Proposal for 2.4-GHz PAR

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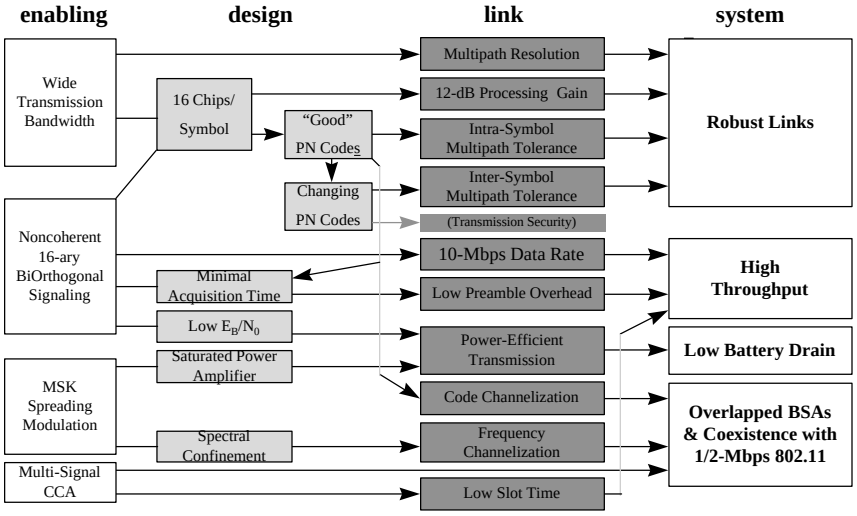
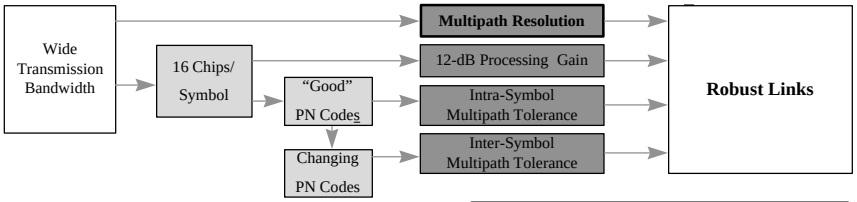
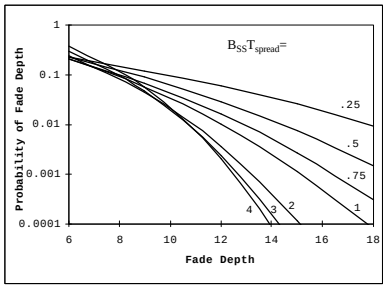
Key Features



Robust Links



- Resolving paths gives more independent trials
- Reduced strength per path, but
- Low probability that all fade
- **D11-97/119** demonstrates for diffuse Rayleigh
- Even better with specular multipath



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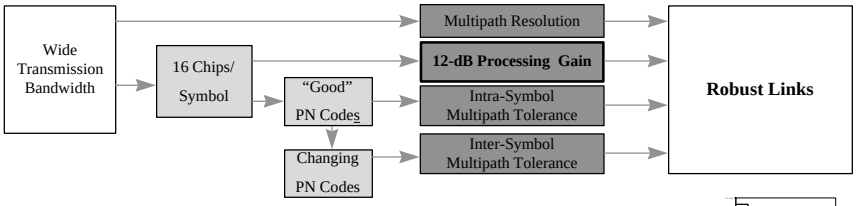
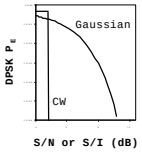
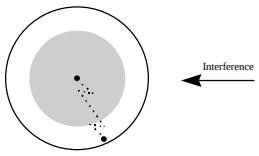


- Functional processing gain (PG) of 12 dB
- **D11-97/116** shows flaw of "computed" PG
- 3 dB increase in PG is significant
  - Factor of two in area coverage (free-space)
  - (would anyone take a 3-dB cut in pay?)





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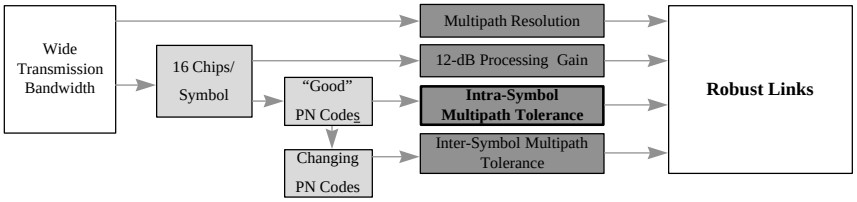
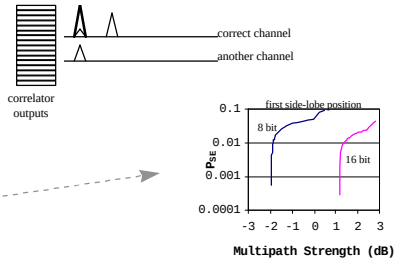


- Test with specular multipath, without noise
  - must consider crosscorrelation side lobes
- **D11-97/117** documents preferred 16-bit codes
  - best 8 of 2048 cosets
- **D11-97/120** compares 8- and 16-bit performance
  - 3-dB better for 16-bit codes
  - 4-dB "gap" as multipath varies



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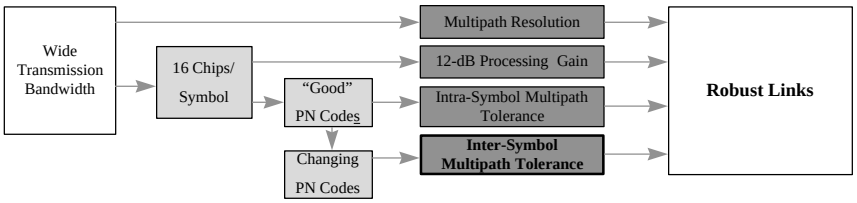
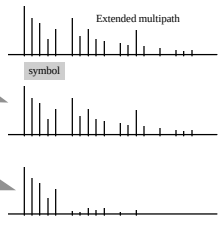
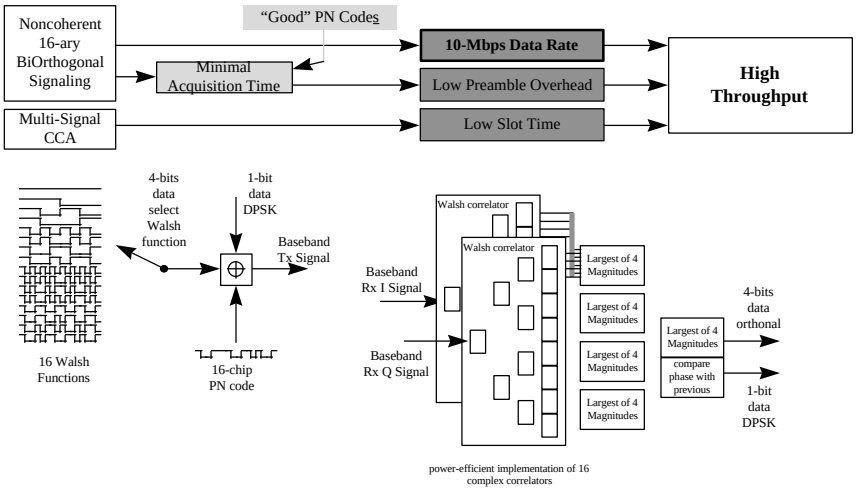


- Repeated spreading code correlates with far-out multipath
  - strong intersymbol interference (ISI)
- Use 4 cosets cyclically
  - no correlated ISI for four symbols
- Could use 8 cosets, but
  - not really needed
  - better to have 2 groups of 4 codes for spatial re-use



High Throughput



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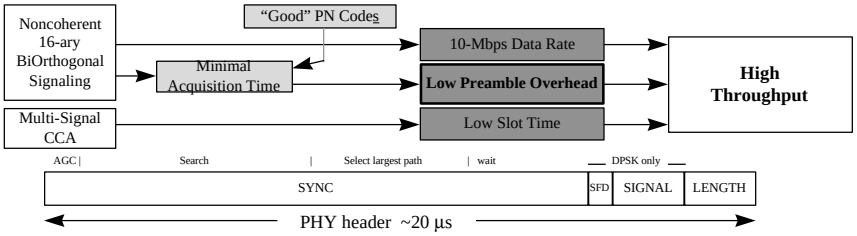
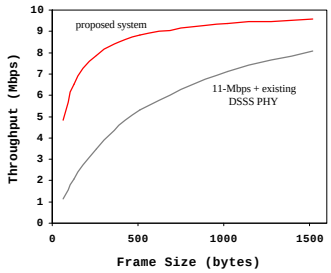
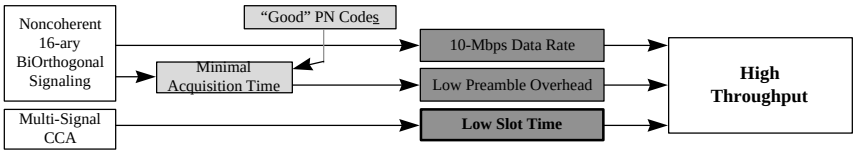


- Noncoherent: no PLL, no settling time
- Good PN codes: no equalizer, no adaptation time
- DPSK on SFD & SIGNAL: no CRC required
- ~ Order-of-magnitude shorter than current DSSS PHY

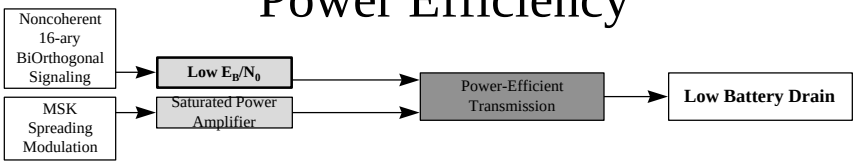


High Throughput

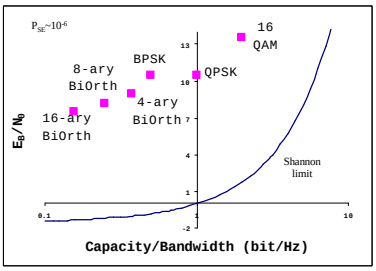


- Matched-filter detection of 10-Mbps preamble
  - 1 sample/chip; 3-of-3 symbols to boost P_D/P_{FA} performance
  - not an issue in setting slot time (~ 3 symbols detect time)
- Matched filter only operates slot time before transmission
  - no impact on power dissipation
  - correlator performs normal (Rx mode) acquisition
  - matched filter queues correlator (CCA mode) if CSMA detection

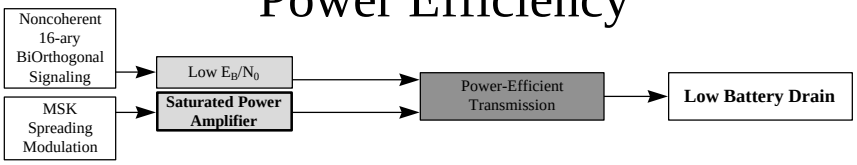
Power Efficiency

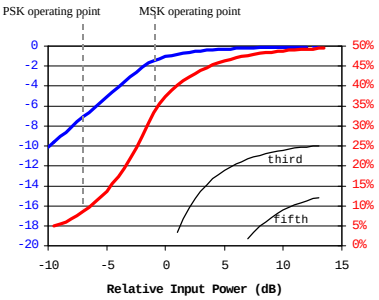


- Expands data bandwidth to equal spread bandwidth
- 7.4 dB E_B/N_0 for 10^{-6} P_{SE}
- Approximately 3 dB more efficient than DPSK



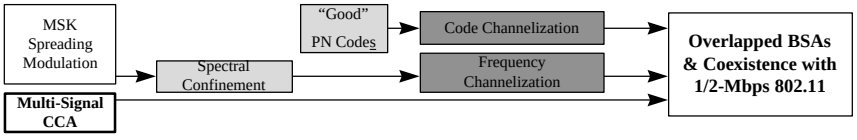
Power Efficiency





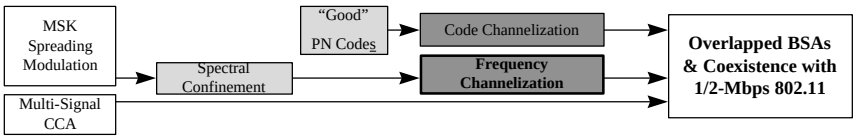
- MSK allows operation into power-amp saturation
- PA efficiency greatly improves
- **D11-97/118** describes generation and performance
  - low-cost implementation
  - operates at high chip rate
  - works fine at PA 1-dB compression point

Channelization and Coexistence

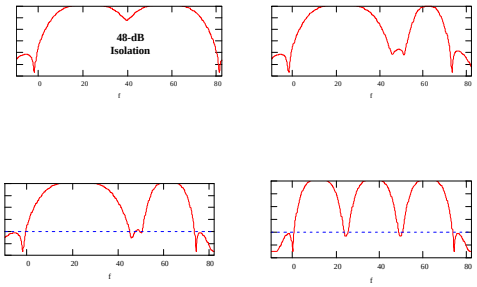


- Multi-signal CCA described in **D11-97/128**
- Matched-filter detection of 11-Mchip/s Barker code; preamble or data
- Feature detection of 1-Msymbol FSK on 802.11 FH frequencies in 10-Mbps passband
  - excellent sensitivity for preamble
  - -good sensitivity for 1- or 2-Mbps data (similar to 802.11 FH)
- Allows 10-Mbps transmissions to defer to legacy 1-/2-Mbps where desired
- CCA only operates slot time before 10-Mbps transmission
  - no impact on power dissipation

Channelization and Coexistence

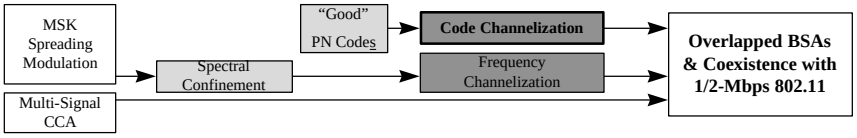


- MSK enhances channelization
- 32-Mchip/s options
  - two 10-Mbps (48-dB isolation)
  - a 10- & a 2-Mbps
  - three 2-Mbps
- options if 16-Mchip/s
  - a 10- & a 2- or 5-Mbps
  - three total 5- and/or 2-Mbps



D11-97/118 describes MSK generation

Channelization and Coexistence



- Selected best 8 codes (of 2048) for demodulating data in multipath
- Selected best 8 codes for preamble search (and acquisition) in multipath
- Mutual rejection much better than "random" implied by processing gain
- Many strategies for code assignment
  - unique pairing of data/search codes gives 8 code channels
  - arbitrary pairing of data/search codes gives 64 code channels
  - intra-frame code changing greatly expands the possibilities
- Can be combined with frequency channels
  - doesn't suffer frequency channel cross-talk (as with only one code)

D11-97/117 describes data codes

Summary of Possible Data Modes

Chip Rate	Modulation Option	Data Rate	Threshold
32 MHz[1]	~~DPSK~~	~~2 Mbps~~	~~-95 dBm~~
	16-ary BiOrthogonal	10 Mbps	-92 dBm
	16-ary BiOrthogonal with (15,13) FEC	8.7 Mbps	-94 dBm
	4 x 4-ary BiOrthogonal[3]	18/24 Mbps	-86 dBm
16 MHz[2]	~~DPSK~~	~~1 Mbps~~	~~-98 dBm~~
	16-ary BiOrthogonal	5 Mbps	-95 dBm
	16-ary BiOrthogonal with (15,13) FEC	4.3 Mbps	-97 dBm
	4 x 4-ary BiOrthogonal	9/12 Mbps	-89 dBm

[3] primary use North America [2] primary use Japan/Europe [3] see **D11-97/130** (5-GHz PAR proposal)