Proposal for 2.4-GHz PAR
March 1998 Update

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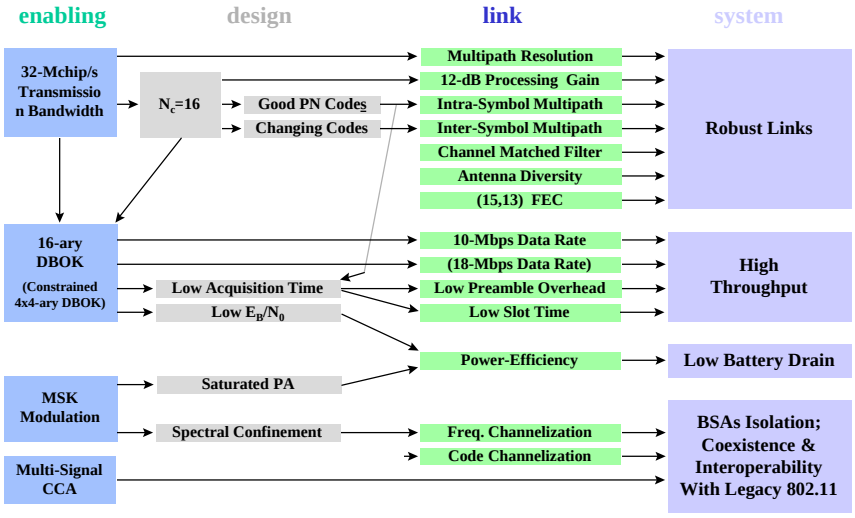
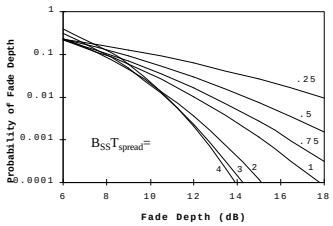
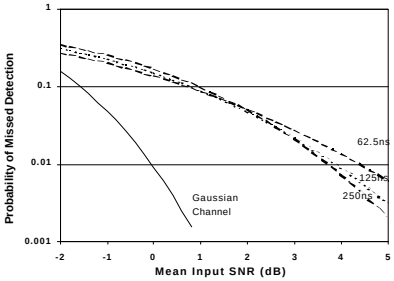
Key Features



Robust Links

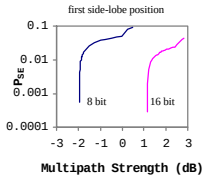
- Resolving paths gives more independent trials
- **D11-97/119** demonstrates for diffuse Rayleigh
- Even better with specular multipath
- Rayleigh Channel Detection Performance:

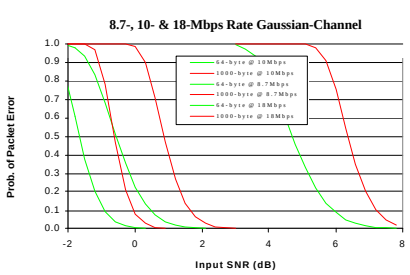


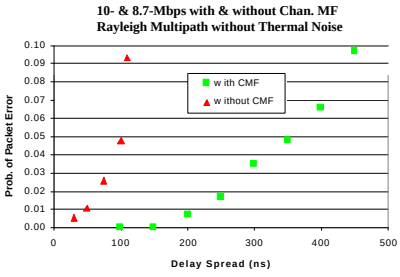


Robust Links

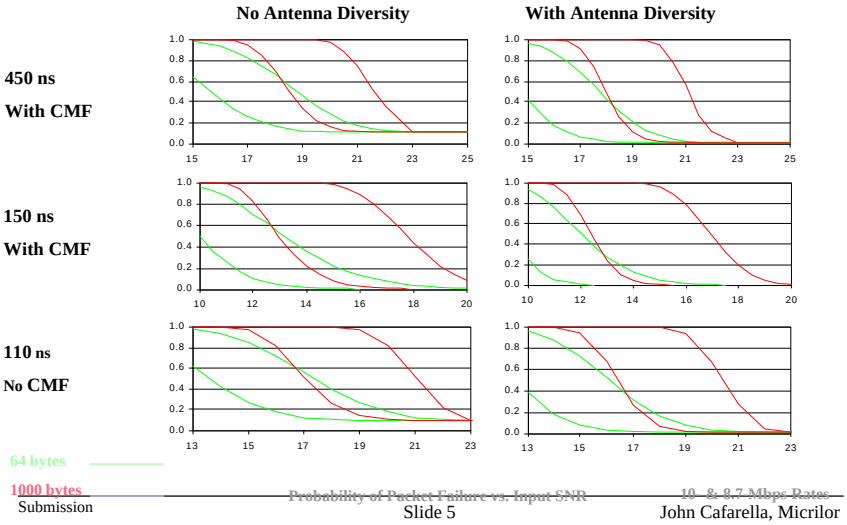
- **D11-97/117** documents preferred 16-bit codes
- **D11-97/120** compares 8- and 16-bit performance
-
- Gaussian- and Noiseless Rayleigh-Channel Results:







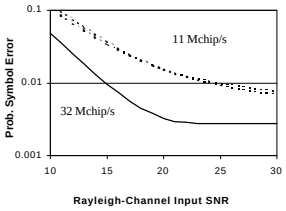
Robust Links



Robust Links

Perspective on “Reduced-Complexity” Implementation

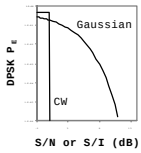
Wider bandwidth gives “multipath diversity” as shown here for **simple Gaussian-Channel receivers** operating in 50-ns Delay Spread.

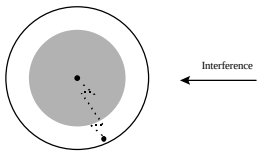


- For 16-DBOK @ 32-Mchip/s Using Channel Matched Filter
  - •CMG enables operation for >100 ns at cost of ~2K gates
  - •FEC adds ~2 dB at cost of ~1K gates
  - •Diversity adds ~1 dB at cost of antenna, Div. Switch (&connector)
- •No Leverage in Carrying Two Chip Designs (Nearly the Same)
- •Great Leverage in PCMCIA Board Design Leaving out Diversity

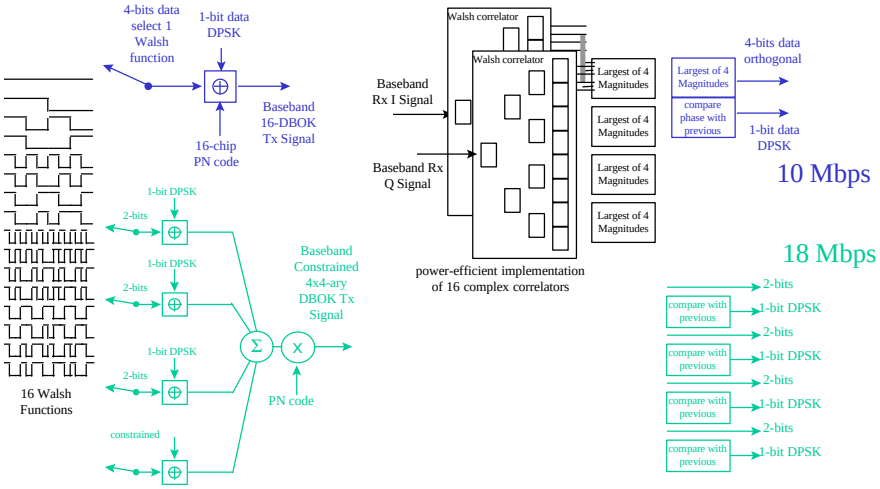
Robust Links

- Processing gain of 12 dB
- 10-Mbps Operation with
  - Arbitrary Interference 2-dB Below Signal
  - CW Interference Equal to Signal
- **D11-97/116** shows PG for CW vs. Gaussian
- 3 dB increase in PG is Factor of two in (free-space) area coverage

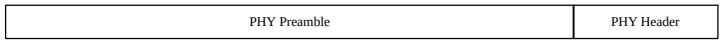




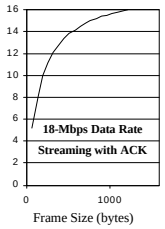
High Throughput

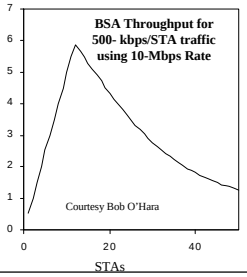


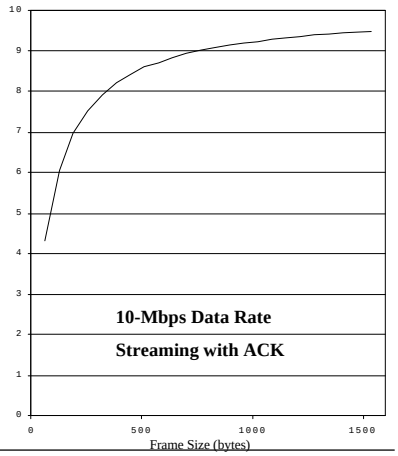
High Throughput



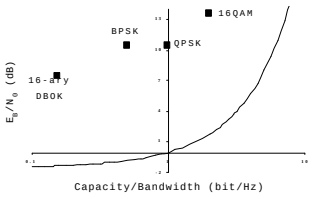
- 20-µs PHY Preamble
- No PLL Settling Time
- Multiple Correlators for Rx Detection
- Matched-Filter Assist for Adaptation
- Matched Filter for CSMA Detection
- Slot Time = SIFS = 9 µs

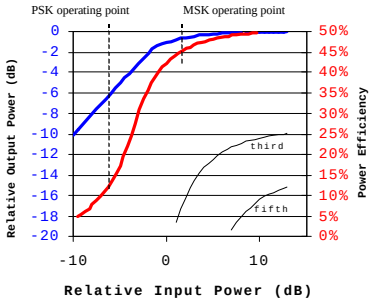






Power Efficiency





- Expands data bandwidth to spread bandwidth
- 7.4 dB E_B/N_0 for 10^{-6} P_{SE}
- Approximately 3 dB more efficient than DPSK
- MSK allows operation into power-amp saturation
- PA efficiency greatly improves
- **D11-97/118** describes low-cost implementation

Coexistence/Interoperability

- Multi-signal CCA described in **D11-97/128**
- Matched-filter detection of 11-Mchip/s Barker code
  - – Interoperability with Legacy DSSS Possible
- Aliased Detection of Legacy FH in 10-Mbps passband
- Allows 10-Mbps transmissions to defer to legacy systems
  - – as non-cooperative measure, where desired
  - – cooperative measures (DS & FH) also possible
- CCA operates only for slot time before 10-Mbps transmission
  - – no impact on power dissipation

Code Channelization

- Best 8 (of 2048) Code Cosets for Demodulation
  - – used in two groups of 4 cosets each
  - – 48 cyclic channels (best in multipath)
  - – 64K pseudorandom channels (for un-coordinated BSAs)
- Best 8 (of 16K) Codes for Search and Acquisition
- Many Strategies for Code Assignment
- Combined With Frequency Channels for BSA lay-down
  - – Rejection of Interference from Closest Neighboring BSAs

Frequency Channelization

- Legacy Channel Center Frequencies
- 32-mchip/s Possibilities
  - two 10-/18-Mbps
  - one 10-/18- plus one 2-Mbps
- Possibilities If 16-mchip/s Included
  - one 10- plus one 2- or 5-Mbps
  - three total 5- and/or 2-Mbps
- May Be Mixed Spatially as Required

Channelization

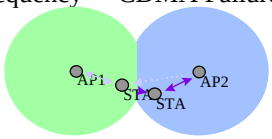
- Three-Frequency/One-Code Deployment
  - – Re-use of frequency channels demands sharing capacity (802.11)
- Two-Frequency/Many-Code Deployment
  - – Re-use of frequency channels can be shared or independent
- Isolation for High System Capacity:

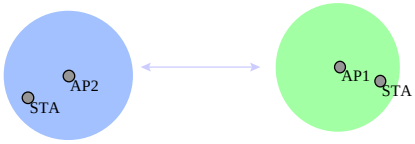
Three-Frequencies/One-Code	**Two-Frequencies/Many-Codes**
Interference Rejection Stronger	**Interference Rejection Weaker**
Leakage Rejection Weaker	**Leakage Rejection Stronger**

- Cell-Overlap vs. Spatial-Re-Use

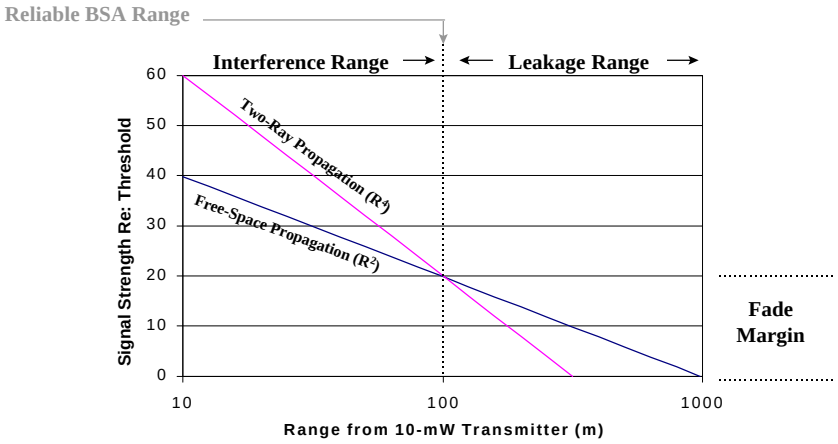
Channelization

- Interference Rejection
  - – Interference > Signal on same frequency = CDMA Failure
  - – Near-in Frequency Re-Use
  - –
- Leakage Rejection
  - – Weak signal above threshold
  - – Can limit capacity
  - –
- Deployment dependent



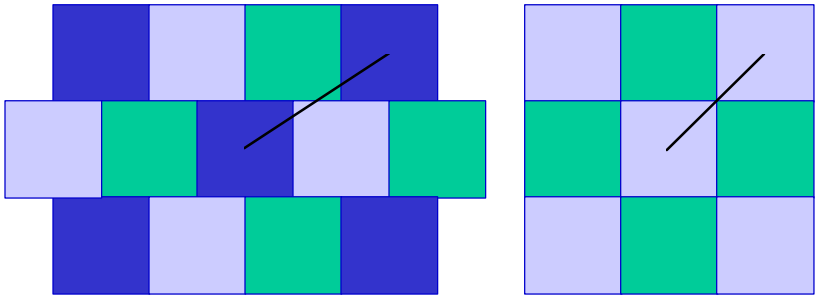


Channelization



Channelization

3 vs. 2 Frequency Channels Does Not Ensure Performance



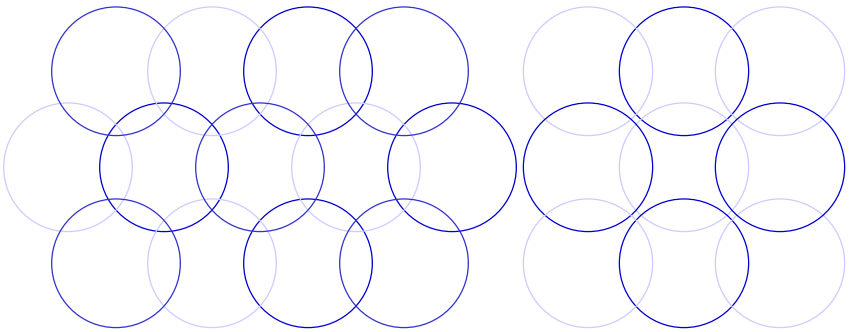
Three-Frequency-Channel Deployment

4 re-use neighbors at 1.66 relative separation
Nearest separation not = zero

Two-Frequency-Channel Deployment

4 re-use neighbors at 1.41 relative separation
Nearest separation = zero

Channelization

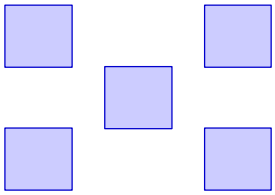


3-Frequency/1-Code Deployment

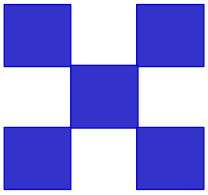
2-Frequency/Many-Code Deployment

Three frequency channels lessens same-frequency-channel interference (CDMA failure) but does not help same-frequency-channel re-use

Channelization

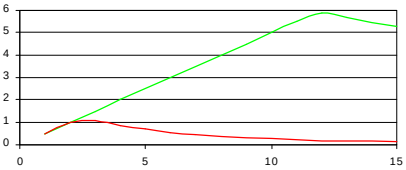


1 of 3 Frequencies on Same Code



1 of 2 Frequencies on Different Codes

Throughput per BSA using 10-Mbps @ .5 Mbps/STA Offered Traffic



STAs/BSA

Courtesy of Bob O'Hara

This needs refinement, but the effect is real.

Leakage Assumed 0% for Green and 100% for Red; Interference not Included Here

Near/Far Interference Examined in Separate Simulation (Mori/Clarion)

For Next Time: One Simulation to Include Both Near/Far and Leakage Effects