



Information Sciences Institute

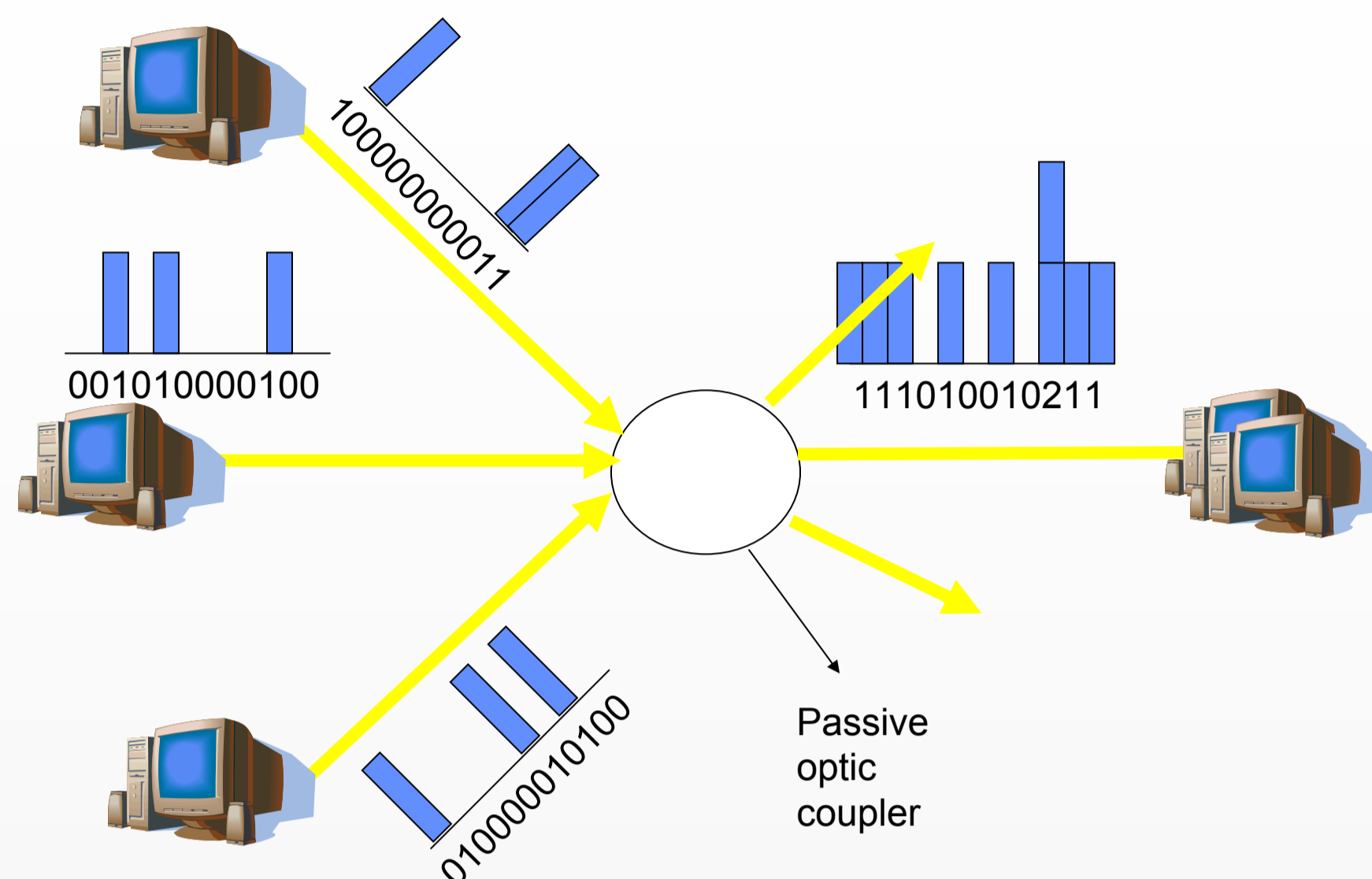
# Interference Avoidance in Optical CDMA LANs

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## Physical layer based on Optical CDMA

- Unipolar codewords
- A family of (0,1) sequences
- Auto- and cross-correlation constraints
- Length  $N$ , weight  $w$ , maximum cross-correlation  $\kappa$
- ON-OFF keyed modulation



## Media access control

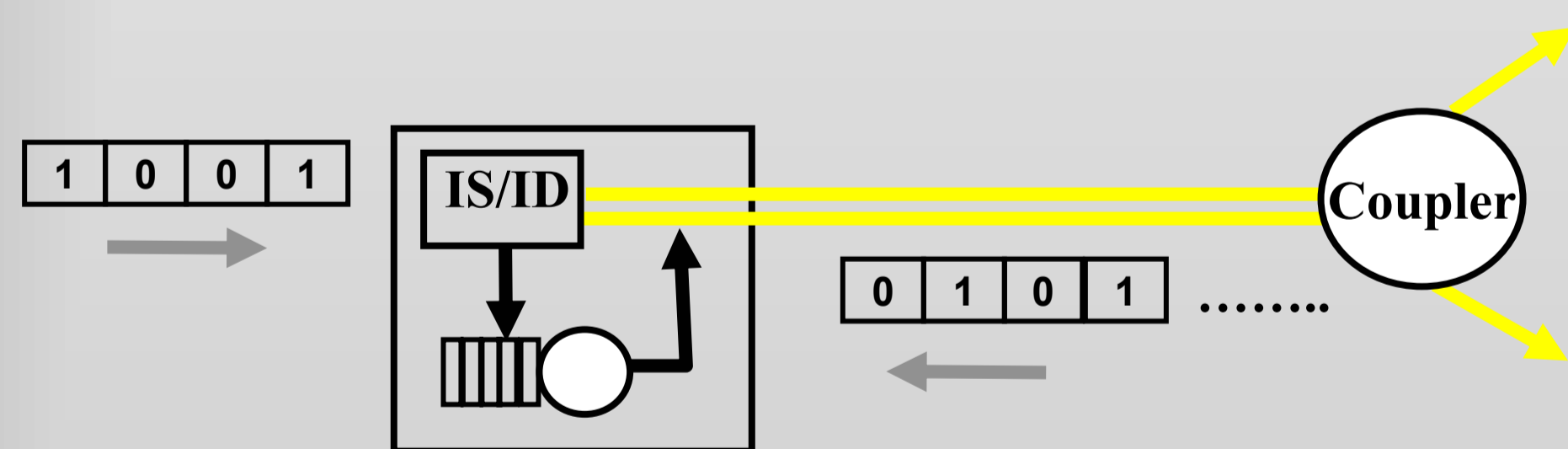
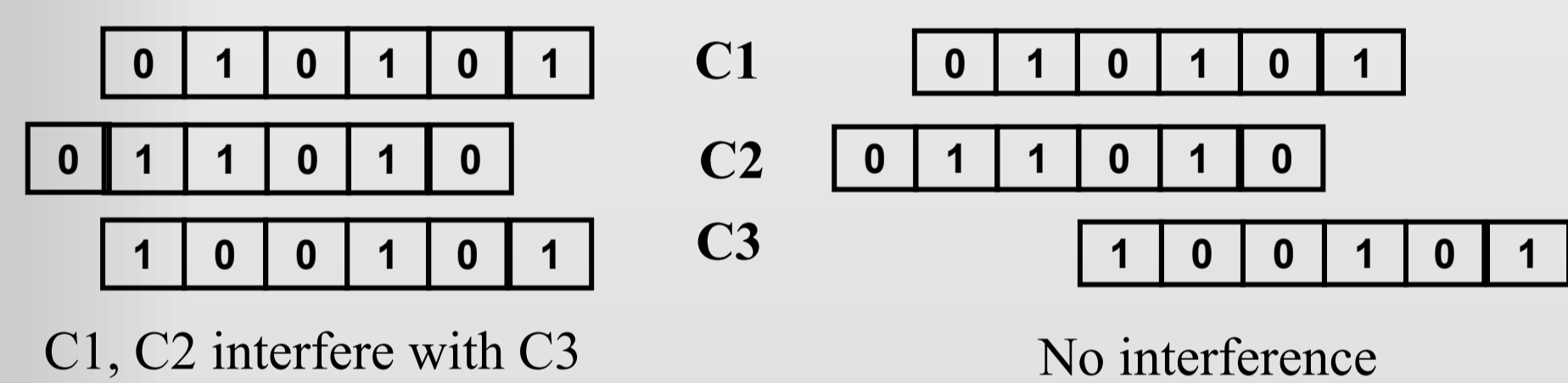
- Aloha-CDMA
- Low interference at low loads
- Multi-user interference increases with offered load: throughput degradation

## Network Architecture

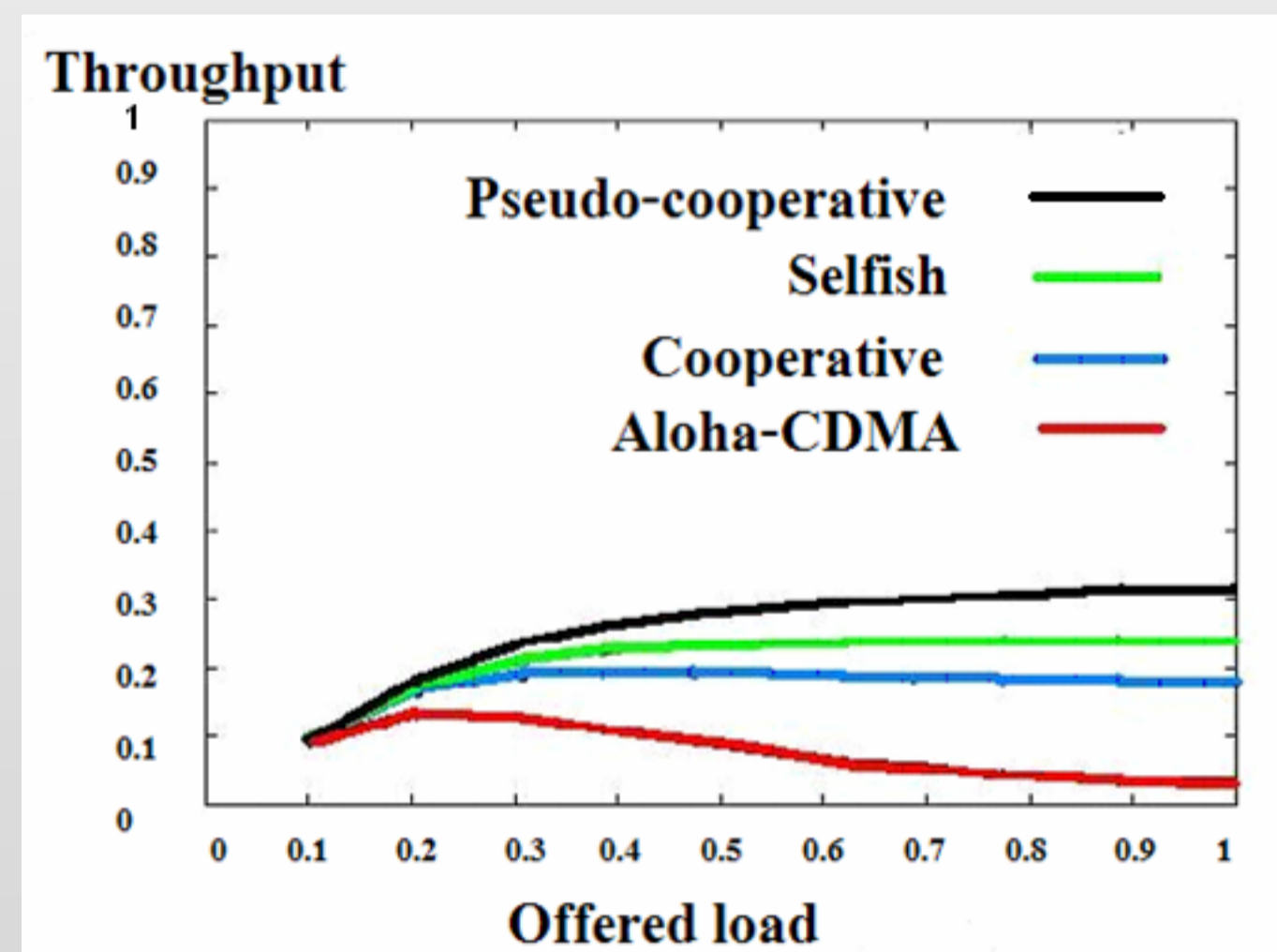
- Shared medium local area network
  - Optical fiber
  - Passive star coupler
- Star or bus topology
- Single wavelength
- Optical CDMA physical layer
- Tunable transmitter–fixed receiver
- Correlation receiver
- Node addresses mapped to codewords

**Problem: Low throughput at high loads due to multi-user interference**

## Interference Avoidance



- State estimation
  - Nodes estimate the state of the line
  - State of the line: sum of the codewords on the line
- Transmission scheduling based on estimated state
  - Aloha-CDMA: transmit on arrival
  - Selfish: attempt to maximize transmitter's throughput
  - Cooperative: attempt to maximize network throughput
  - Pseudo-cooperative: attempt to limit number of chip overlaps
- Prevents throughput degradation at high loads



## Results

- Algorithms
  - Analysis of state estimation and transmission scheduling based on probabilistic and Markovian modeling
    - Upper bound on throughput
  - Validation through simulation with real network traffic
- Testbed
  - Testbed constructed from discrete optical components
  - Lasers, FDLs, EDFAs, couplers, threshold detectors

**Interference avoidance can prevent throughput degradation of an OCDMA LAN at high loads**