July 7, 1998 doc.: IEEE 802.11-98/267

A Review of the Alantro 11Mbps Proposal

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The Alantro Proposal

- QPSK @ 11Msps
- Basic Rate: 11Mbps (R = 1/2), 64 state BCC
  - Coding Gain of ~ 7dB
- Variable rate via puncturing (500kbps possible)
- Excellent Multipath performance with reasonable complexity

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How did Alantro get here?

- **Objective:** ***create a standard that will realistically meet the goal of robust, cost effective, transmission in excess of 10Mbps***
- **Studied existing proposals (summer '97)**
- **Decided Harris was best starting point**
  - **MBOK "code" weak**
    - **Small coding gain**
    - **Problems with joint M.P./Decoding**
- **Studied BCC**
  - **Larger gain**
  - **Reasonable Complexity**
  - **Good match to joint M.P./decoding**

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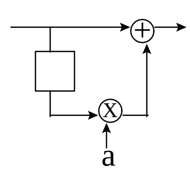
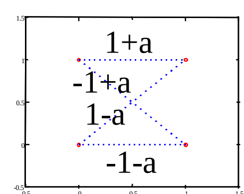
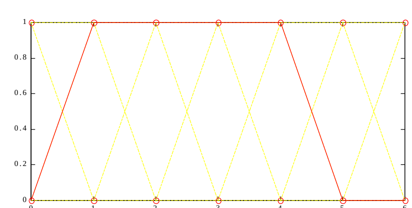
Trellises: A unifying concept for digital transmission

- **Multipath: $h(z)=1+az^{-1}$**







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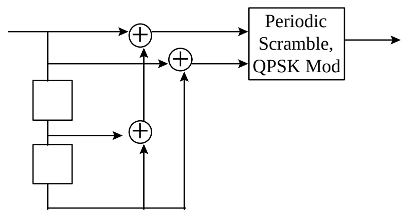
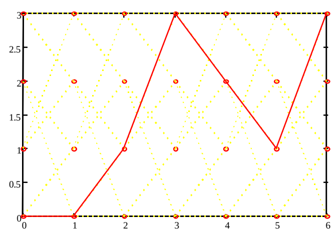
BCC Trellis

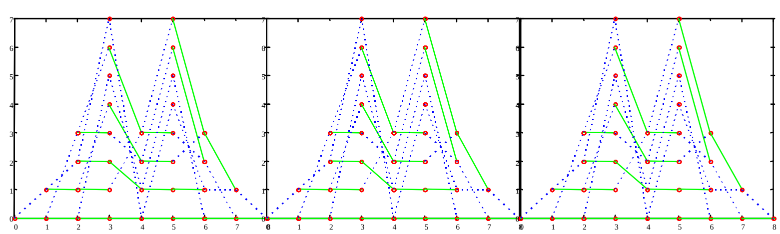
- G = [1+D+D^2, 1+D^2]
- **The regular trellis structure is consistent with the multipath trellis**
- **Scrambling helps with multipath robustness**
-





Trellis of a Block Code

- **(n=8, k=4, d=4) F_2**
- **The irregular trellis structure makes it difficult to jointly demodulate/decode**



CCK code (n=8, k=4) Z_4 [(n=16, k=8) F_2]

- G = [1 1 1 1 1 1 1 1] a = [0 0 0 2 0 0 2 0]
  [1 0 1 0 1 0 1 0]
  [1 1 0 0 1 1 0 0]
  [1 1 1 1 0 0 0 0]
- c = **m**G+**a** (over Z_4)
  – A linear code (**m**G) with scrambling (**a**)
- d = 4
- Number of Nearest Neighbors = 24

Code Performance

- **Free Distance (AWGN tolerance)**
  - **Coding Gain**
  - **BER vs Eb/No**
- **Complexity**
  - **Additions/bit**
  - **Comparisons/bit**
- **Multipath Robustness**
  - **Joint Demodulation/Decoding**
  - **BER vs Eb/No with Delay Spread**

Examples

- **(n=2, k=1, v=2) [4 state BCC]**
  - **d = 5 (3.97 dB), adds = 12, cmps = 4**
- **(n=8, k=4) E.H.C. - F_2 [MBOK]**
  - **d = 4 (3.01 dB), adds = 14, cmps = 3.75**
- **(n=8, k=4) Z_4 [CCK]**
  - **[(n=16, k=8) F_2]**
  - **d = 4 (3.01 dB), adds = 32, cmps = 8**
- **(n=2, k=1, v=6) [64 state BCC]**
  - **d = 10 (6.99 dB), adds = 132, cmps = 64**

Block versus Convolutional Coding

- BCC's are a well established technique that dominates successful standards
  - v.34, v.90, HDTV, DirectTV, CDMA cell phones, 802.14, HDSL-2, …
  - Block codes???
- BCC's have a consistent trellis structure that compliments the trellis of the multipath

802.11 Code selection

- Consider which coding options will provide for the best trade-off between AWGN performance, complexity and multipath robustness
- Comparison of coding techniques should be made on a quantitative technical basis
- Programmable code??? (v.34, HDSL-2,…)