Joint Access Control and Detection for CDMA

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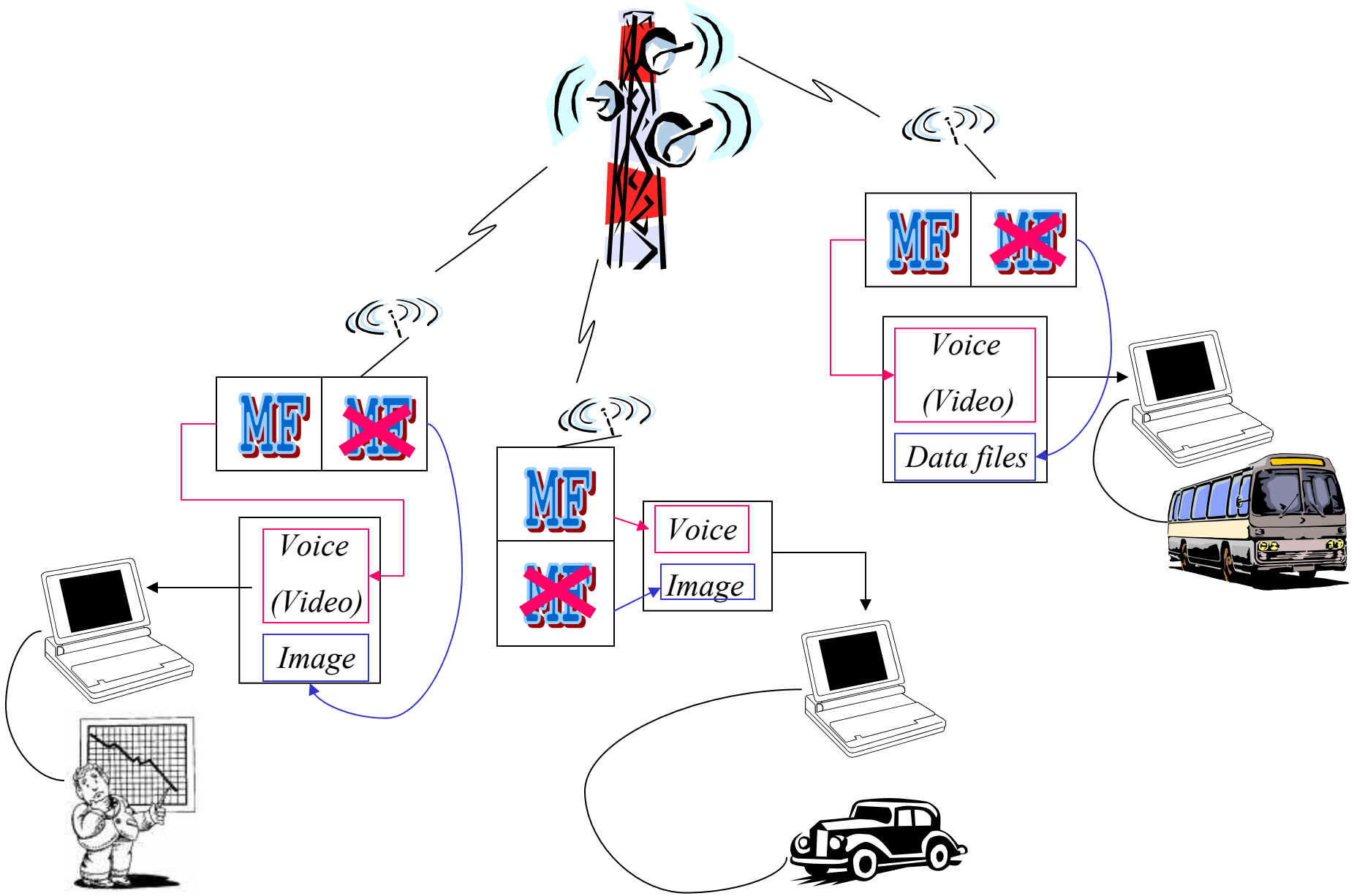
Overview

- QoS provisioning for multimedia streams requires efficient resource management
  - Access Control: efficient multiplexing among bursty streams with varied QoS
  - Receiver design (multiuser detection - MUD): improves power efficiency
- Can we combine access control with detection ?
- Relevant issues for the joint design:
  - Activity/burst detection, power control feasibility, receiver filter update, implementation associated with uplink/downlink

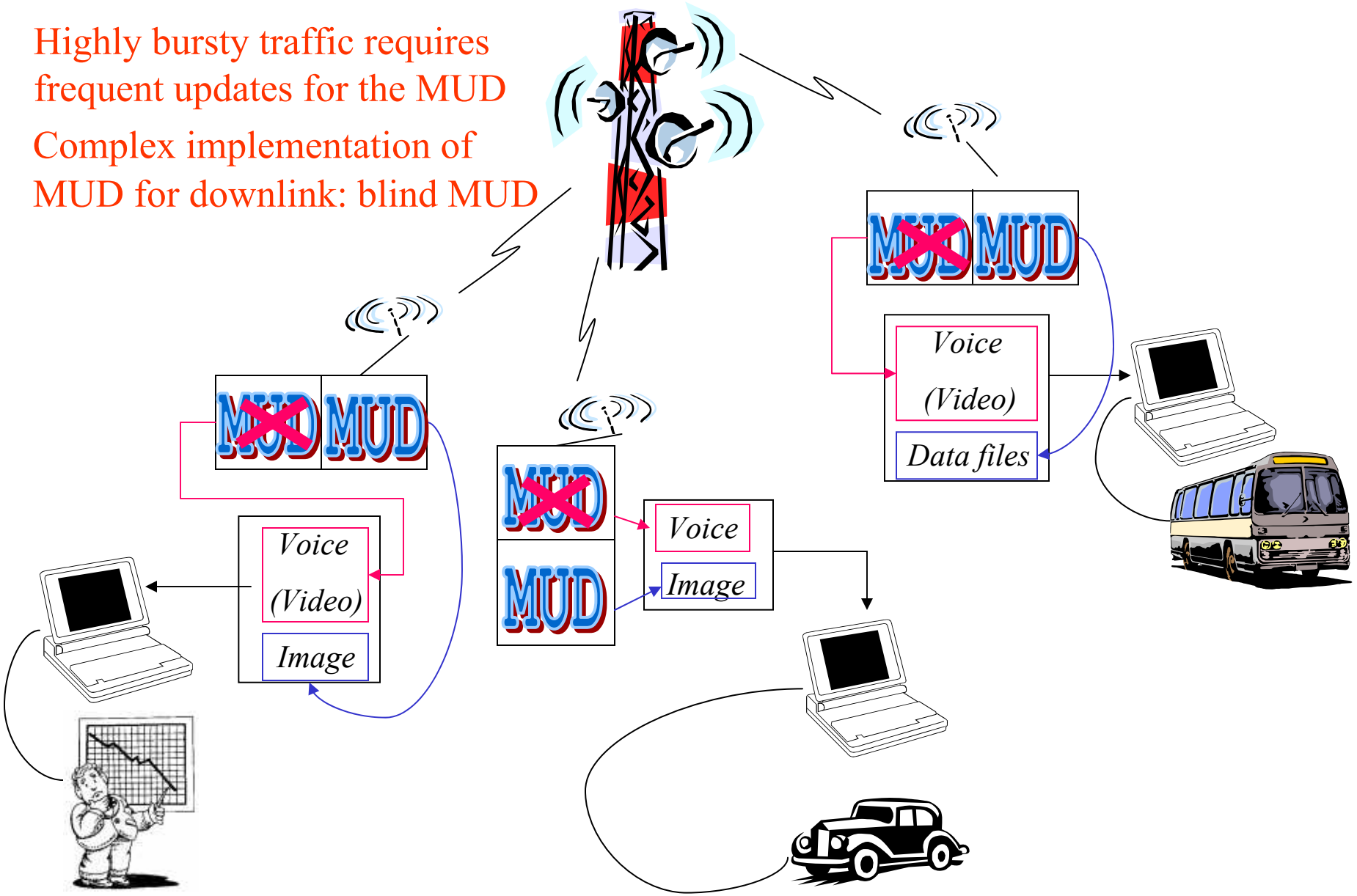
Receiver Design for Multimedia Communications



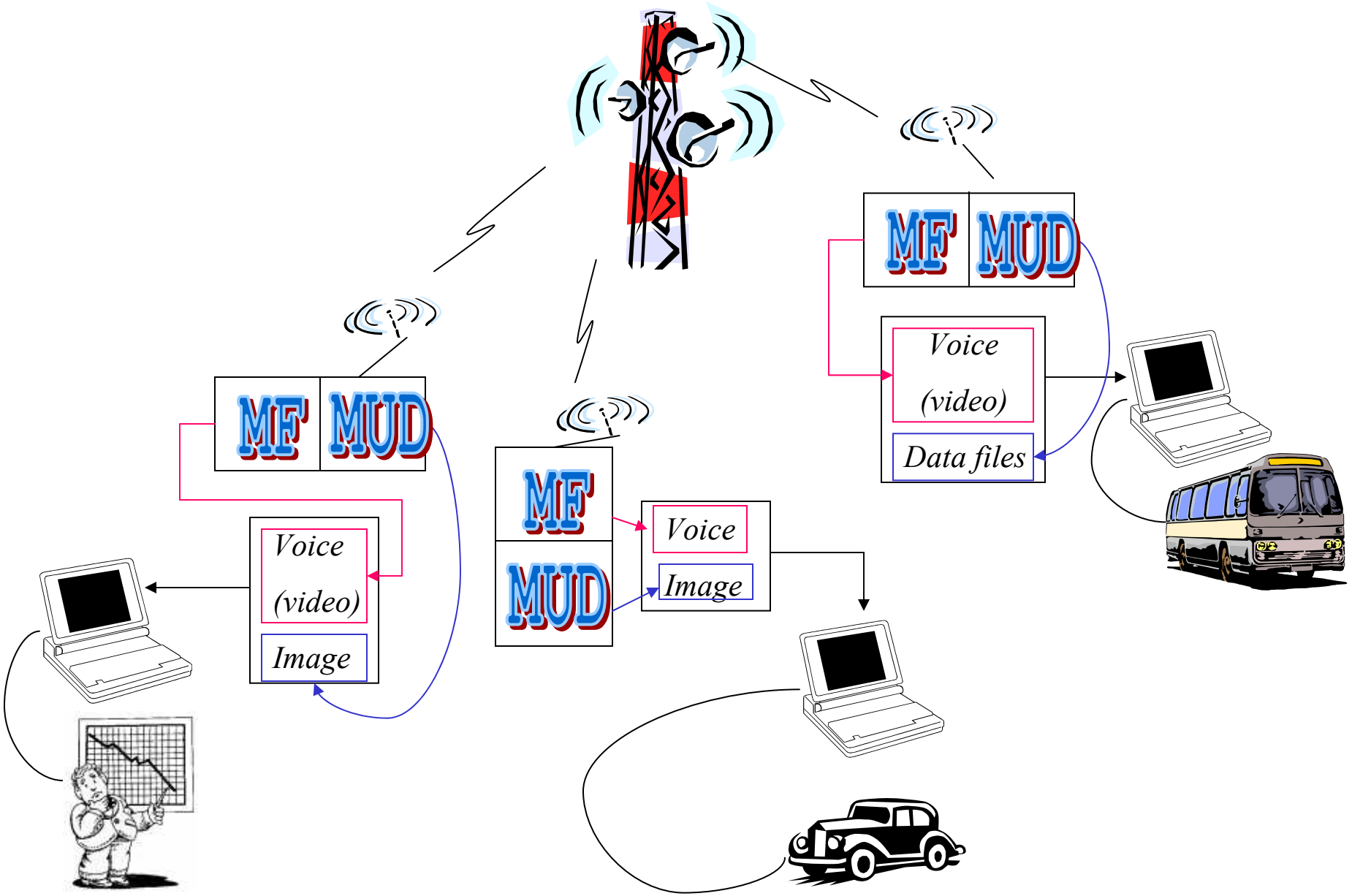
Receiver Design for Multimedia Communications

Highly bursty traffic requires frequent updates for the MUD

Complex implementation of MUD for downlink: blind MUD



Receiver Design for Multimedia Communications



Different Receiver scenarios

- Uniform Matched Filter (U-MF): both voice and data use MF
- Uniform MMSE (U-MMSE): both voice and data use MMSE
- Partial Hybrid CDMA system: MF for voice, MMSE for data

  - Implementation: voice treated as background noise

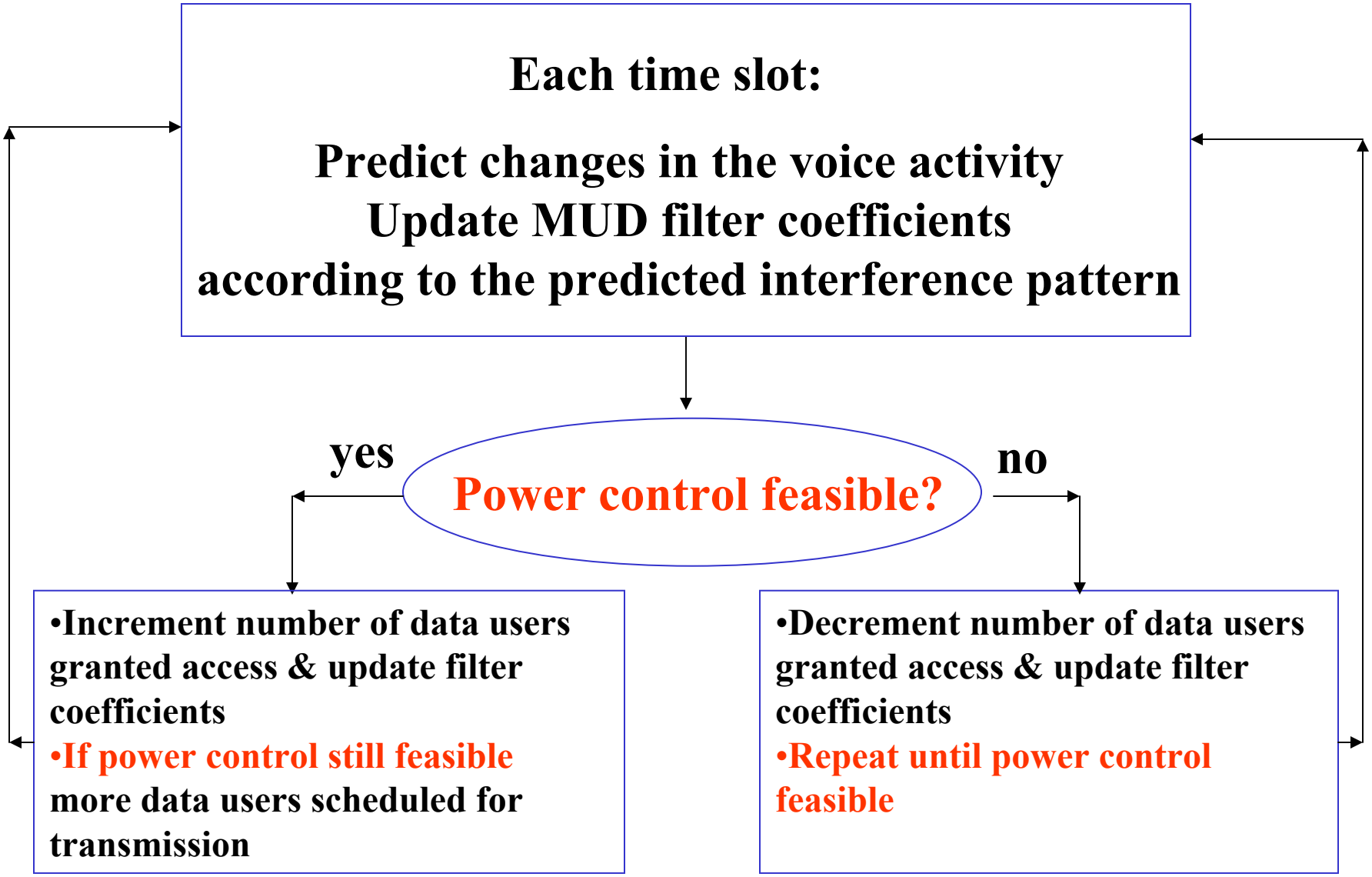
  - Advantage: Reduced implementation complexity:
    - No need to know the signature sequences for the real time traffic
      - Can be easily used in conjunction with access control
    - For fixed data rate transmission, no need to implement multirate multiuser detector receivers

  - Disadvantage: Reduced capacity: asymptotic bidimensional capacity analysis to characterize capacity loss (not addressed in this talk)

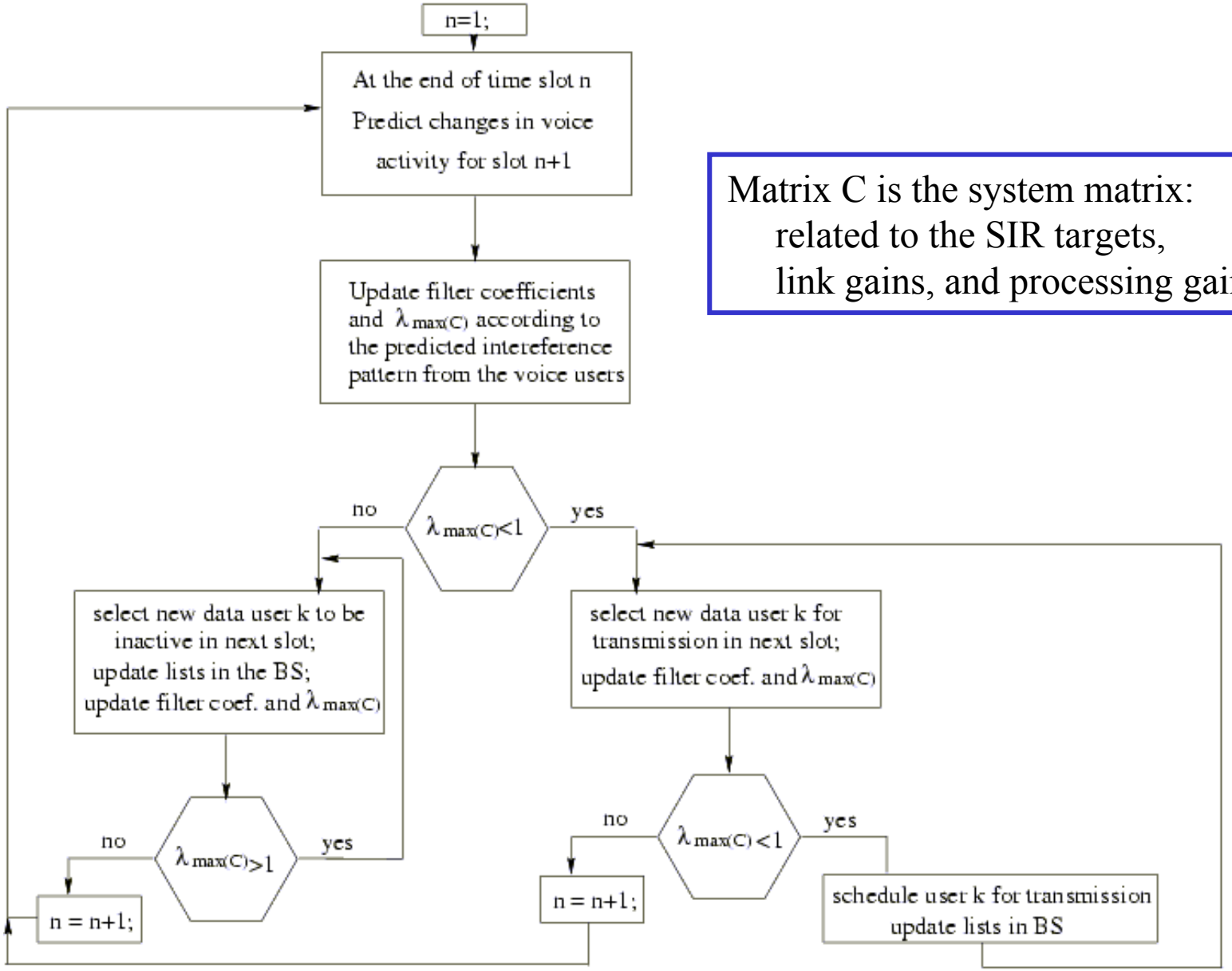
Joint Access Control and Receiver Adaptation

- QoS requirements:
  - BER: target SIR guaranteed by the power control feasibility condition
  - Delay: guaranteed by the access control based on voice activity prediction
- Power control feasibility:
  - Requirement: all users achieve their target SIR choosing appropriate power and receiver filter coefficients
  - Reduces to an eigenvalue condition (Perron-Frobenius theorem)

Joint Access Control and Receiver adaptation



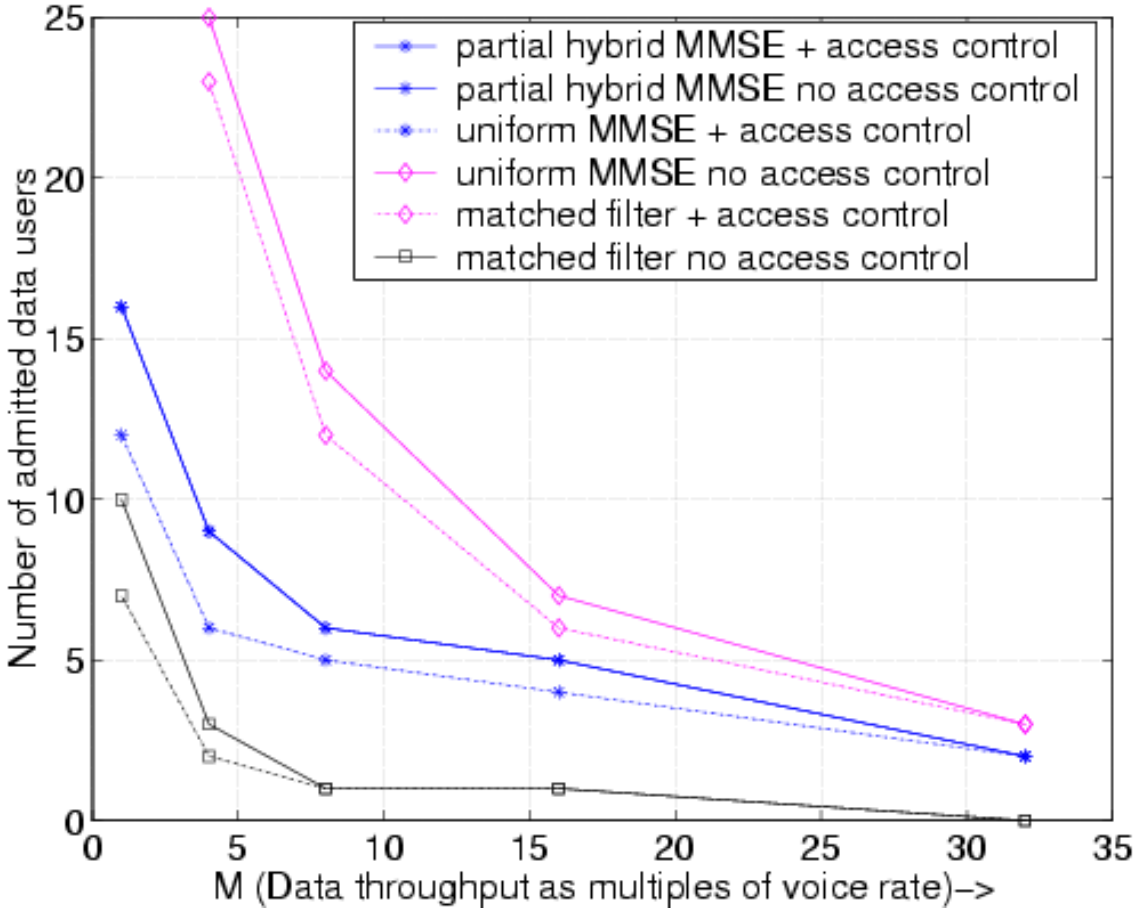
Joint Access Control and Receiver adaptation Algorithm



Matrix C is the system matrix:
related to the SIR targets,
link gains, and processing gains

Capacity comparison

10 ongoing voice calls
voice activity coef. 0.4
W = 1.25 MHz
SIR req. 7dB for voice,
10 dB for data
G_v = 128 – voice spreading gain
$G_d = G_v/M$ – data spreading gain



Access control guarantees M*9.6 Kb/s data throughput per user

Conclusions

- Joint access control and receiver design improves system capacity while guaranteeing QoS for multimedia traffic
- Relevant design issues:
  - Activity/burst detection, power control feasibility, receiver filter update, implementation related to uplink/downlink
- Implementation scenarios: uniform MF, uniform MMSE and hybrid partial MMSE
- The hybrid partial MMSE: good tradeoff between the implementation complexity and system performance
    - Higher capacity than the uniform MF
    - Lower implementation complexity than the uniform MMSE