



An IC Manufacturer's Perspective on Digital TV


- Digital Broadcast Issues
- Product History
- Technology
- Outlook

June 01 Proprietary Information 

The Wireless Problem

Problem: Wireless broadcast signal robustness and coverage area depends on noise, reflections, weather and terrain effects.

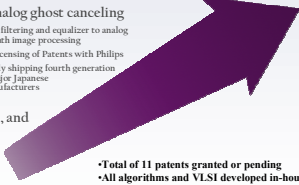



June 01 Proprietary Information 

Product History

- ▶ 1998 - Digital demodulators
 - Introduced Oren's first 8-VSB digital TV demodulator according to ATSC
 - Oren OR51210 8-VSB demodulator is recognized as a top competitor at ATTC
 - For HD set-tops, Satellite/HDTV, PC add-in cards, and datacasting applications
- ▶ 1997 - Analog ghost canceling
 - Applied filtering and equalizer to analog multi-path image processing
 - Cross Licensing of Patents with Philips
 - Currently shipping fourth generation to all major Japanese TV manufacturers
- ▶ 1995 - Digital filter, DSP, and equalizer technology
 - Company founded on auto-tracking technology for military applications

•Total of 11 patents granted or pending
•All algorithms and VLSI developed in-house



June 01 Proprietary Information 

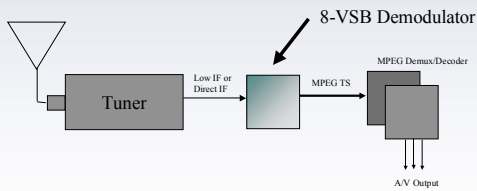
Basic VSB demodulation

- ▶ Known Series of digital bits used to 'train' the chip
- ▶ In strong multipath, blind or predictive equalization used to train the chip
- ▶ Equalizer acts like a Taylor series multiplier, iterating coefficients toward a final solution using an LMS algorithm
- ▶ Data is deinterleaved and further corrected in the Forward Error Correction Circuitry

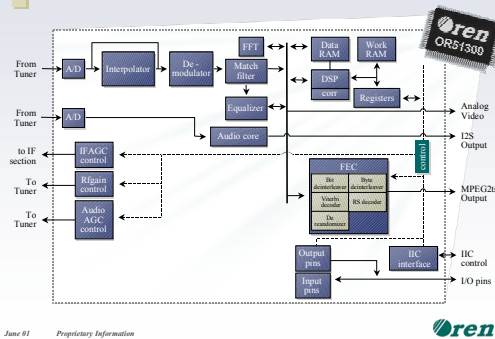


Demodulation Technology

- ▶ 8-VSB IF in and MPEG-2 Transport out



Block Diagram



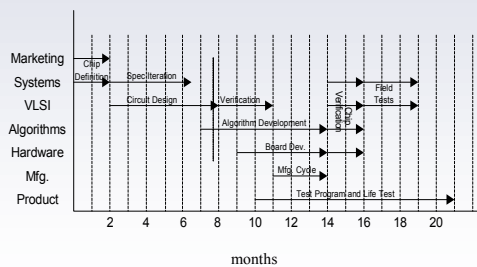
Integrated Circuit Development Team

- ▶ Marketing: Interviews Customers to understand high level requirements. Work with system engineering on spec.
- ▶ Systems Engineering: Have knowledge of entire system, including transmitter side. Generate top level spec for chip. Involved in Field testing the device
- ▶ Algorithms: Write code that runs IC. Have knowledge of the various communications schemes. QAM, VSB, COFDM
- ▶ VLSI Engineering: In charge of circuit design and simulation inside the IC itself.
- ▶ Hardware Engineers: Develop circuit schematics that connect the chip to surrounding ICs
- ▶ Product Engineering: Develop test programs and life tests

June 01 Proprietary Information



Design Flow



June 01 Proprietary Information



Summary of Design Flow

- 1) Marketing and Systems Engineering Develop Product Spec
- 2) VLSI Engineering generates actual IC from this spec
- 3) Hardware Engineering develops a board for the IC
- 4) Algorithms generate the 'software' that drives the IC
- 5) Systems Engineering takes the board and software for test
 - Lab testing against ATTC benchmarks
 - Field testing both indoor and outdoor
 - Alpha Customer Testing
- 6) Product Engineering puts the chip into production

June 01 Proprietary Information



Integration Development of "Cascade"

Cascade OR51300 series demodulators for:

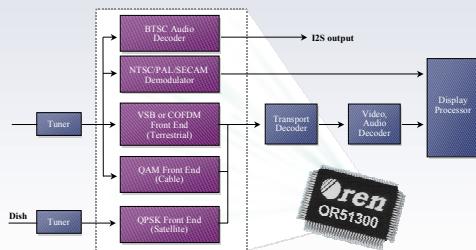
ATSC:	8-VSB (with FFT enhanced performance)
DVB-T:	COFDM (2k and 8k hierarchical)
Cable:	64/256-QAM (ITU-T j.83 Annex A/B/C)
DVB-S/DSS:	QPSK (Satellite)
Analog Video:	NTSC/PAL/SECAM demodulation Adds ClearCast ghost cancellation to analog video output
Analog Audio:	NTSC/PAL/SECAM demodulation NTSC audio is also decoded by OR51300, eliminating the need for a discrete BTSC decoder for mono, stereo, SAP, dBx

Process: 0.18 μ m, 5M, 3P TSMC

June 01 Proprietary Information



Simplified Front End Design



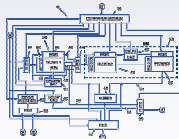
Oren Cascade replaces five chips

June 01 Proprietary Information



Cascade Patented VSB Enhancement

- ▶ Use of FFT enables improvements in VSB performance
- ▶ Replaces current LMS algorithm
- ▶ FFT allows:
 - ▶ Real time channel snapshot
 - ▶ Dynamic allocation of FIR and IIR filter taps
 - ▶ Accurate channel model

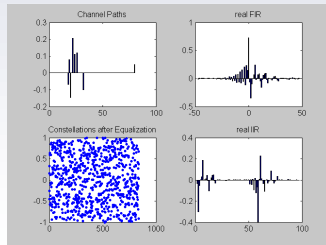


June 01 Proprietary Information



FFT Hardware Benefits

- ▶ Strong short ghosts with traditional receiver "LMS" equalization

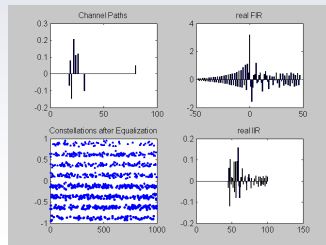


June 01 Proprietary Information



FFT Enhancement

- ▶ Same test with FFT equalization

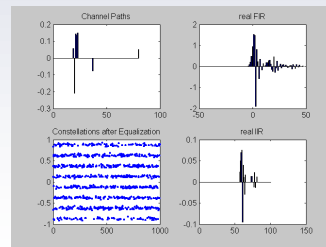


June 01 Proprietary Information



FFT Enhancement

- ▶ Case 2: traditional receiver failed to lock, but achieved great performance with FFT equalizer (see notes)



June 01 Proprietary Information



Summary

- ▶ Collaboration between IC makers and Broadcasters
- ▶ Innovation takes time
- ▶ There is Hope!!!

June 01 Proprietary Information