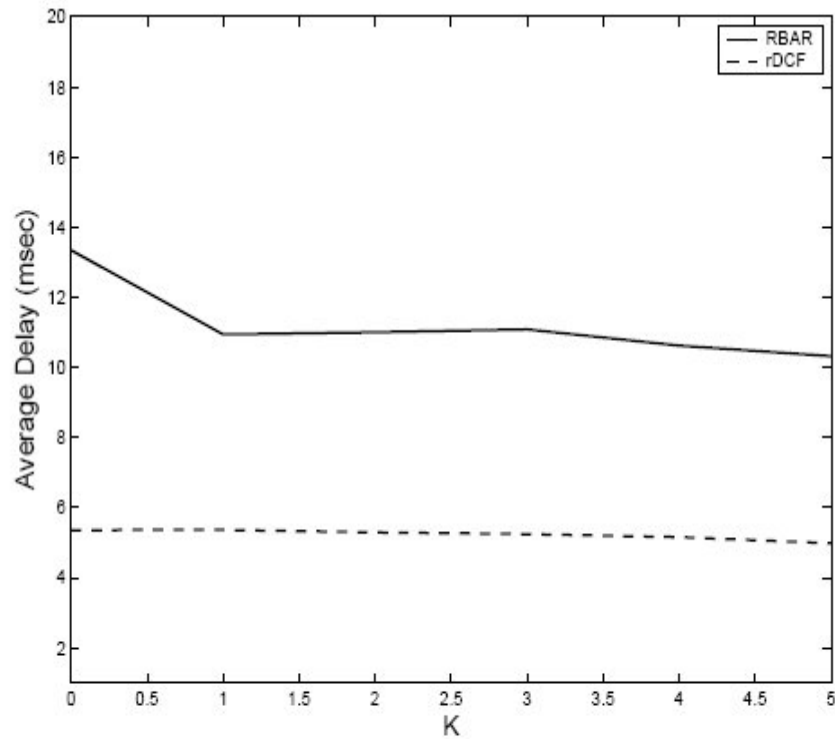
(a) Delay of flow 1



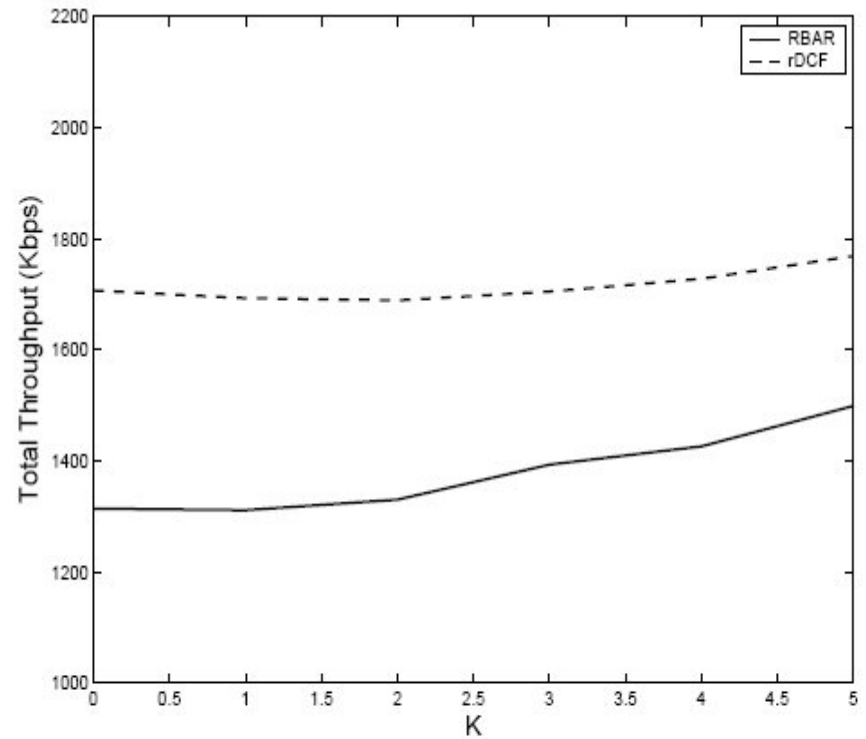
(b) Throughput of flow 1



Performance Comparison



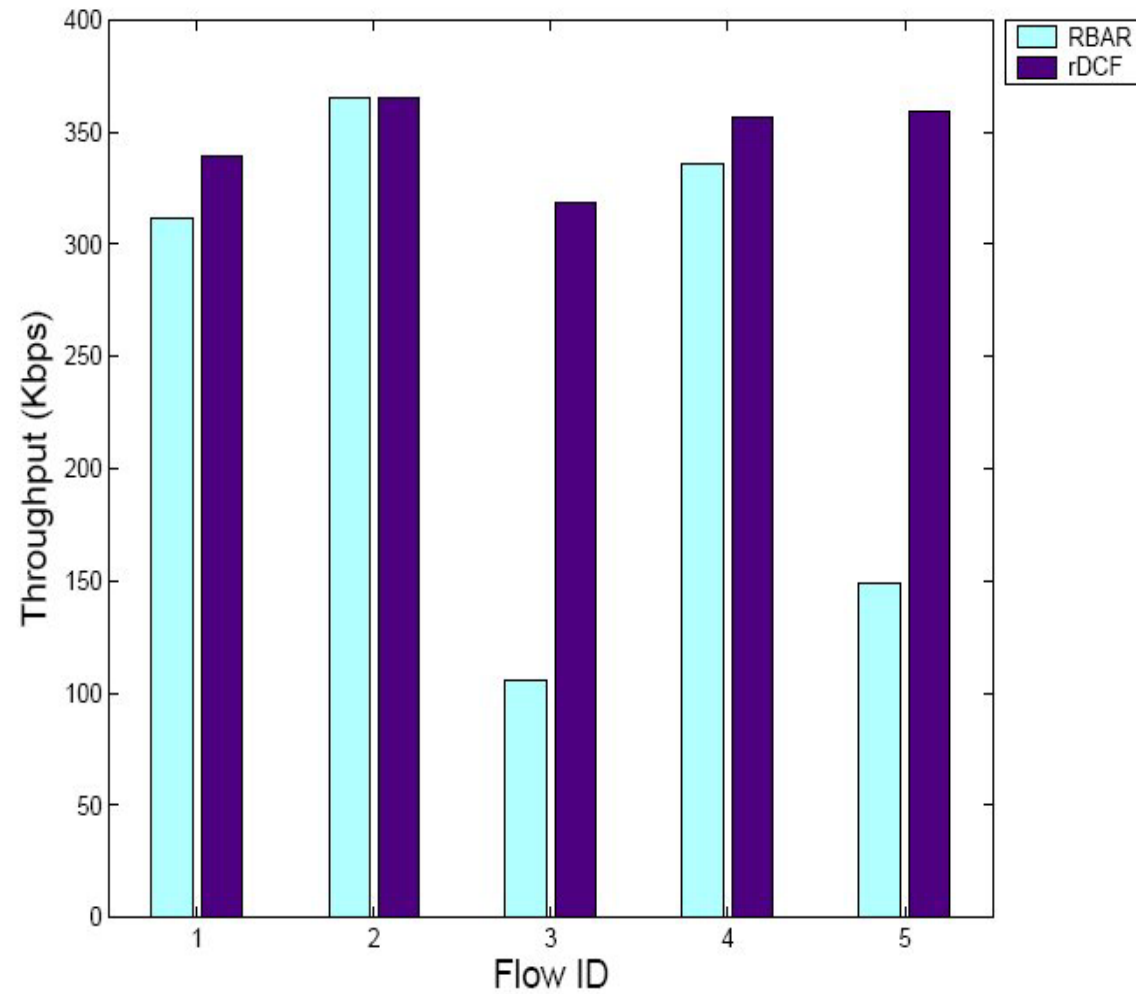
(a) Delay



(b) Throughput

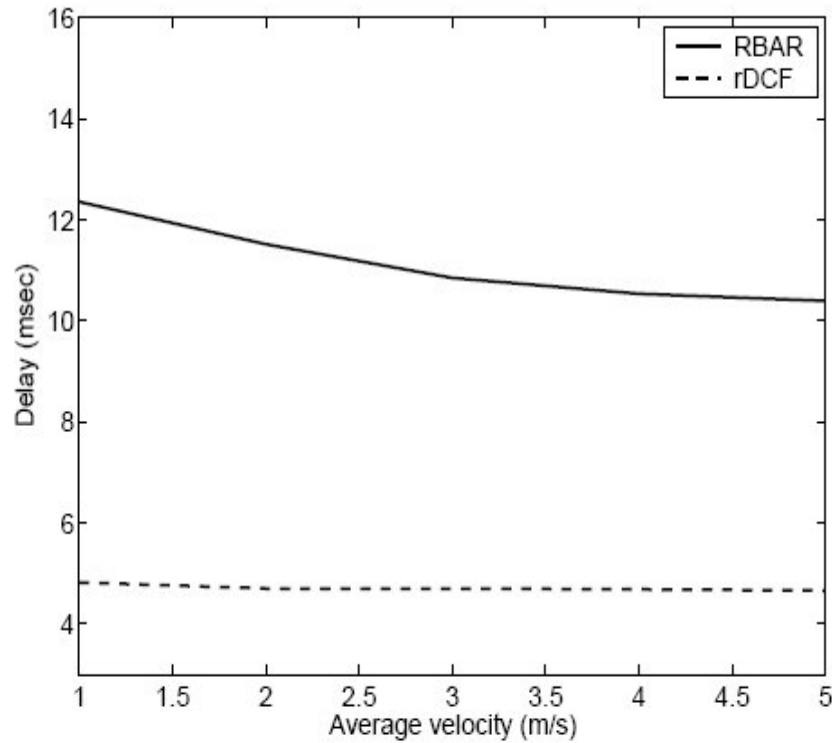


The Fairness Comparison

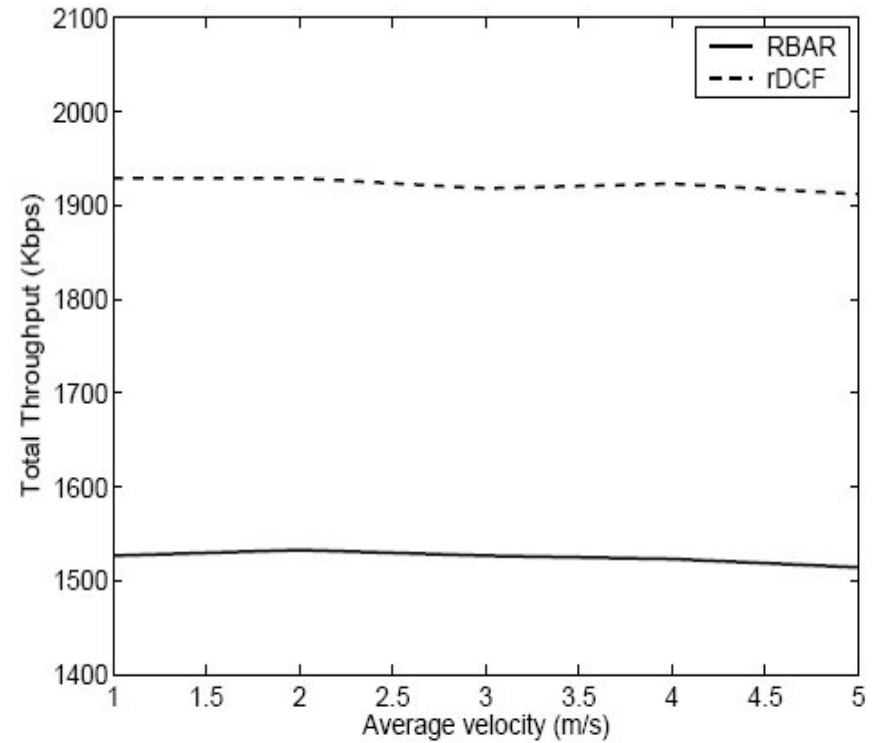




Performance Comparison



(a) Delay



(b) Throughput



Summary

- The paper presented a novel relay-enabled DCF protocol, called rDCF, to exploit the physical layer multi-rate capability.
- Considering the bandwidth utilization and the dynamic nature of wireless channels, this paper also propose several techniques to enhance the performance of rDCF.



Discussion

- Relay-enabled PCF?
 - Power saving
 - QoS
- Relay-enabled super frame?