

## Introduction

- **Advantages of a Mixed Rate Protocol**
  - Higher Performance
  - Expandability to Support Higher Data Rates
  - Greater Range
  - Lower Infrastructure Costs
- **Concerns of the Mixed Rate Protocol**
  - MAC is Aware of the PHY Data Rate
  - MAC Decides the PHY Data Rate
  - What Data Rate Should Control Packets be Sent?
  - How Does it Effect Hidden Terminals?
  - Resource Requirements

## Should the MAC be Aware of the PHY Data Rate?

- **Want Layer Independence**
- **Is it Realistic to be Completely Independent?**
  - In the 802.3 Specification, the MAC is aware of the 10 MBit/s Data Rate
  - In the DFWMAC, the Data Rate is Known to Calculate the NAV
- **Pave the Way for Future Data Rates**

### Control Packet Speed

- **Control Packets Should be Transferred at the Base Mode Rate**
  - Allows Inter-operability with Base Mode Only Units
  - Allows Single Rate Implementation Which Complies with the specification
  - Better Reception Reliability in Base Mode
- **Speed Negotiation Done in the RTS/CTS Exchange**

### Data Rate Field in the MAC Header

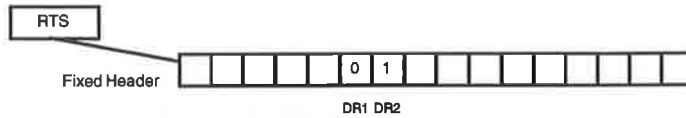
Control Field of the Fixed Header in the MAC



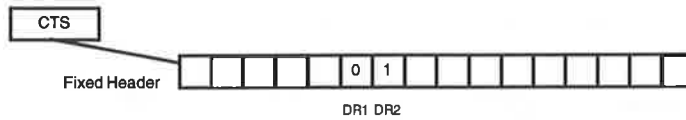
Data Rate Request Bits: 00 = Base Rate  
01 = Gear Shift Rate  
10 = Future Gear Shift?  
11 = Future Gear Shift?

### Sample Data Rate Negotiation

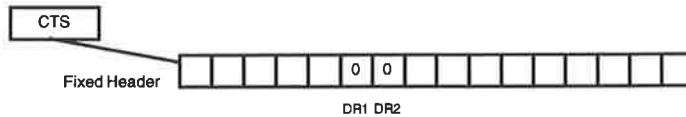
Request Gear Shift Rate in the RTS Packet



Gear Shift Rate Granted in the CTS Packet



Gear Shift Rate Denied in the CTS Packet

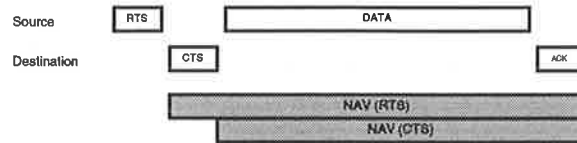


### Hidden Terminals With a Multi-Rate Protocol

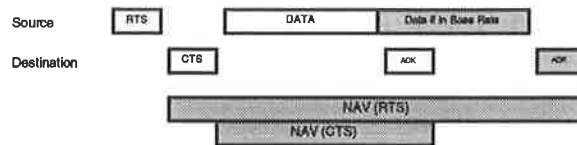
- **Need to Minimize Affects of Hidden Terminals**
- **NAV Requirements**
  - RTS Packets Set NAV for Base Rate, Even When Requesting Gear Shift Rate
  - CTS Packets Granting the Gear Shift Rate Adjust the NAV for the Shorter Reservation
- **Hidden Terminals Have a Disadvantage**
  - May Obey a Longer Reservation than is Required
  - Disadvantage on the Next Contention
  - This is Better than Interfering with Other Transmissions
- **Optimization Possible**
  - Hidden Terminals May Update Their NAV After Detecting the Data Rate of the Data Packet Being Sent

## NAVs with a Multi-Rate Protocol

### Request Gear Shift Rate (RTS) with Gear Shift Rate Denied (CTS)



### Request Gear Shift Rate (RTS) with Gear Shift Rate Granted (CTS)



Stations which do not receive the CTS must obey the longer NAV because they do not know if the destination granted the Gear Shift Rate request.

## Data Packets Sent Without RTS/CTS

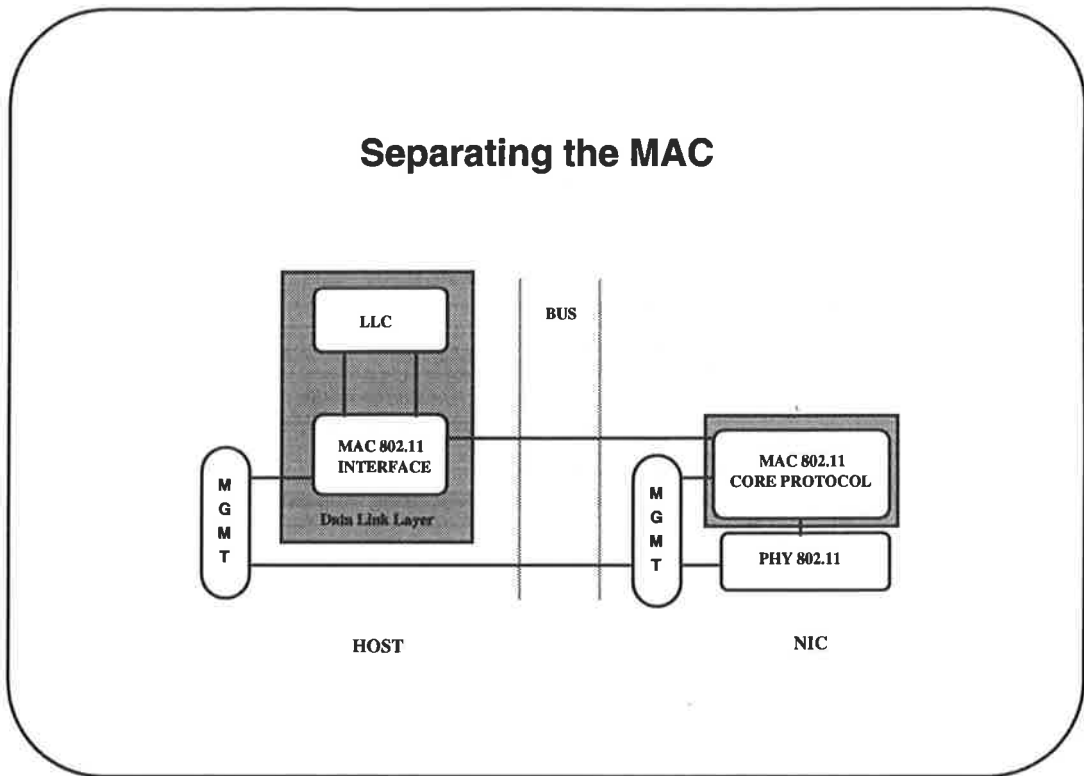
- **What Rate Should These Packets Be Sent at?**
  - **Easiest to Always Use the Base Rate**
    - » **Preserves Inter-Operability**
    - » **No Tables Are Required**
  - **More Efficient if Tables are Built**
    - » **Transmit in Gear Shift Mode if the Destination can Receive at that Rate**
- **Burst Mode “Down” Frames use Base Rate**
- **Broadcast and Multicast Packets Should Always be Transmitted at the Base Rate**
  - **Again Preserves Inter-Operability**

### **Data Rate, ANTSEL, TXPWRLVL Parameters**

- **Pass as Parameters or Control through Management Interface?**
  - Since Based on Destination Node, Should be Passed as Parameters with the Data to the MAC
  - Example
    - » `ma.request (data, source, dest, data_rate, ANTSEL, ...)`
  - Allows Synchronous Selections
  - Otherwise a Management Packet would be Required to Change the Data Rate
    - » What Rate Would Packets Queued in the MAC be Transmitted at?

### **Resource Requirements for Mixed Rate Support**

- **Memory Storage and Processing Power for Table Lookups**
  - Tables are Not Necessary
    - » Single Base Rate System can be Implemented
    - » Can Always Request Gear Shift Rate without Remembering Nodes' Capabilities!
  - MAC can be Split (NIC and Host)
    - » Table on Host Side of the Bus
      - Host has more Memory and Processing Power
      - More Natural in the LLC since Connection Oriented
- **Table Lookups Reduce Throughput**
  - Only if Tables are Used!
  - Minimal Affect if Lookup is Done on the Host Side
  - Lookups Occur While Other Packets being Sent
  - Bottleneck in the Wireless Bandwith



- ### Conclusion
- **Multi-Rate Support is not Difficult**
    - Multi-Rate Implementation not Required
      - » Make sure Control Packets Sent at the Base Rate
    - Tables and Table Lookups by the Host Reduce NIC's Resource Requirements
  - **Fear of Gear Switching is Unjustified**
  - **Multi-Rate Support Improves the MAC and Makes it Expandable in the Future**