Experimental Results for Extensions to the IS-136 TDMA Standard Based on Higher Level Modulation, Coherent Detection, and Equal Gain Antenna Combining

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Outline of Talk

- Options investigated to enhance IS-136 system
- IS-136 basics/enhancements
- Experimental system
- Performance results
- Conclusions

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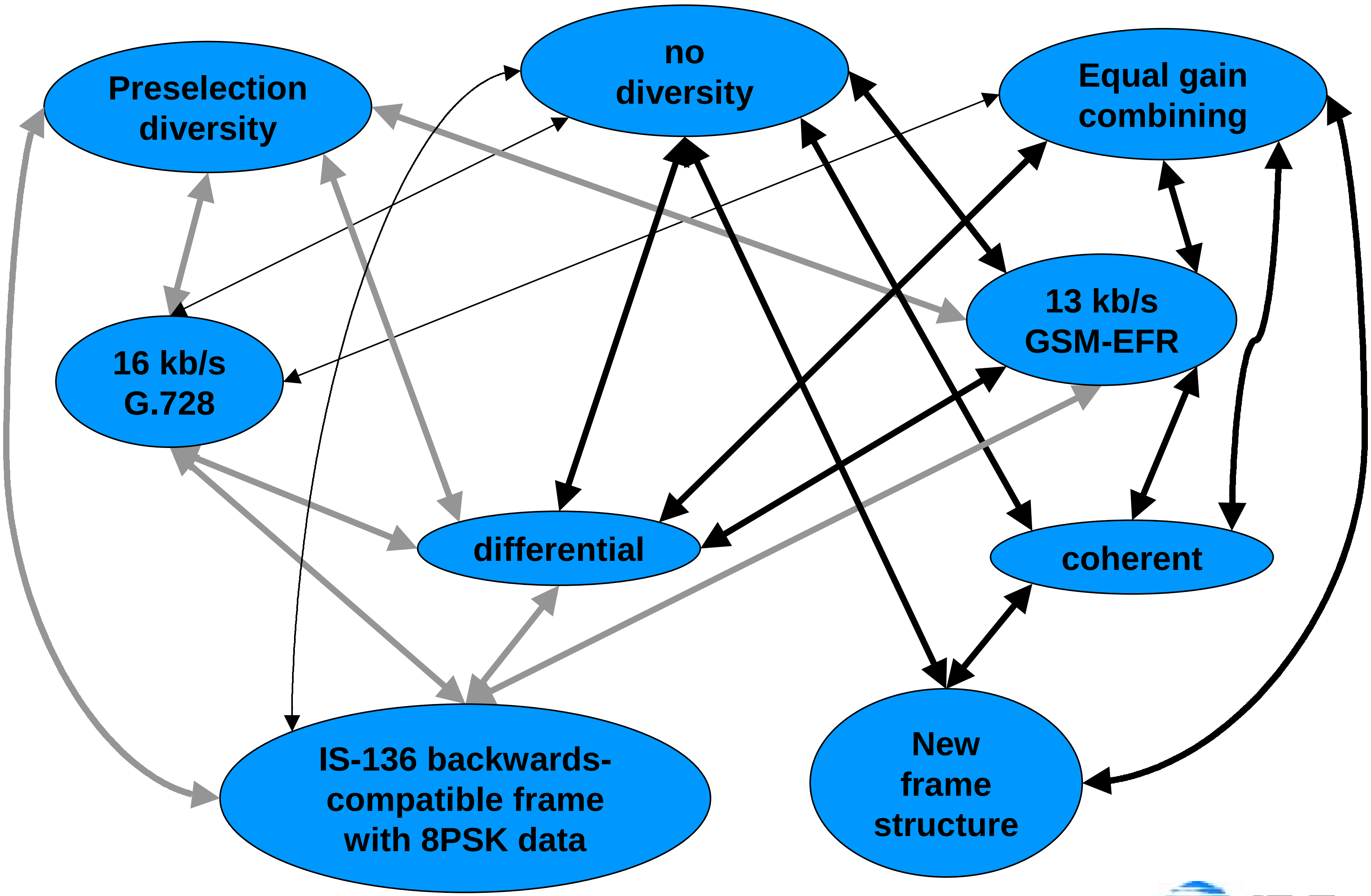
Options Considered



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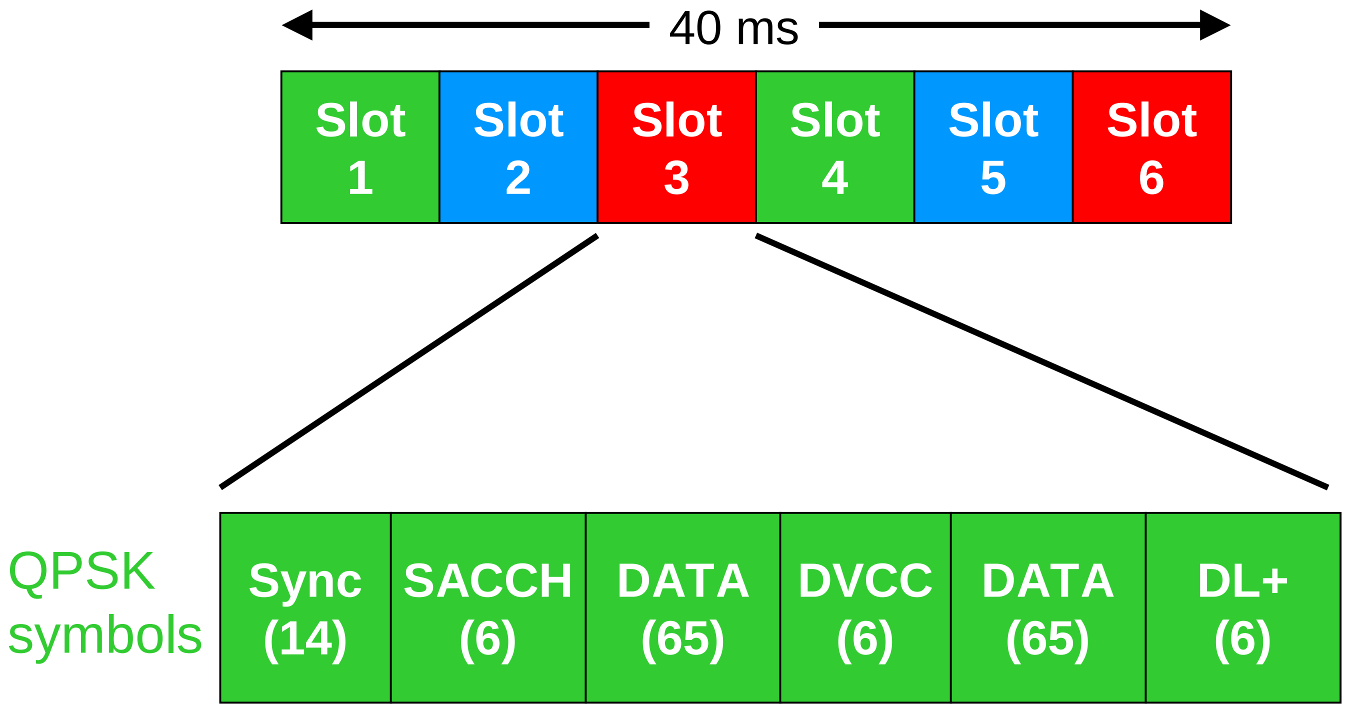
Existing IS-136 Frame Structure
(downlink)



- **Provides 8 kb/s end user data rate**

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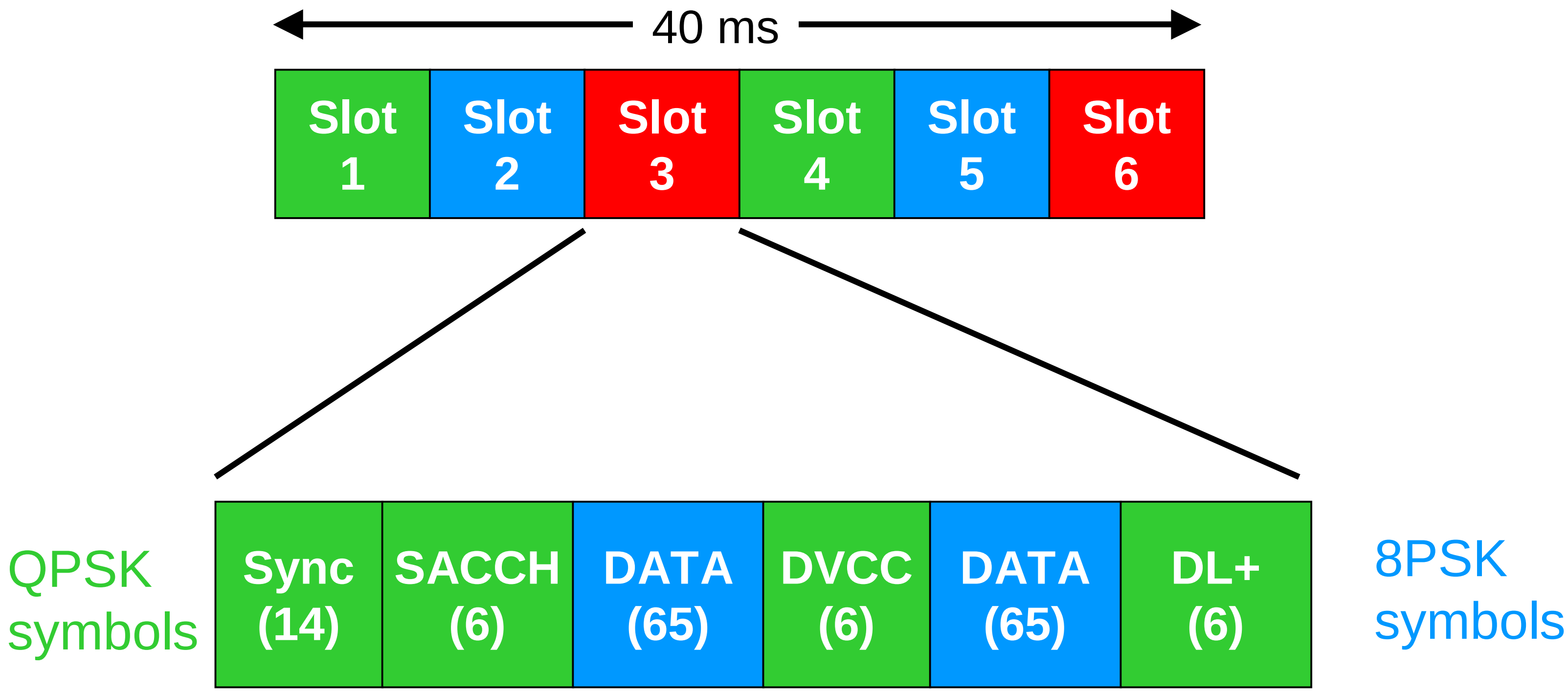
IS-136+ Frame Structure
(backwards compatibility mode)



- **With appropriate coding, provides 13-16 kb/s end user data rate**
- **With preselection diversity, performs well in an indoors, slow fading environment**
- **Retains interoperability with existing IS-136 systems**

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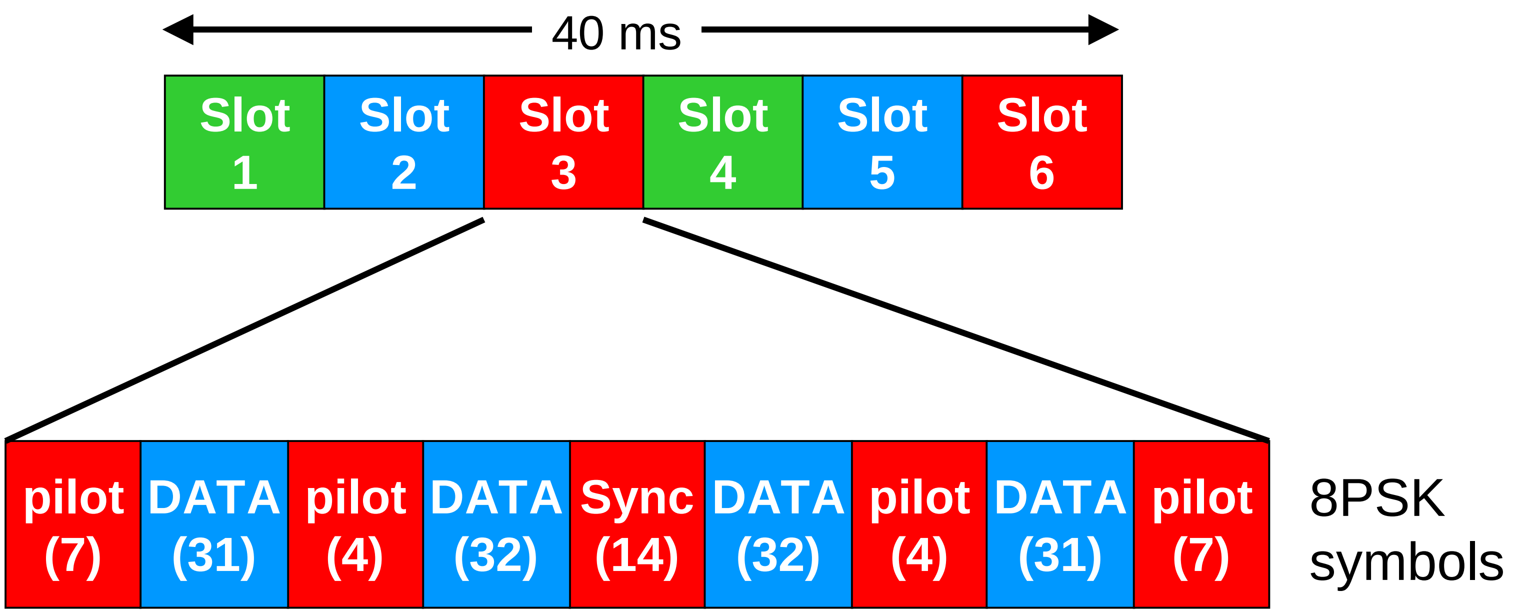
IS-136++ Frame Structure
(coherent detection)



With appropriate coding, provides 13-16 kb/s end user data rate
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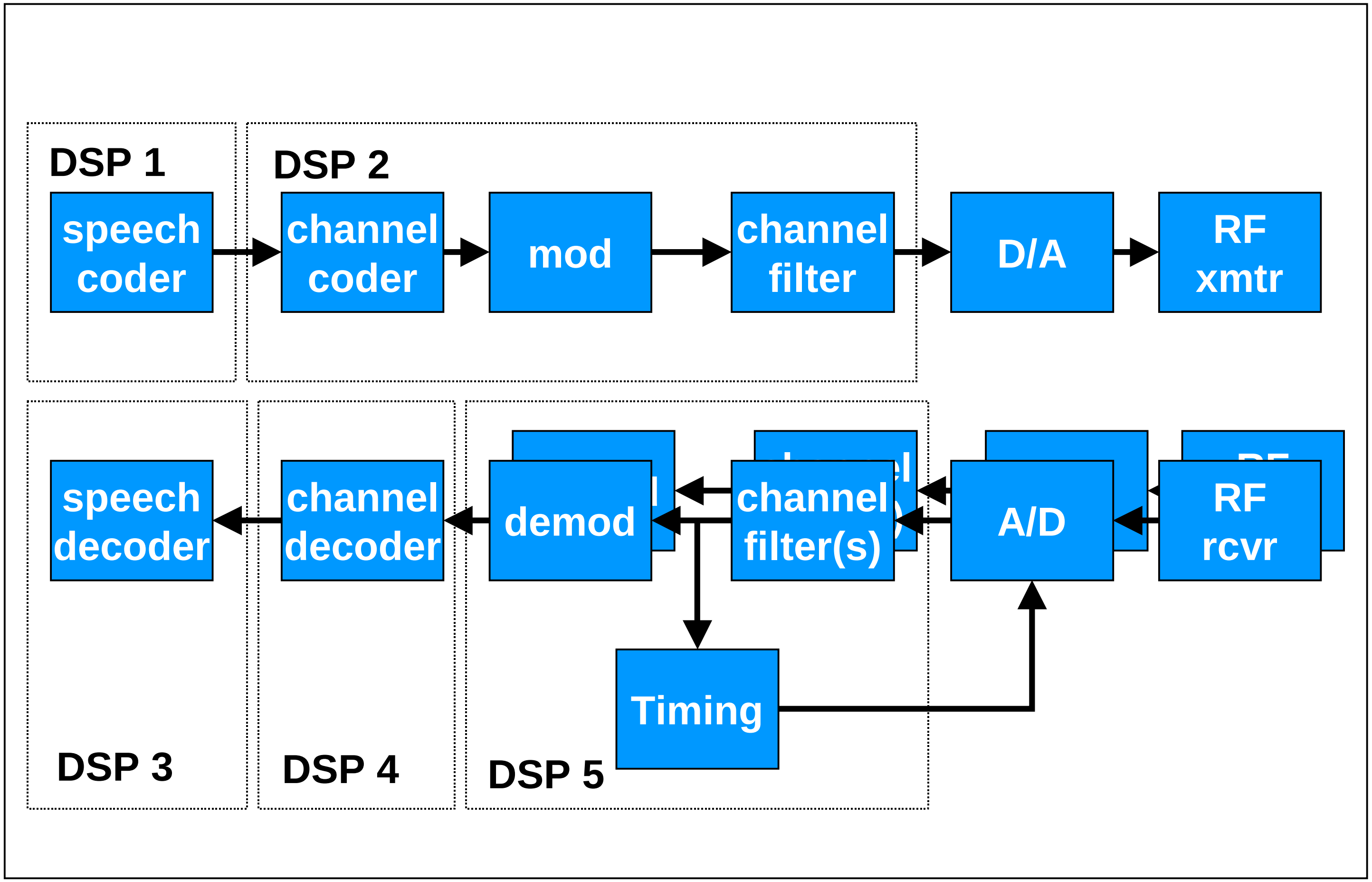
Prototype Architecture



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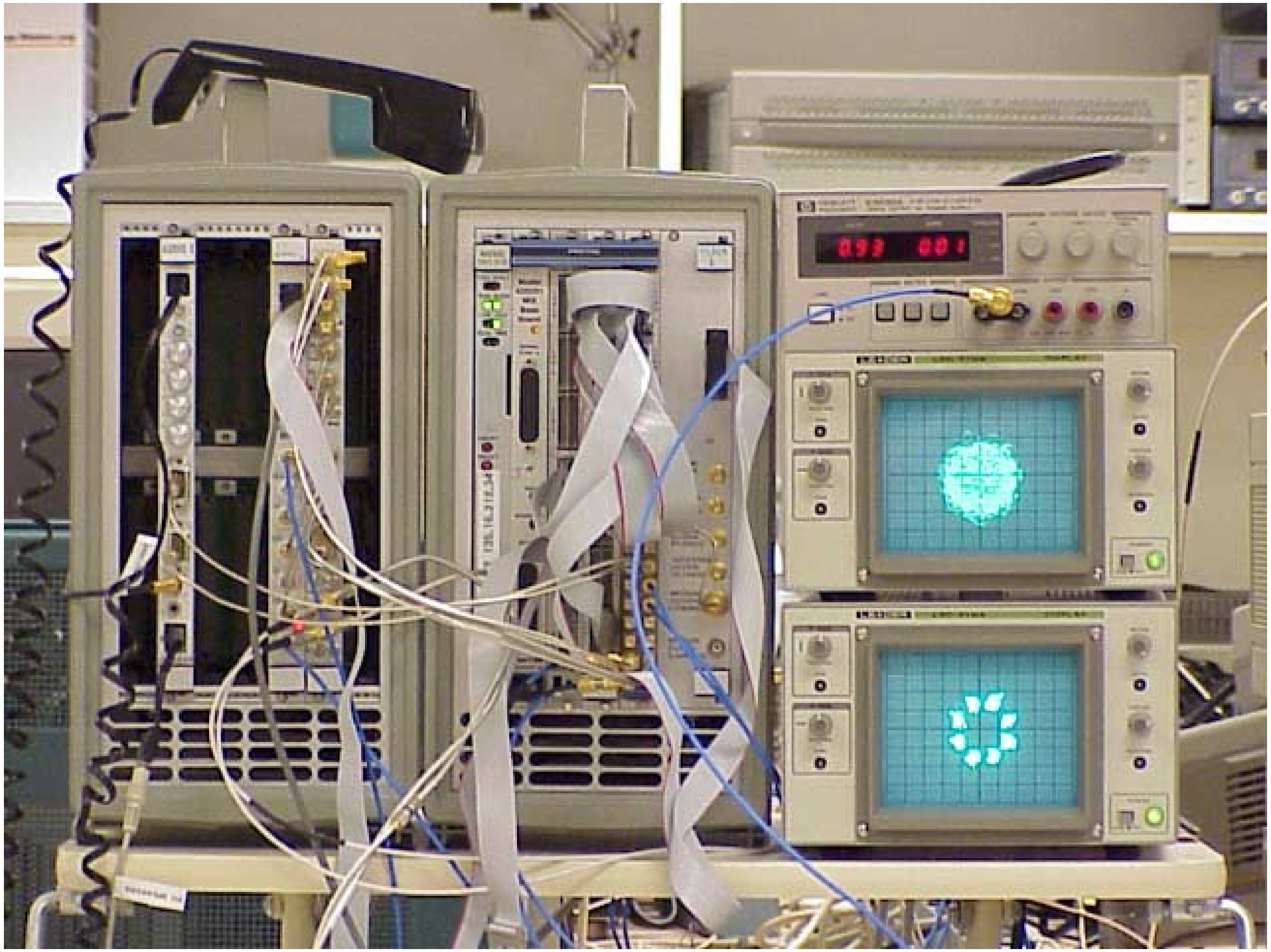
Prototype “Mobile”



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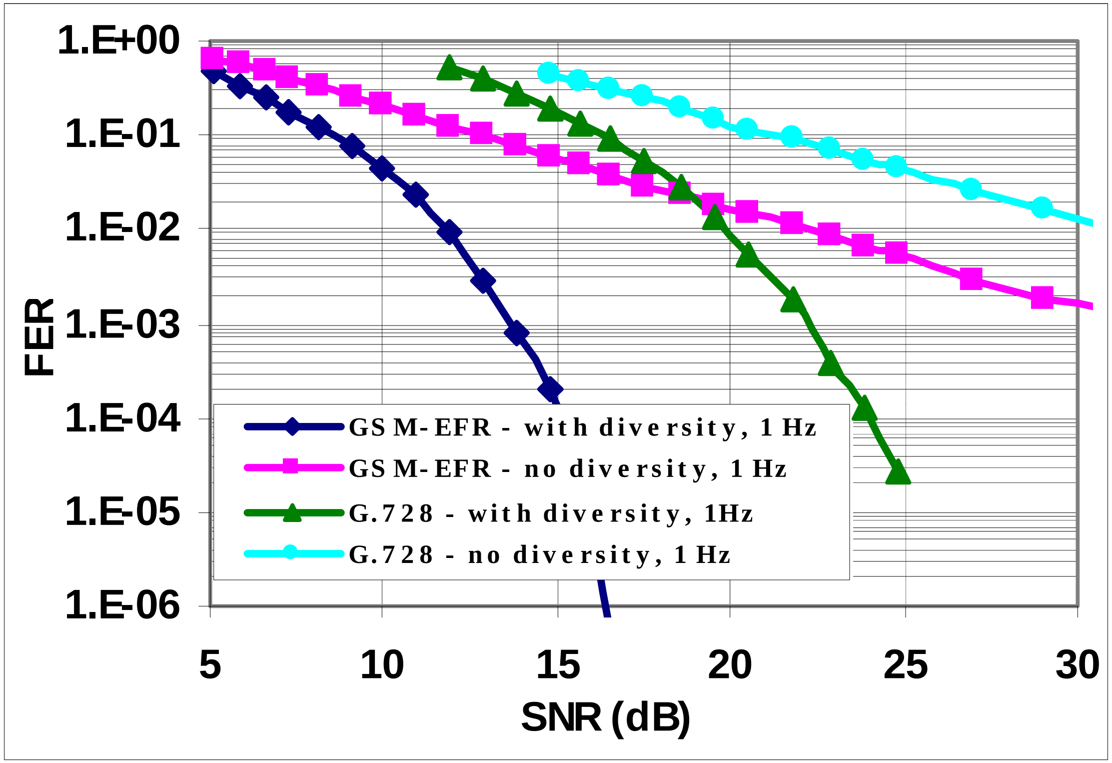
Performance

(1 Hz fading, preselection diversity)



- **G.728 uses equal error protection vs. GSM-EFR with different protection classes**
  - FER is enhanced by unequal error protection
- **A considerable improvement in FER is realized with preselection diversity at low fading rates**

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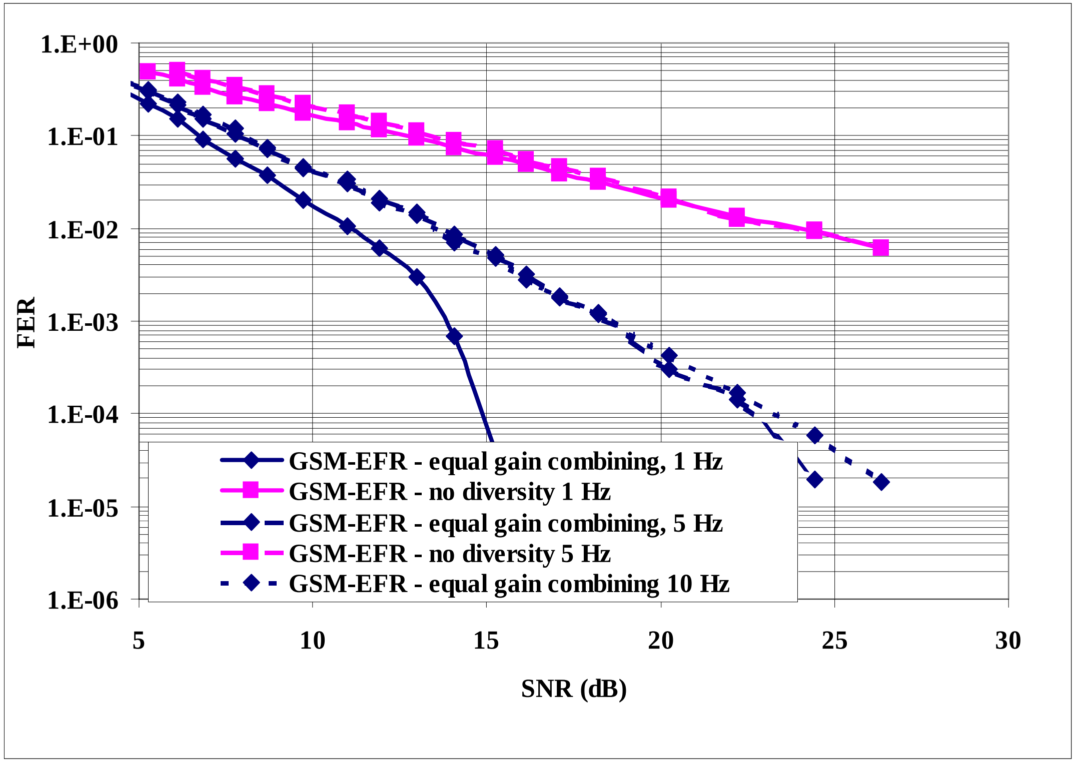
Performance

(1-10 Hz fading, equal gain combining)



- **A substantial improvement in FER is realized with equal gain combining**
- **The improvement is not as sensitive to higher fading rates as preselection**

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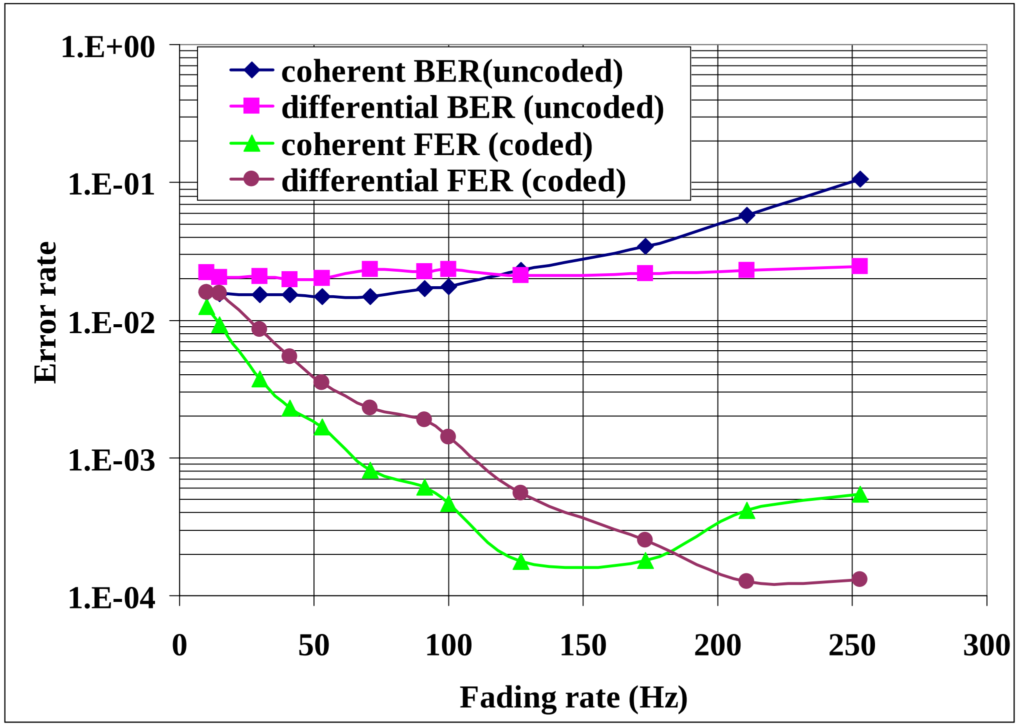
Performance
(coherent vs. differential 5-250 Hz)



- **The distribution of bit errors in a frame varies considerably with fading rate and demodulation method.**
- **At high fading rates, the advantage of coherent over differential detection is lost**

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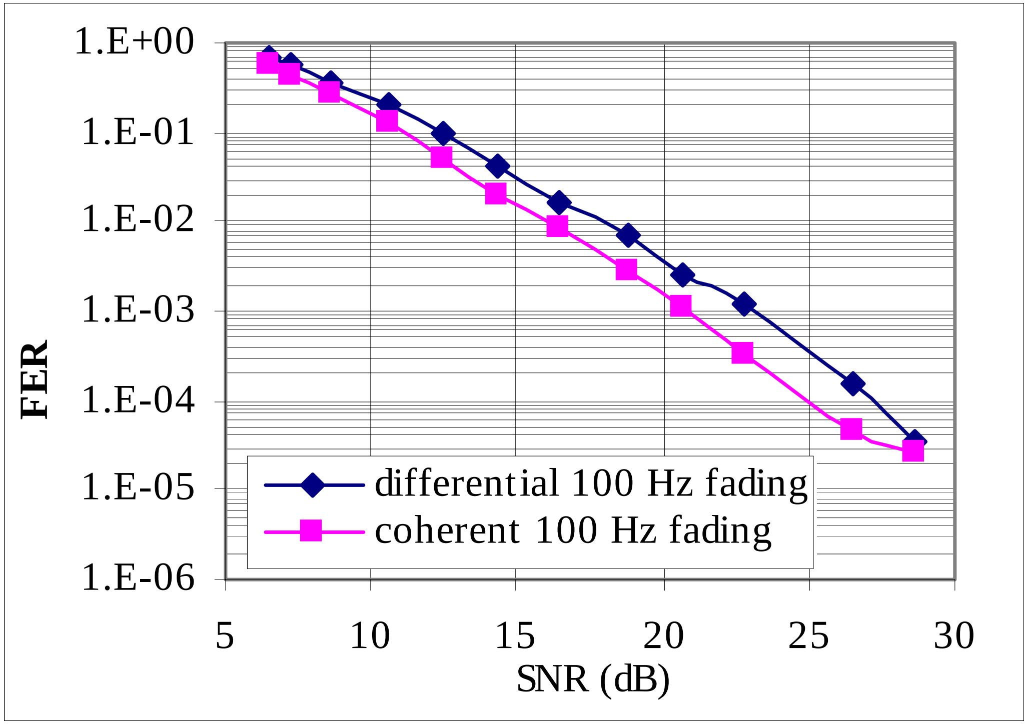
Performance
(coherent vs. differential, 100 Hz fading)



- **Practically, under the best fading rate conditions, the advantage of coherent detection is <2 dB**

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Conclusions

- In a practical implementation, coherent detection can be expected to yield <2 dB improvement over differential detection
- At higher fading rates, the problem of estimating the channel degrades coherent detection compared to differential detection
- At low fading rates, simple preselection diversity provides significant improvements in system performance
- Over a range of fading rates, equal gain combining provides significant performance improvements
- The interactions between detection, coding, diversity and fading are complex