

The Parallel Universe of OFDM Displays

By Signal Display Systems

5/6/2006

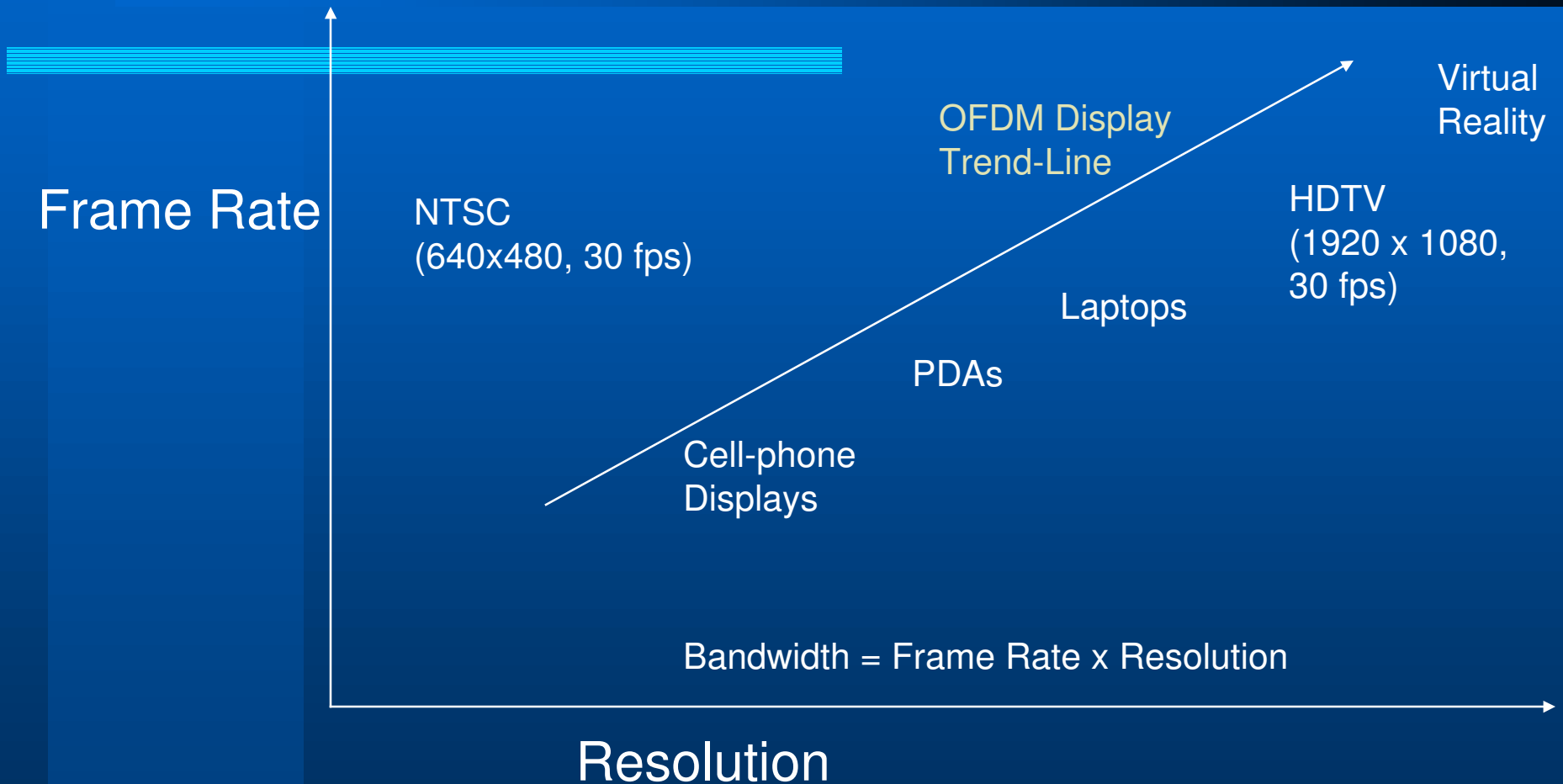
Why Use Parallel Displays?

- **Higher Resolution and Frame Rate Attainable With Current Computing Power**
- **More Bandwidth-Efficient and Requires Less MIPS and Power Consumption from Processor.**
- **Frequency-Modulation of Signals Improves Image Quality**
- **Paradigm Shift**
 - **Current Line by Line Refresh**
 - **OFDM is new paradigm - All Lines Refreshed Simultaneously**

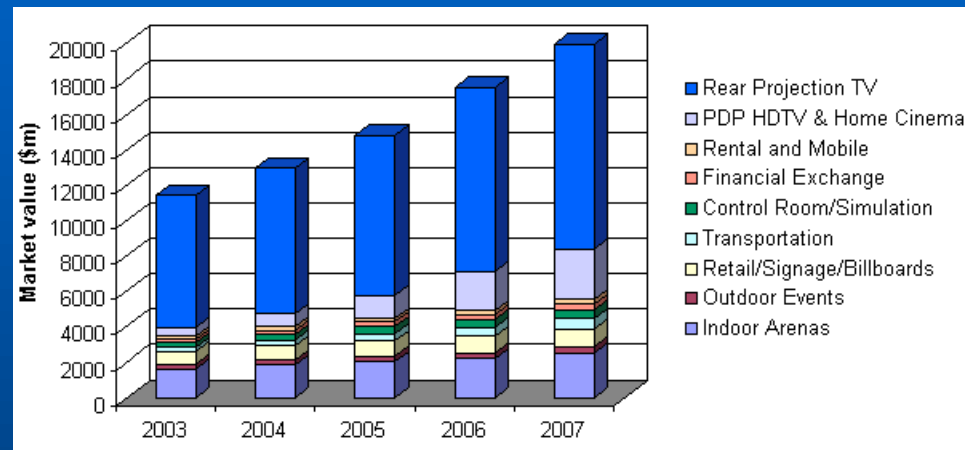
Applications For OFDM Displays

- **Light Emitting Diode – LED**
 - Hi-Resolution Advertising Bill-Boards
 - Smart LED Modules for Decorative Lighting
 - Large screen Video Systems
- **Liquid Crystal Displays**
 - HDTV
 - Virtual Reality Headsets
 - Video phones with Faster Refresh Rate
 - Desktop, Laptop, & low-powered PDA Displays

Applications With Higher Frame Rates and Resolutions Will Use OFDM Displays For Efficiency



Market Growth For Flat-Panel Displays



SRI and Display
Search Data

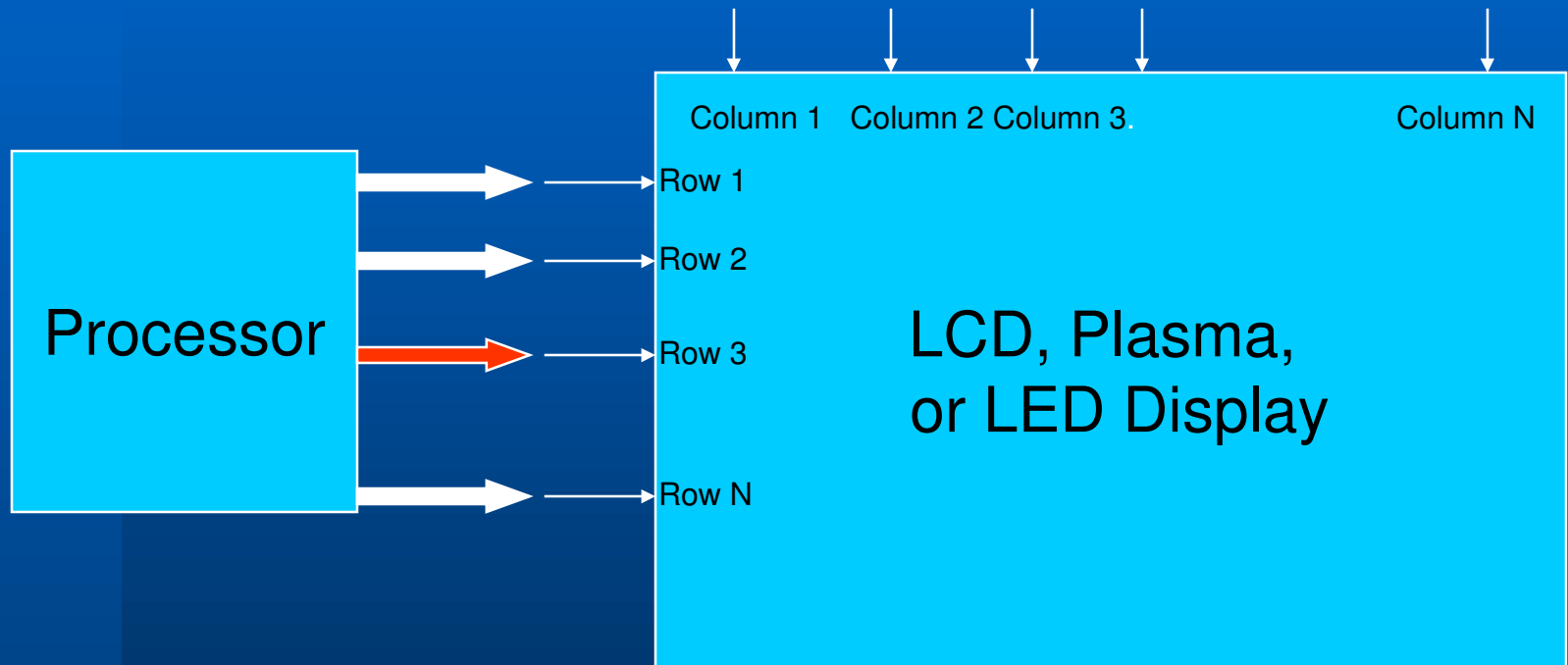
- Flat Panel Display Market Will Grow To
77 Billion (USD) by 2007

- Growth Percentage is High in HDTV
and other High-Resolution Displays

How Do OFDM Displays Work?

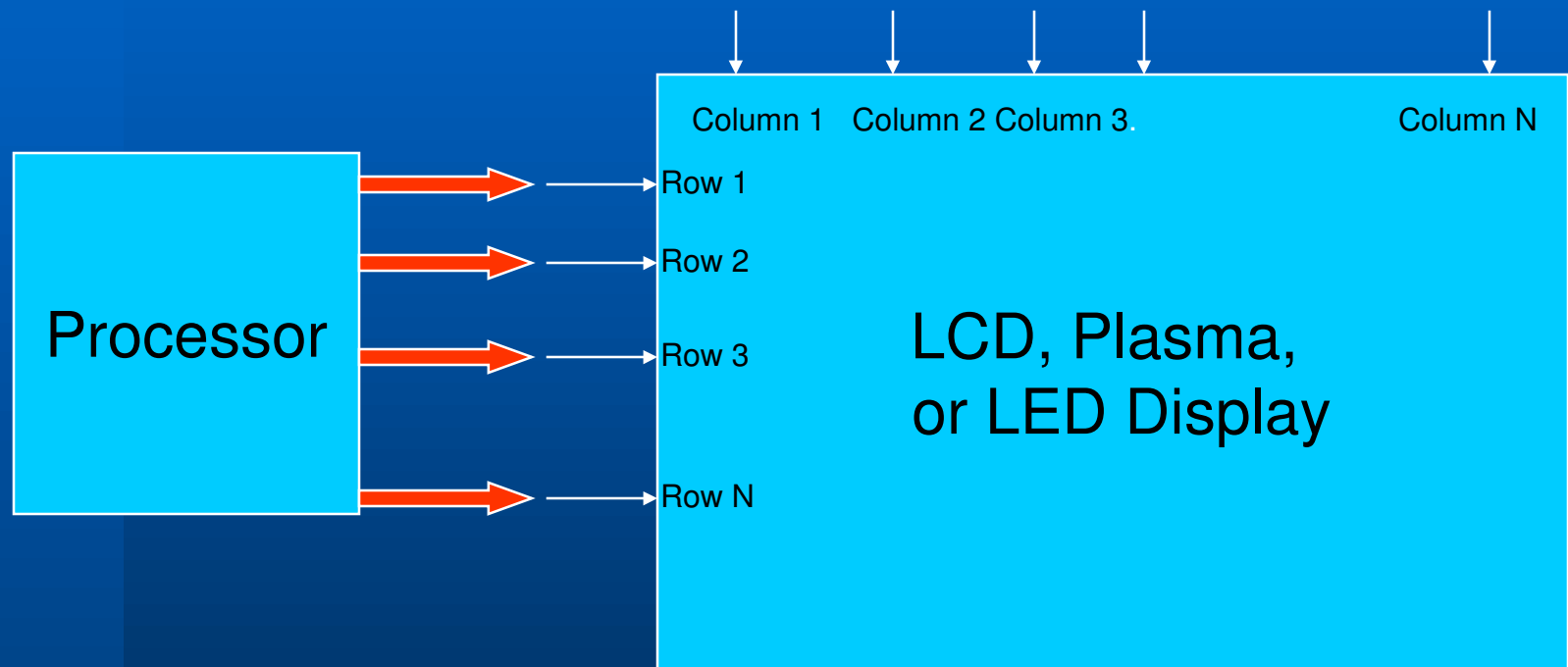
- **Current display technology updates the image one line at a time - a slow serial process for the flow of information**
- **OFDM displays update all lines in the display at the same time, eliminating the slow serial transfer**

Existing Matrix Displays - Only One Row or Column Is Updated At A Time



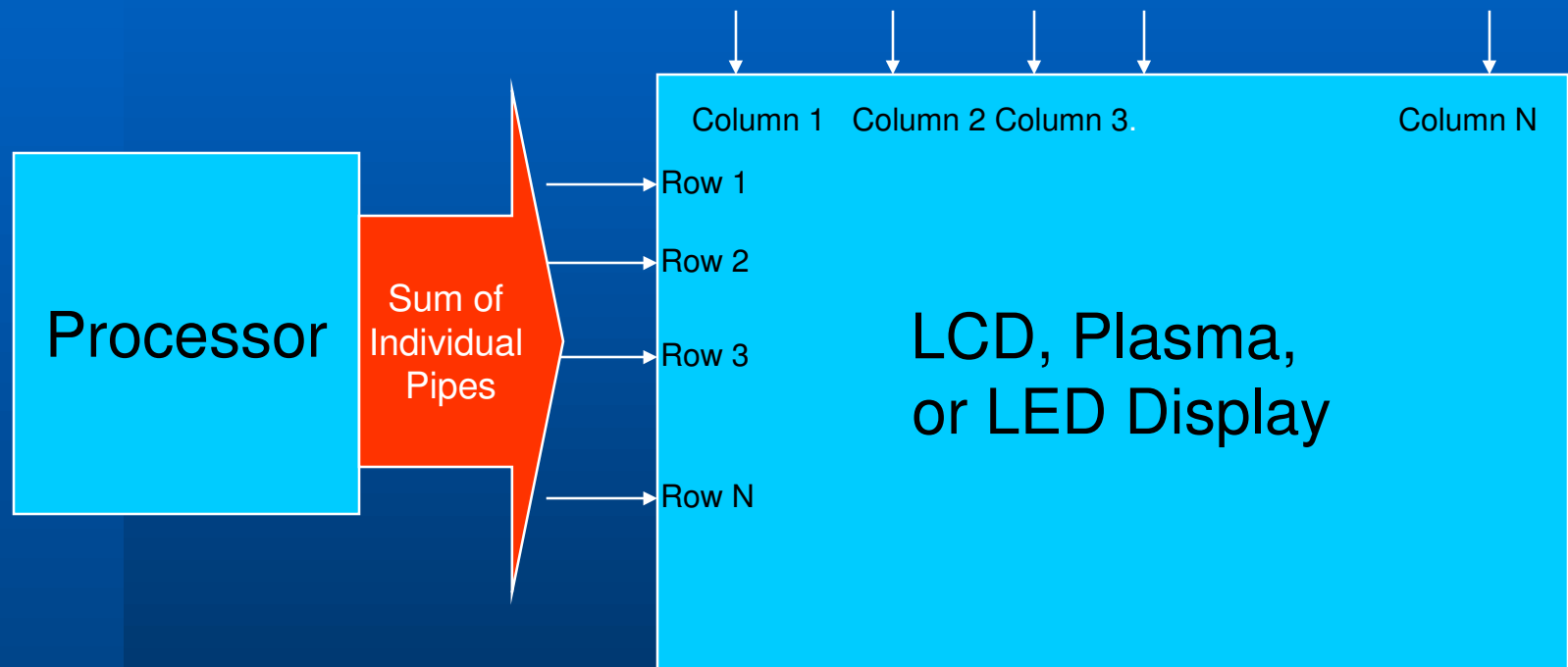
Several Data Pipes Are Going to the Display, but only one is active at a time = Low-Bandwidth, Single-Access Pipe To Display (Row 3 currently active)

OFDM Display - All Rows and Columns Are Active At The Same Time



Same Data Pipes To Display As Before, All Rows and Columns Currently Being Updated

Many Active Individual Pipes is Equivalent To One Larger Pipe



Parallel Data Transfer Requires Lower Computation For Processor Than Serial Data Transfer. Lower Computation and Data Rate Means Less Power Required

Why Can't Current Digital Displays Access All Pixels At The Same Time?

	"1"	"1"	"0"
"0"	Pixel 1	Pixel 2	Pixel 3
"1"	Pixel 4	Pixel 5	Pixel 6
"0"	Pixel 7	Pixel 8	Pixel 9

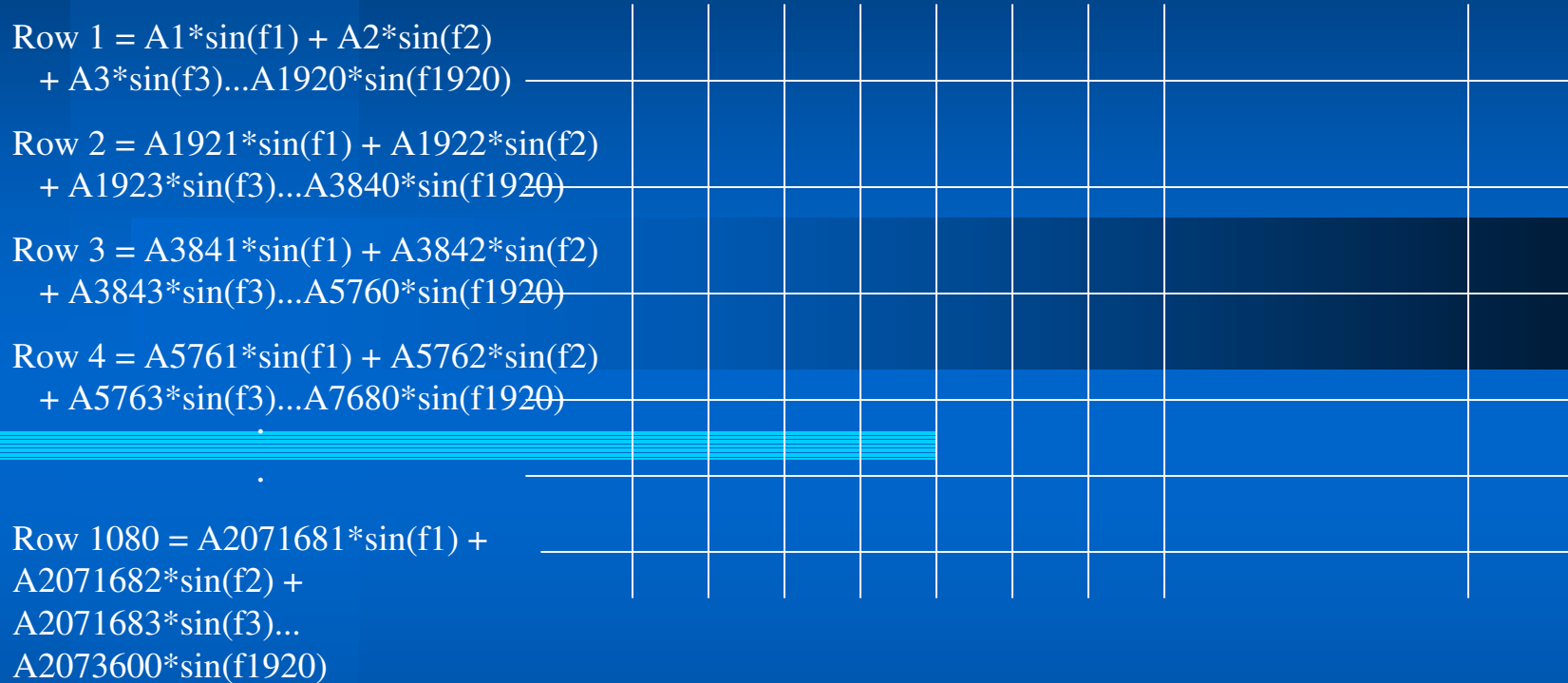
Pixel is defined at the intersection of a row and column

Pixel is turned on when "1" is on a column and "0" is on a row

An attempt is made to turn on pixel 1 and pixel 8 at the same time by placing "1" on the first two columns and "0" on the first and third rows. The result is that pixel 1 and pixel 8 are turned on, but so are pixel 2 and pixel 7, which is an undesired result. The same result occurs for all combinations of binary signals that control a matrix-display.

Example Design - HDTV System(1920 x 1080)

f1 = 1000 Hz f2= 1200 f3= 1400 f4= 1600 f1920= 385 KHz



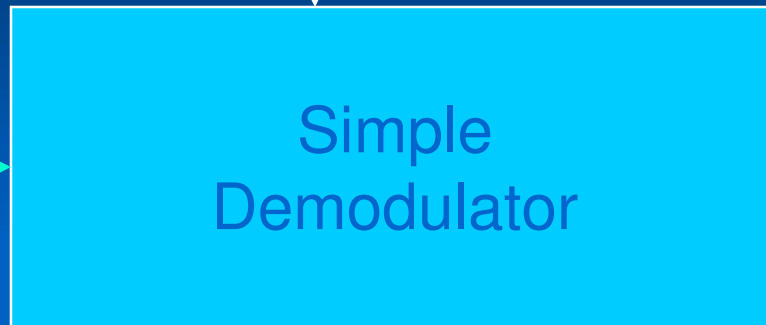
Highest Frequency Driving Display = 385 KHz

At intersection of rows and columns (pixel locations), a demodulator and LPF determine pixel amplitude A (A_1, A_2 , etc.) associated with frequency f where row and column frequencies are equal (200 Hz frequency discrimination).

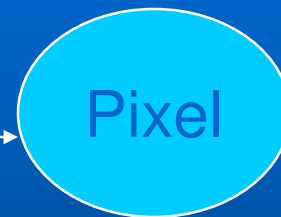
Column = $\sin[(f_1)t]$

Row = $A_1[\sin(f_1)t]$
+ $A_2[\sin(f_2)t]$
+ $A_3[\sin(f_3)t]$...

Row = $A_1[\sin(f_1)t]$
+ $A_2[\sin(f_2)t]$
+ $A_3[\sin(f_3)t]$...
To next pixel cell



$$Pixel_Voltage = \frac{1}{T} \int_0^T Row \bullet column = A_1 \cos(f_1 - f_1)t = A_1$$



Column = $\sin[(f_1)t]$
To next pixel cell

Pixel Cell Architecture

Intellectual Property

- **Signal Display Systems Has Patented The Concept of OFDM in Active-Matrix Displays**
 - Refreshes all pixels in a display simultaneously using OFDM technology
 - Classified by Lawrence Tannas, Jr. (past SID president, Congressional Witness on Display Technology) as one of only six methods for driving a display, and the only method for driving all pixels in parallel in an active-matrix display

LED Module Design Example

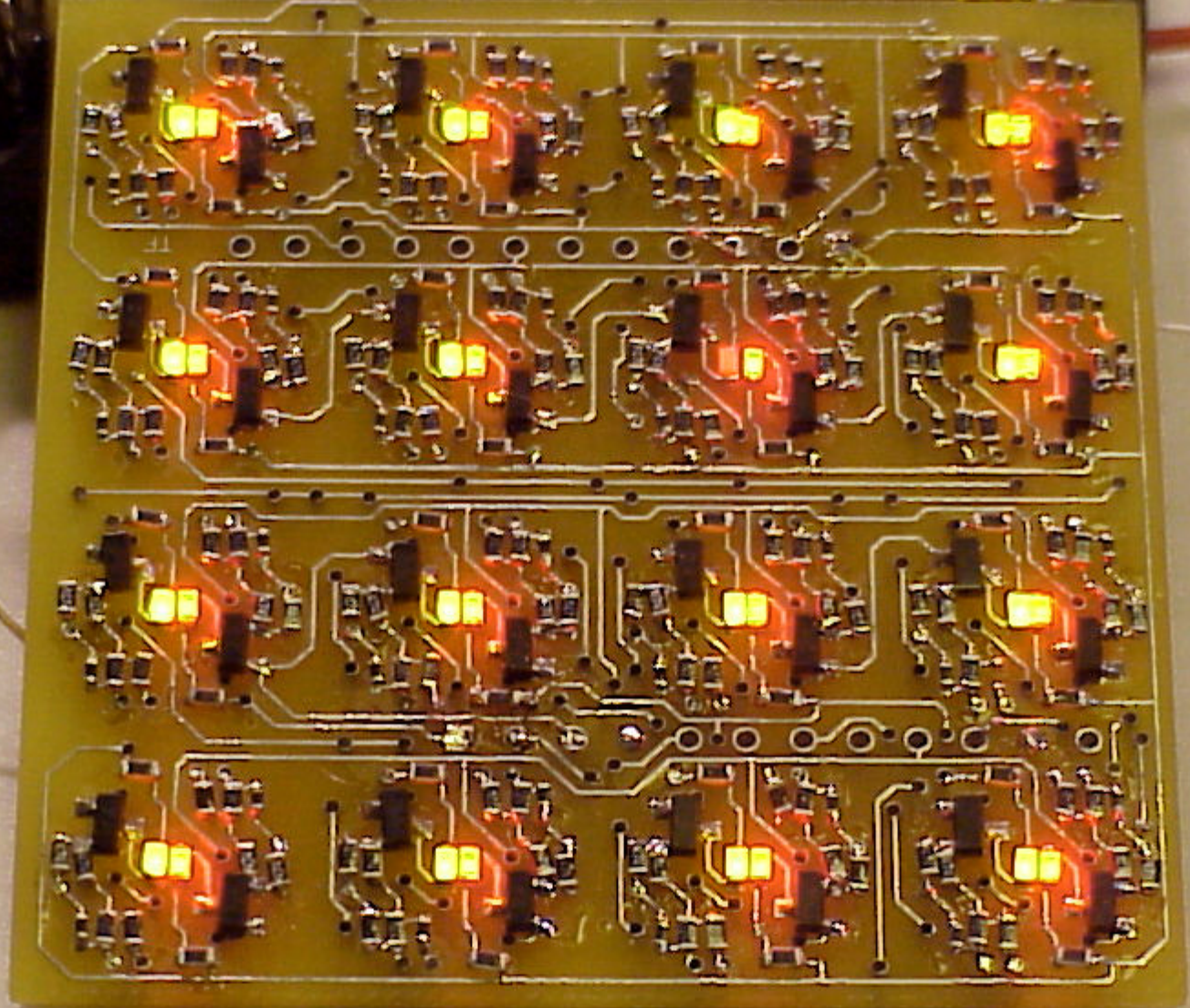
4 x 4 Module (5 cm side) with Red-Green Pixels

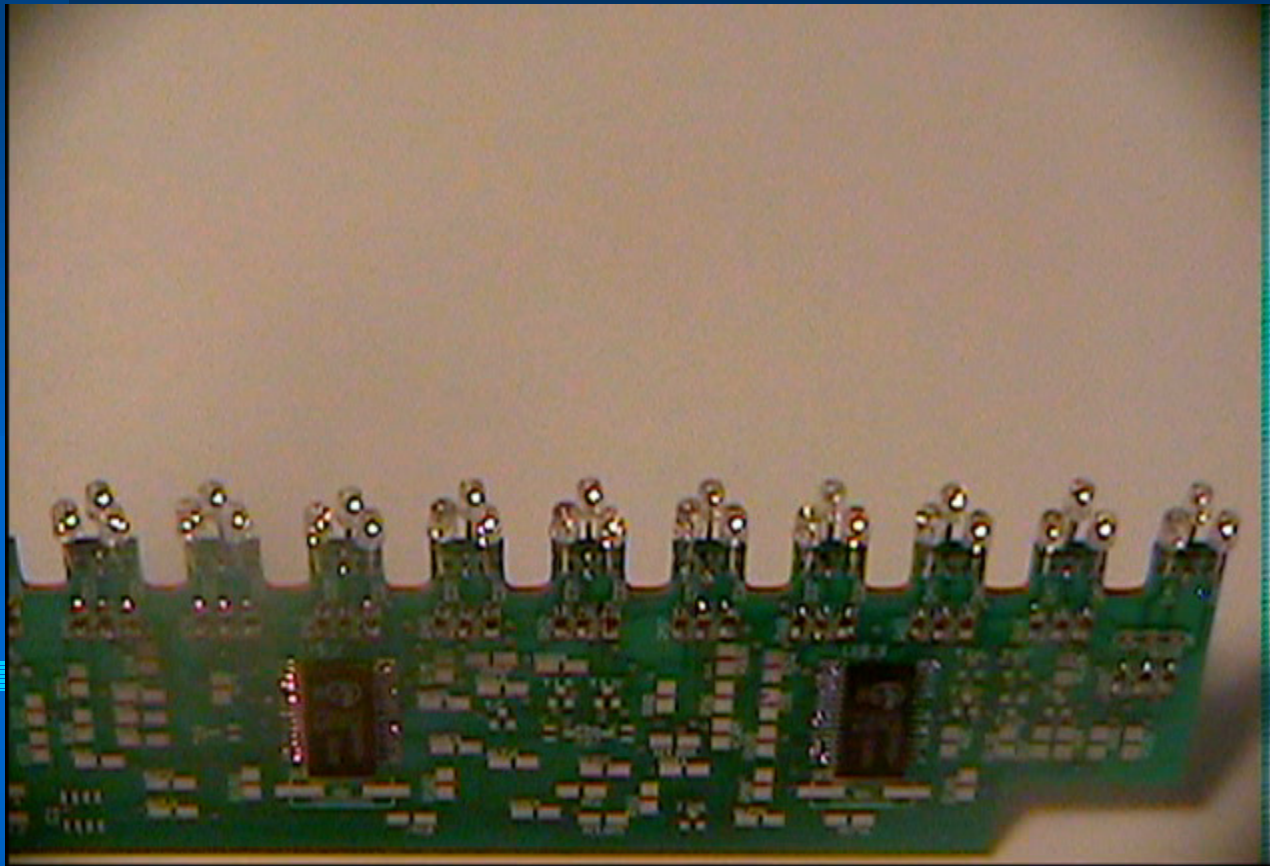
For High Resolution LED Displays

One-Transistor Mixer at Each Pixel

Frequency Discrimination of 100 Hz at Each Pixel

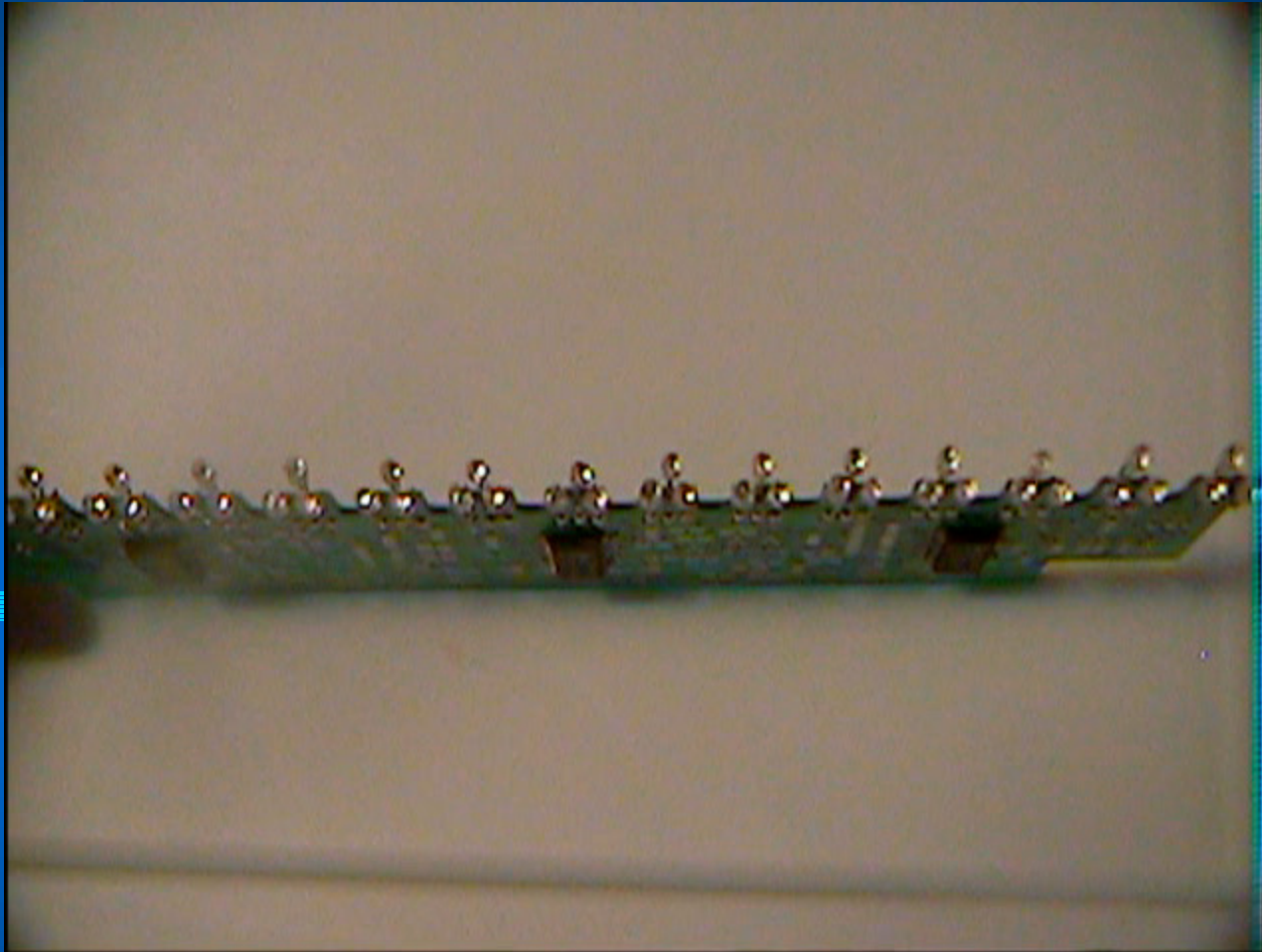
Eveready 1.5V
ALKALINE BATTERY





Heat Efficient - LED leads lay on side of copper board
Fine mesh between RGB pixels
Plug and play architecture

OFDM over Power LEDs - angle view



OFDM Over Power LEDs - side view

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The Final Analysis

Parallel Displays are More Bandwidth-Efficient than Serial Displays Which Means:

- Reduced Computing Requirements
- Reduced Power Consumption
- Increased Frame Rate

Frequency-Modulation of Signals Means:
Improved Image Quality

OFDM Displays are Unparalleled in Performance!