The Evolution of Video Walls in Digital Signage
What is a Video Wall?

- **Traditional Definition:**
  Tightly tiled display matrix

- **Broader Definition:**
  Loosely tiled display matrix

- **Broadest Definition:**
  Coordinated set of displays
## Why Use Video Walls?

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Advantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Larger display area</td>
<td>improved audience draw and retention</td>
</tr>
<tr>
<td>Higher aggregate resolution</td>
<td>ability to deliver more detailed content</td>
</tr>
<tr>
<td>Distributed displays</td>
<td>ability to deliver content to multiple locations</td>
</tr>
<tr>
<td>Multiple content sources</td>
<td>ability to deliver multiple simultaneous messages</td>
</tr>
</tbody>
</table>
Why Videowalls Now?

Annual flat panel videowall display sales = 55.2% CAGR, source = iSuppli

Units

2010 2014
Early Videowall History
The First Videowalls

- The videowall emerged in the early 1980s, but two obstacles limited the performance of early videowalls.
- The first videowalls were all based on standard CRT monitors, typically 28 inch diagonal, with the resulting large gap between image sections.
- It was difficult to achieve the “image split”, that is the means by which a single input video signal could be split into, say, 16 separate image signals to produce one large image on a 4 × 4 array of monitors.
Laser Disc Improves Content

- Such signal splitting required storage memory and computer processing.
- This meant that early videowall processors from vendors such as Philips Vidiwall and Delcom (Gundermann) were very expensive.
- One way to work around this problem, when dealing with a permanently installed system, was to use laser disc technology.
- The process was to use multiple synchronized laser disc players, one for each display. The content would be prepared by a production house, with each laser disc producing a single part of the image.
- This method gave remarkably good results, but had only limited application since most users wanted a system that would split images in real time.
In the late 1980’s, new lower cost CCD memory devices from companies like Philips entered the market, driving the cost per display channel down, making videowall processors more affordable.

Companies such as Electrosonic and Synelec introduced new programmable videowall processors that allowed videowalls to be used creatively, and to exploit the “multi-image” nature of the medium, especially when multiple image sources were used.
Cubes Eliminate Gaps

- Around 1989 we see the arrival of the videowall “cube” from companies such as Pioneer, Electrosonic, Sony, Toshiba, Electrohome, Barco, and others.
- The “cube” consisted of a CRT projector mounted in an enclosure fitted with a rear projection screen.
- The videowall cube transformed the market.
- Now the gaps between screen sections was negligible, and the increased screen brightness, enhanced by the high contrast screen material, meant that videowalls became a viable “big image” presentation medium.
- Cube based displays still exist today, although based on more modern LCD or DLP display technology to produce higher resolution images and crisper text and graphics.
Advances in Processors

- The next major advancement was a change in how video was processed.
- Basic image splitting and multi-image capability of early processors was fine for video, but as command and control applications grew in the early 1990s, computer graphics became critical.
- New videowall processors were based on computers with multiple graphics cards that could manage multiple windows simultaneously.
- This worked as long as all the content could be displayed by a program running on that computer.
- In the late 1990s a new breed of processor was developed that could offer the benefits of a computer based display system, but could accept non computer sources.
- Significant players in the market included Jupiter and Electrosonic of the USA and Synelec of France.
Quality Considerations
### Scaling Artifacts

Artifacting increases in proportion to scaling.

<table>
<thead>
<tr>
<th>1x Scaling</th>
<th>2x Scaling</th>
<th>3x Scaling</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Artifacts</td>
<td>Mild Artifacts</td>
<td>Moderate Artifacts</td>
</tr>
</tbody>
</table>

Artifact visibility depends on viewing distance.
Bezel Compensation

**Enabled**
- Some pixels hidden
- Linearity maintained
- Best for images & video

**Disabled**
- All pixels visible
- Linearity lost
- Best for data
The Evolution of Modern Videowalls
Video Wall Architectures

- **Hard-Wired**
  - Oldest
  - Simplest

- **Video Processor**
  - Dedicated Hardware

- **Distributed System**
  - Most Flexible

- **Matrix Switch**
  - Introduces Flexibility

- **Daisy-Chain Scalar**
  - Usually Free

1960’s | 1980’s | 2000’s
Hard Wired Description

- One source permanently connected to each display
- Oldest Architecture
- Supports wide variety of source types
- Supports wide variety of display types
Hard Wired Architecture
Hard Wired Analysis

- **Advantages**
  - Simplest Architecture
  - Supports almost any source or display
  - Low cost or no cost included with the display

- **Disadvantages**
  - Most Restrictive: Content can’t be moved/resized
    - Only one source per display
    - Only one display per source
    - Switching requires rewiring or patch panel
  - Limited distance without extender
  - No synchronization of sources, unless external
Matrix Switch Description

- Dedicated hardware “switchboard”
  - Multiple input sources
  - Multiple output targets
  - May duplicate 1 source on multiple displays
  - Might translate between different video formats
    - Composite, S-video, component, VGA, DVI, HDMI
Matrix Switch Architecture

Inputs

Matrix Switch

Outputs
Matrix Switch Analysis

- **Advantages**
  - Flexibility to put any input on any display

- **Disadvantages**
  - Limited distance without extenders
  - Limited display and source count
  - Moderate Cost
  - Content only in whole monitor increments
Daisy-Chain Scalar Description

- One input, PC or video
  - Looped through multiple monitors
  - Each monitor picks off one quadrant of the signal
Daisy-Chain Scalar Architecture
Daisy-Chain Scalar Analysis

- **Advantages:**
  - Low cost, usually included for free with monitors
  - Simple setup

- **Disadvantages:**
  - Only one input at a time
  - Low resolution means possible scaling artifacts
Daisy-Chain Scalar Example: NEC’s Tile Matrix

The Tile Matrix feature of the NEC Display allows one image to be expanded and displayed over a Video Wall setup. This is accessed through the On Screen Display Controls under the “MULTI-DISP” main menu icon. Under the “Tile Matrix” sub-menu, enable the feature and set the necessary parameters that match the 2x2 Video Wall setup.

<table>
<thead>
<tr>
<th>Input Source</th>
<th>Main Menu Icons</th>
<th>Main Menu Item</th>
<th>Sub Menu</th>
</tr>
</thead>
<tbody>
<tr>
<td>RGB1</td>
<td>Return</td>
<td>Monitor ID</td>
<td>Power on delay</td>
</tr>
<tr>
<td></td>
<td>Browser</td>
<td>IR Control</td>
<td>Power indicator</td>
</tr>
<tr>
<td></td>
<td>Audio</td>
<td>Tile Matrix</td>
<td>Multi display reset</td>
</tr>
</tbody>
</table>
Video Processor Description

- Specialized PC Chassis
- Slots contain boards for video inputs/outputs

- 4 input boards
- DVI or VGA

- 4 output boards
- Dual DVI or VGA

This example displays up to 4 inputs on up to 8 monitors
Connections are composite, s-video, component, VGA, DVI or HDMI.
5 meter limit unless extenders are used.
Video Processor Analysis

- **Advantages**
  - High flexibility for content size & placement
  - Multiple simultaneous sources
  - Programmable

- **Disadvantages**
  - Expensive: Often requires over-provisioning
  - Limited scalability
  - Limited distance without extenders
Distributed System Description

- A distributed system is made up of autonomous commodity sources and destinations, connected by a commodity communication system, such as a local area network.

- This network is controlled by specialized software installed on commodity PCs that perform management, source, and display functions.
Distributed Architecture

- **Inputs**
- **Gigabit LAN**
- **Outputs**

All connections are Ethernet
Distributed Analysis

- Advantages
  - High flexibility for content size & placement
  - Highly scalable
  - Elimination of specialized hardware
  - Cat5e infrastructure
    - Low material and installation cost
    - Broad selection of configurations/options
  - Programmable
  - Modular hardware system

- Disadvantages
  - Moderate cost
  - Uses multiple hardware modules
# Content Comparison

<table>
<thead>
<tr>
<th></th>
<th>Direct</th>
<th>Daisy Chain</th>
<th>Matrix</th>
<th>Processor</th>
<th>Distributed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PC Sources</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quantity</td>
<td>1 per screen</td>
<td>1</td>
<td>≤ 1 per screen</td>
<td>Chassis Limit</td>
<td>Network Limit</td>
</tr>
<tr>
<td>Maximum Resolution</td>
<td>≤1920x1080</td>
<td>≤1920x1080</td>
<td>≤2048×1536</td>
<td>≤2560x1600</td>
<td>Source Limit</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>≥100M pixels</td>
</tr>
<tr>
<td><strong>Video Sources</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quantity</td>
<td>1 per screen</td>
<td>1</td>
<td>≤ 1/screen</td>
<td>Chassis Limit</td>
<td>Network Limit</td>
</tr>
<tr>
<td>Maximum Resolution</td>
<td>≤ 1080P</td>
<td>≤ 1080P</td>
<td>≤ 1080P</td>
<td>≤ 1080P</td>
<td>Source Limit</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Movie Files</strong></td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Still Images</strong></td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Sizing</strong></td>
<td>Standard Only</td>
<td>Standard Only</td>
<td>Standard Only</td>
<td>Variable</td>
<td>Variable</td>
</tr>
</tbody>
</table>
## Functional Comparison

<table>
<thead>
<tr>
<th></th>
<th>Direct</th>
<th>Daisy Chain</th>
<th>Matrix</th>
<th>Processor</th>
<th>Distributed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positioning</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Sizing</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Cloning</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Shading</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Transparency</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Rotation</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Play Lists</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Presets</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>External Control</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
## Configurability Comparison

<table>
<thead>
<tr>
<th></th>
<th>Direct</th>
<th>Daisy Chain</th>
<th>Matrix</th>
<th>Processor</th>
<th>Distributed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Connectivity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cable Type</td>
<td>Any Input</td>
<td>DVI</td>
<td>Any Input</td>
<td>Any Input</td>
<td>Cat 5e</td>
</tr>
<tr>
<td>Length Limit*</td>
<td>≤ 5 meters</td>
<td>≤ 5 meters</td>
<td>≤ 5 meters</td>
<td>≤ 5 meters</td>
<td>≤ 100 meters</td>
</tr>
<tr>
<td>Cable Cost</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Low</td>
</tr>
<tr>
<td>Installation ease</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Easy</td>
</tr>
<tr>
<td><strong>Displays</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variety</td>
<td>Any</td>
<td>Any</td>
<td>Any</td>
<td>Any</td>
<td>Any</td>
</tr>
<tr>
<td>Quantity</td>
<td>Unlimited</td>
<td>25 (Realistic)</td>
<td>Matrix Limit</td>
<td>Chassis Limit</td>
<td>Network Limit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100 (Theory)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asymmetric Scaling</td>
<td>Single monitor only</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

* Assumes no extenders are used
## Cost Comparison

### Distributed System vs Video Processor System

<table>
<thead>
<tr>
<th>Item</th>
<th>Distributed System</th>
<th>Video Processor System</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 - 46&quot; Ultra Thin Bezel LCD Displays</td>
<td>$37,295.88</td>
<td>$37,295.88</td>
</tr>
<tr>
<td>12 - 46&quot; Wall Mount</td>
<td>$2219.88</td>
<td>$2219.88</td>
</tr>
<tr>
<td>Distributed Videowall Software Licenses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 – Display PC Licenses</td>
<td>$23,383.00</td>
<td>$51,995.00</td>
</tr>
<tr>
<td>1 - Control PC License</td>
<td>$23,383.00</td>
<td>$51,995.00</td>
</tr>
<tr>
<td>1 - Streaming PC License</td>
<td>$23,383.00</td>
<td>$51,995.00</td>
</tr>
<tr>
<td>3 - Source PC Licenses</td>
<td>$23,383.00</td>
<td>$51,995.00</td>
</tr>
<tr>
<td>12 - Small Form Factor Desktop PC (Display PCs)</td>
<td>$6168.00</td>
<td>$2995.00</td>
</tr>
<tr>
<td>1 - Small Form Factor Desktop PC (Control PC)</td>
<td>$519.00</td>
<td>$3227.88</td>
</tr>
<tr>
<td>1 - Quad Core Full Form Factor Desktop PC with Capture Card (Streaming PC)</td>
<td>$1116.00</td>
<td>$119.97</td>
</tr>
<tr>
<td>3 - Small Form Factor Desktop PC (Source PC)</td>
<td>$1557.00</td>
<td>$31.99</td>
</tr>
<tr>
<td>1 - 24 Port Layer 2 IGMP Gigabit Ethernet Switch</td>
<td>$145.99</td>
<td>$1557.00</td>
</tr>
<tr>
<td>1 - 1000' Spool Category 5 Cable</td>
<td>$15.99</td>
<td></td>
</tr>
<tr>
<td>50 - RJ45 Connectors</td>
<td>$15.99</td>
<td></td>
</tr>
<tr>
<td>1 - 10' HDMI cable, connect source to Streaming PC</td>
<td>$15.99</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$73,060.72</strong></td>
<td><strong>$99,442.60</strong></td>
</tr>
</tbody>
</table>

Note: Installation will be higher due to DVI cable installation.
Installation Considerations

- **Power**
  - Wall – often one circuit per 4 displays
  - Network and support equipment

- **Cooling**

- **Low Voltage Infrastructure**
  - GbE switch
  - Cabling – conduit capacity

- **Mounting**
  - Structural strength
  - Flat surface
  - Videowall mounting system
Q&A
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