

THE FUTURE OF CONTROL ROOMS

HUMAN FACTORS IN CONTROL ROOM DESIGN



THE FUTURE OF CONTROL ROOMS

ENABLING THE SUPEROPERATOR



Technology Trends

- More Data at Higher Resolution : *Sensor Platforms, IOT, Digital Twins*
- Higher Data Transmission Rates
- More Sources / More Threats
- Intelligent Sensors
- Intelligence at the Data Center
- More Decisions

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Human Factors



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Human Factors

1. Operator Physiology
2. Operator Environment
3. Design for Visual Acquisition
4. Visual Design Factors
5. Optimum Displays
6. IT-based Content Management

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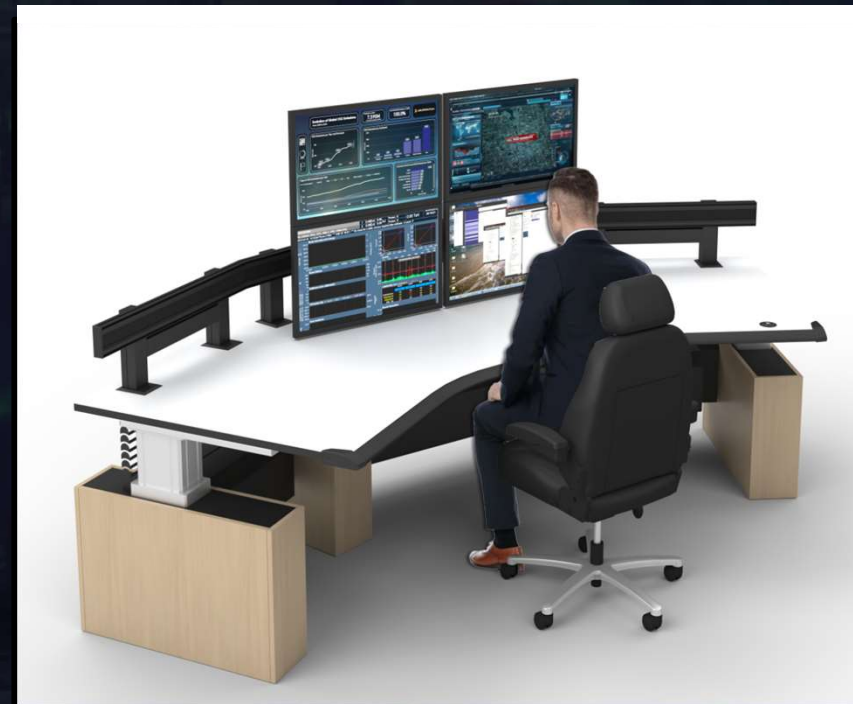
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Operator Physiology



Need for Movement

- Stationary Operator
 - Highly adjustable seating
 - Reconfigurable display mounts
 - Personalized equipment / peripherals



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1 Operator Physiology



Need for Movement

- Stationary Operator
- Sit-Stand Operator



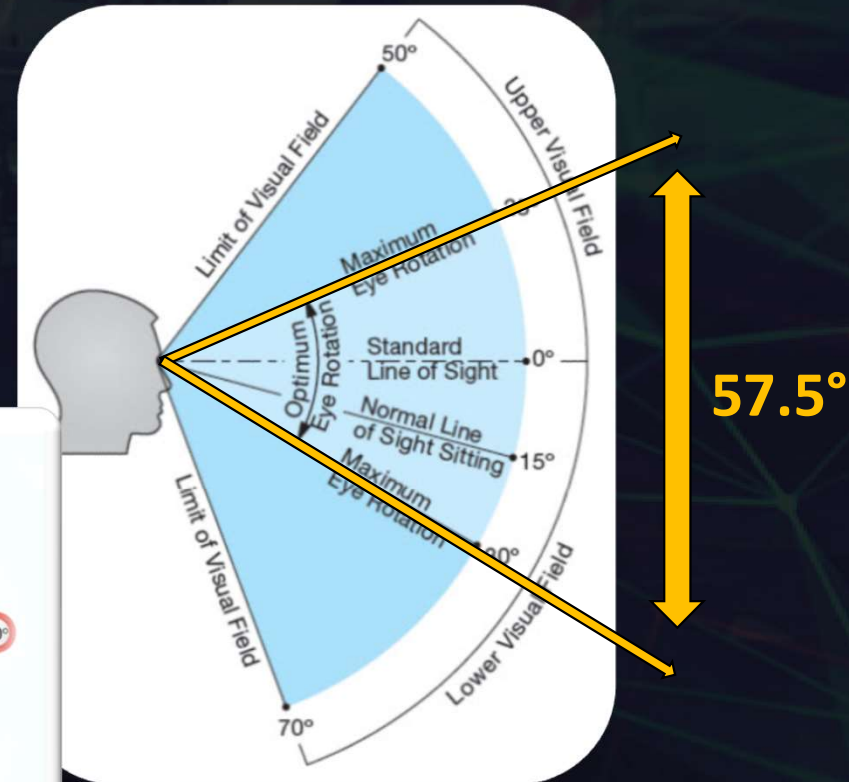
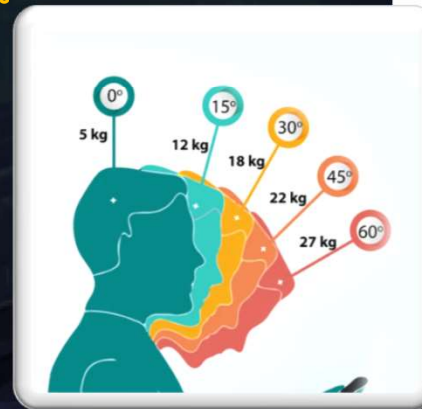
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1 Operator Physiology

Reduce Unnecessary Movement

- Head Tilt
 - Vertical Limitations on Field-of-View [FoV]
 - Optimum Vertical FoV : **57.5°**



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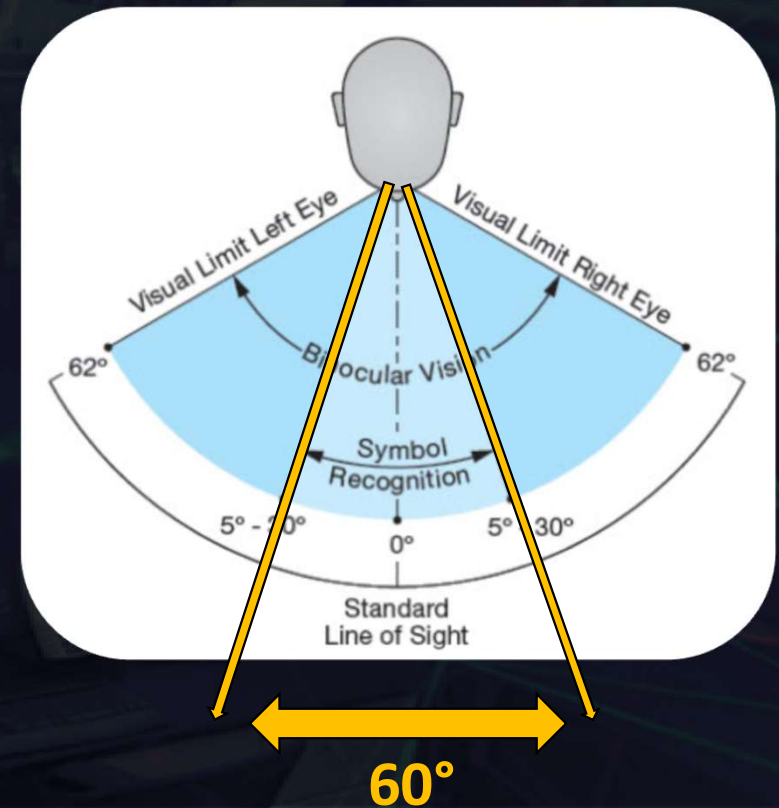
1 Operator Physiology



Reduce Unnecessary Movement

- Head Tilt
 - Vertical Limitations on Field-of-View [FoV]
 - Optimum Vertical FoV : **57.5°**
- Head Swivel
 - Horizontal Limitations on Field-of-View [FoV]
 - Optimum Horizontal FoV : **60°**

Color & Symbol Recognition



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2 Operator Environment



Acoustic Attenuation

- Sound Isolation
- Sound Absorption
- Sound Masking

Climate Control

- Local airflow
- Temperature Controls

Visual Engagement vs. Distraction



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3 Visual Acquisition



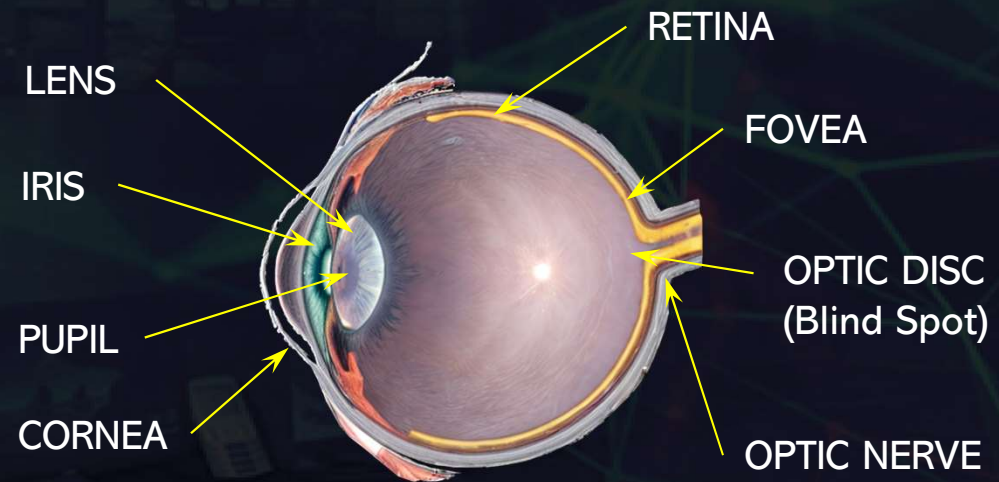
Resolution of Human Eye

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Resolution of Human Eye

- Lens & Iris
 - Controls focus and light reception
- Rods & Cones
 - Photoreceptor Cells: Rods (low light); Cones (color)
 - Lower density at peripheral vision areas
- Fovea
 - Highest density for spatial acuity and viewing detail
 - 3 types of color receptors [R / G / B]



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3

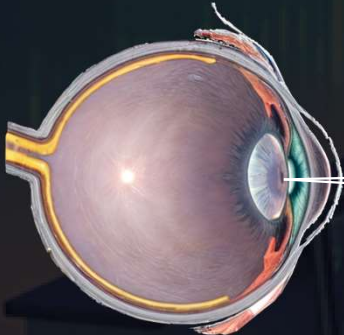
Visual Acquisition

Resolution of Human Eye

- Visual Acuity

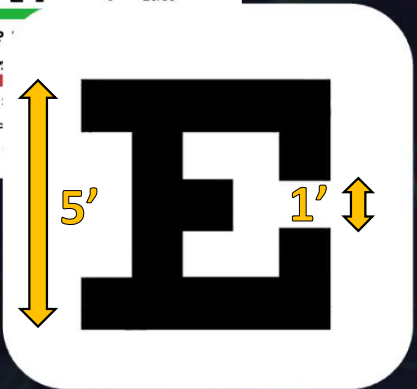
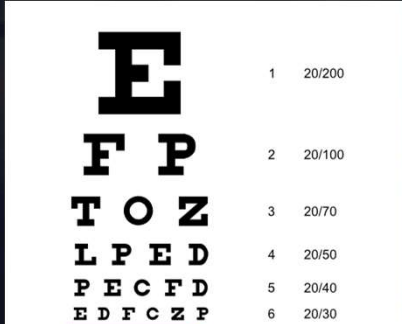
Smallest detail the Eye can differentiate: **1 Arc Minute**

Equivalent to 1/60 degree



1 Arc Minute

1'



5 Arc Minutes

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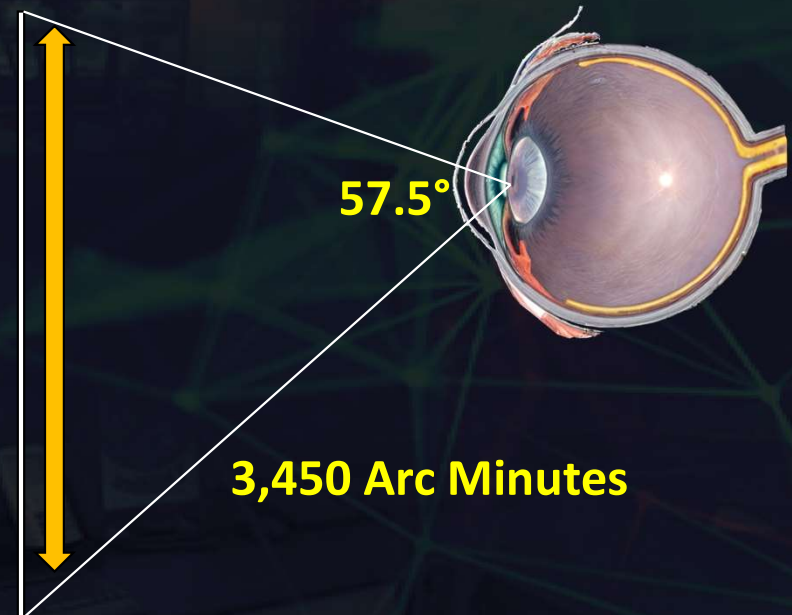
Resolution of Human Eye

- Optimum Vertical Field of View: **57.5°**
- **60 Arc Minutes x 57.5° = 3,450 elements**
Smallest detail the Eye can differentiate: **1 Arc Minute** (1/60 degree)

3600 (H) x 3450 (V) pixels

Horizontal

Vertical



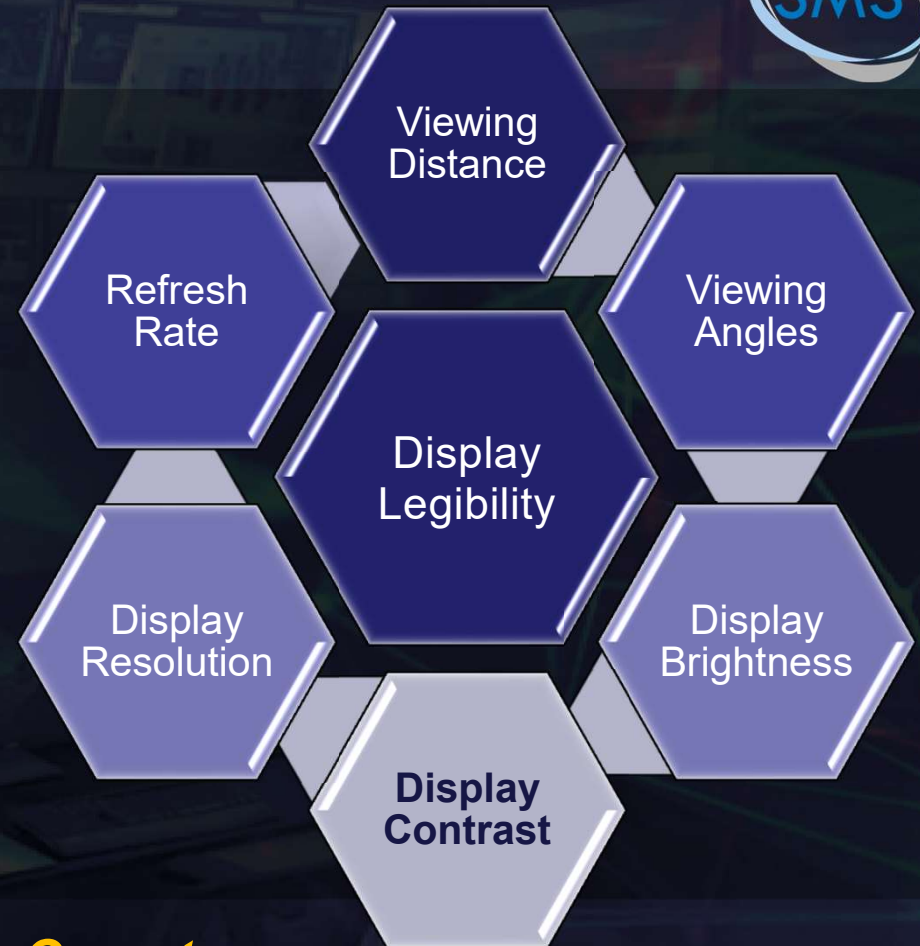
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4 Visual Design Factors

There are many factors at work regarding the legibility of displays in a Control Room environment.



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4 Visual Design Factors



Contrast

- Grayscale: Most sensitive aspect of vision
- Contrast Ratio – 2,000:1 vs. 20,000:1



A and B have the same ratio difference. However, the eye is more sensitive at lower levels. Most people cannot see the difference in between 'B' samples.

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4 Visual Design Factors

Contrast

- Grayscale: Most sensitive aspect of vision
- Contrast Ratio – 2,000:1 vs. 20,000:1



Same Slide without masking.
A and B have the same ratio difference.

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4 Visual Design Factors



Brightness

Ambient Light
400–500 Lux



Console Display
400–450 cd/m²



Videowall
600– 650 cd/m²



The more light is focused to the rear of the eye by the iris, the better visual acuity, spatial perception and color reading.

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4 Visual Design Factors



Flicker

Film
24-120 FPS

Console Display
144 Hz

Videowall
120 Hz



The smoother and more consistent the images are received by the eye, the less Operator feel the strain of iris fatigue.

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4 Visual Design Factors



Blue Light

- Falls in the 380-500 nanometer range on visible light spectrum
- Higher energy than other visible light colors
- Can penetrate to the retina at the back of the eye
- May contribute to digital eye strain and sleep disruption



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5 Engineering for the SuperOperator



Factors to Consider

- Physiological Stressors
- Resolution of Human Eye
- Contrast Ratios
- Brightness Levels
- Refresh Rates (Flicker)
- Radiation Levels / Blue light

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5 Engineering for the SuperOperator



Console Displays

- Bigger : 27", 32", 34"
- Wider : 16:9 and 21:9
- Resolution : 4K and 5K
- Brightness : 400-450 cd/m²
- Contrast : 1:3000
- Refresh : 144-165Hz
- Built-in : Camera, Array Mic, Touchscreen



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5 Engineering for the SuperOperator



Videowall Displays

- Pixel Pitch Calculations

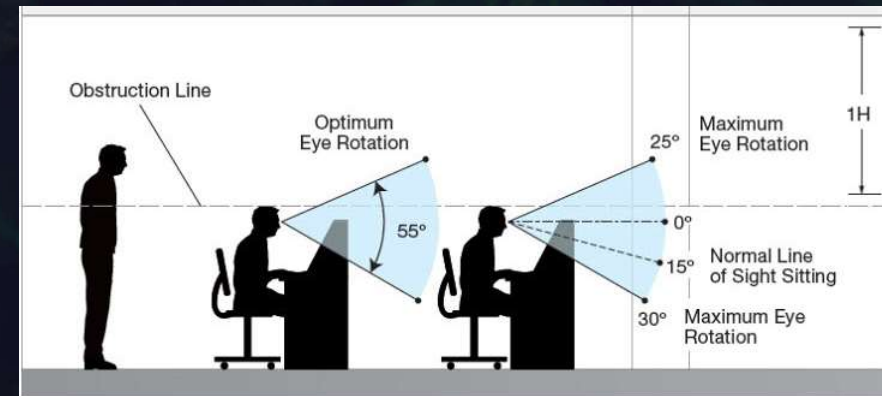
Operator's Extant Vertical Viewing Angle (EVVA): **57.5°**

At 60 Arc Minutes per degree, Total Vertical Elements (TVE): **3450**

Measure the Operator View Angle (OVA) to Monitors & VWs
Divide OVA / EVVA = Total Viewing Angle Percentage (TVA%)

Multiply TVE / TVA % = Operator Vertical Elements (OVE)

Height of Videowall / OVE = **Min Pixel Pitch**



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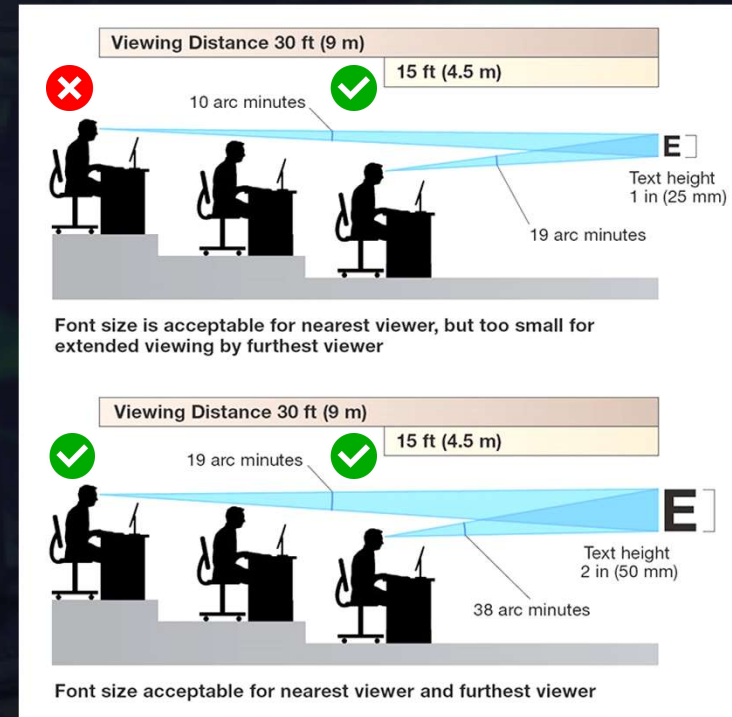
5 Engineering for the SuperOperator



Videowall Displays

- Pixel Pitch Calculations

Pixel Pitch (mm)	Visual Acuity Distance (m)	Avg Comfortable Viewing (m)
0.75mm	2.58m	1.29m
1.00mm	3.44m	1.72m
1.25mm	4.30m	2.15m
1.50mm	5.16m	2.58m
1.75mm	6.02m	3.01m



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Videowall Displays

○ Contrast Criteria

Most important factor for Legibility/Readability

Contrast Ratio

- | | |
|--|---------|
| • LCD 55" Videowalls | 1:3500 |
| • LED Videowall Commercial | 1:6000 |
| • LED Videowall Control Room | 1:9000 |
| • LED Videowall Control Room with HDR processing | 1:20000 |

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5 Engineering for the SuperOperator



Videowall Displays

○ Brightness Criteria

Most important factor for Legibility/Readability

cd/m²

- | | |
|--|-----------|
| • LCD 55" Videowalls | 500 |
| • LED Videowall Commercial | 600-800 |
| • LED Videowall Control Room | 900-1000 |
| • LED Videowall Control Room with microLED | 1100-1200 |

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Videowall Displays

○ Refresh Rate Criteria

Most important factor to reduce eye strain

	Refresh/Hz
• LCD 55" Videowalls	60 Hz
• LED Videowall Commercial	60 Hz
• LED Videowall Control Room	60 Hz
• LED Videowall Control Room with High Refresh & Synch	120 Hz

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Videowall Displays

○ Blue Light Attenuation

Most important factor to reduce eye strain

- | | |
|---|-------------|
| • LCD 55" Videowalls | Windows App |
| • LED Videowall Commercial | Windows App |
| • LED Videowall Control Room | Windows App |
| • LED Videowall Control Room with Blue Light Filter | VW Software |

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Optimized VW Displays

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Unilumin



Unilumin LED Displays



UMiniIIIPro





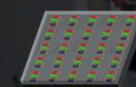
Fully Automated Mini LED Technology



Mini level chip size



RGB Flip-chip technology



COB packaging technology

Optimized Displays

Key Factors

EBL EBL+ Technology

EDL EDL Technology

3DL 3D LUT

 Comfortable use experience

5G 5G Transmission

 Maximum Energy-saving

1 Super-high Contrast with EBL+ Technology



UMiniIIIPro adopts unique **EBL+(Enhance Black Level+)** technology and **multi-layer optical processing technology**, which displays vivid, detailed black content with an amazing 30000:1 contrast providing audiences with a breathtaking immersive viewing experience. In addition, the surface of the COB LEDs is protected by patented technology for durability, quality and performance.



Super black background



30000:1 Super high contrast*



Super soft display



Ultra-low moiré



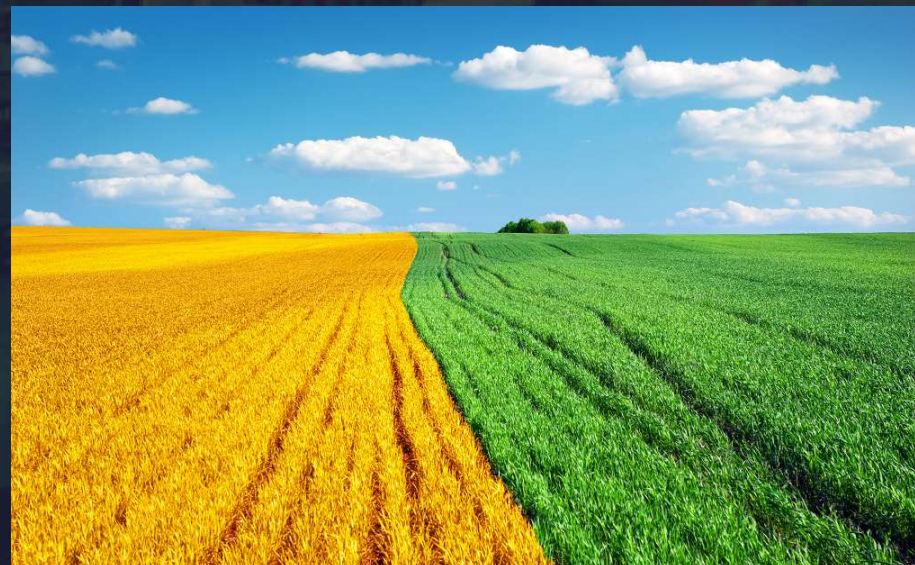
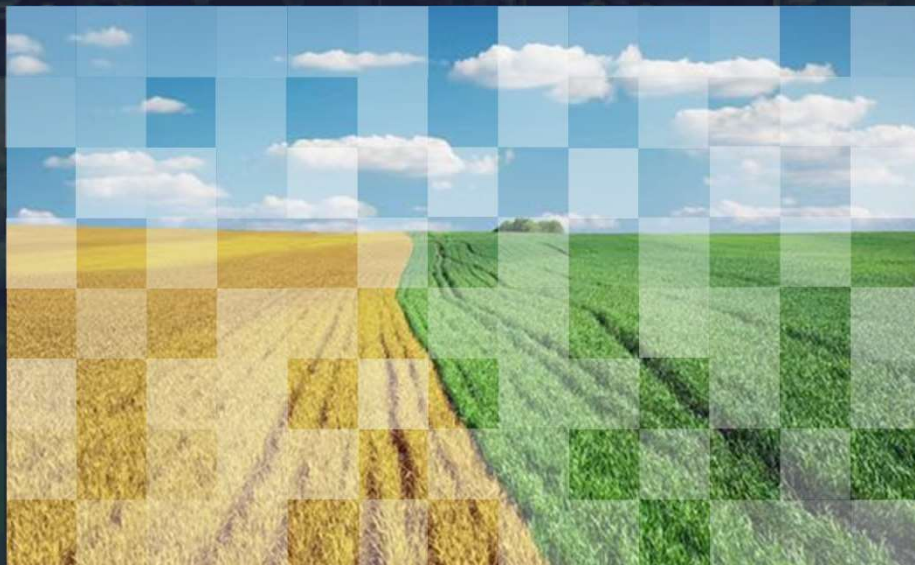
Ultra-low reflectance



Ultra low touch trace

* : support

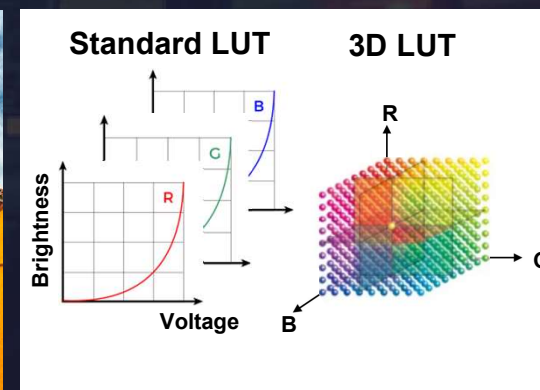
2 Ultra-high Consistency with EDL Technology



UMiniIIIPro features EDL(Enhance Drive Level) technology to improve consistency of the grayscale on the display and effectively solve the heat dissipation problems of micro-pitch LED displays

- 🌡️ Low temperature rise
- ⚡ Low power consumption
- 🔦 No flickering
- 🔲 Ultra high consistency
- 🚫 No high-contrast coupling issues

3 True Color Reproduction with 3D-LUT



High-precision gamut transfer



DCI-P3 color gamut



High saturation

Exact color representation is important, and 3D-LUT technology makes it possible, which allows UMiniIIIPro to accurately present each image in its original color across the screen.

4 Ultra-high Brightness

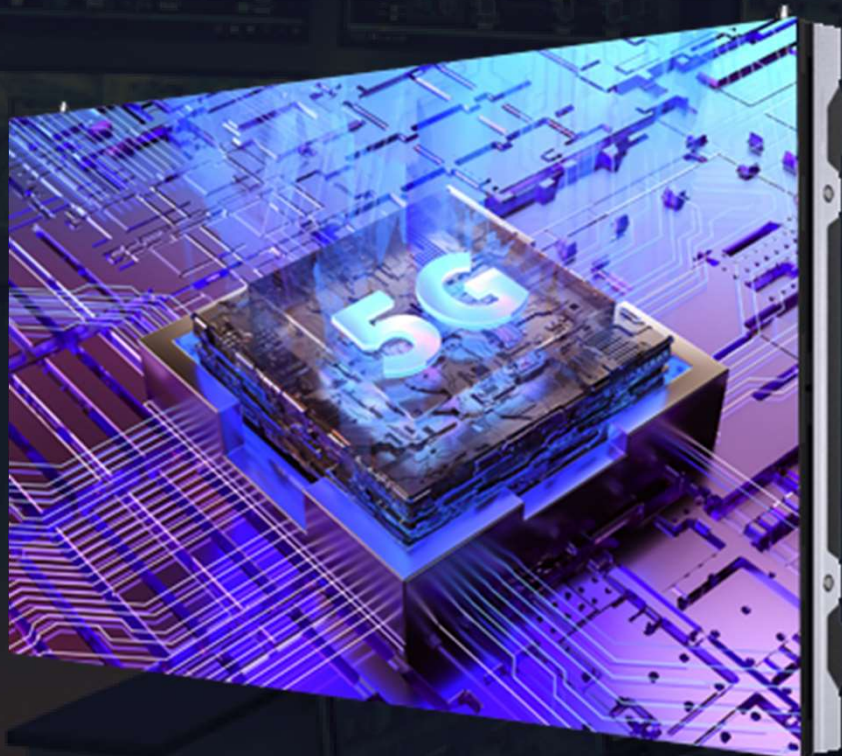
Unilumin



UMiniIIIPro supports ultra-high brightness* to adapt to diverse environments, so the visual experience will not be affected, even if it is directly illuminated by bright lights.

* : support

5 5G Ultra-large Signal Transmission*



Streamlined Hardware Equipment



Fast Data Transmission & Large Load Capacity

UMiniIIIPro utilizes 5G ultra-large signal transmission technology, which ensures the data transmission speed is four times faster than traditional LED display for larger load capacity. In addition, the hardware equipment is more streamlined to facilitate easy installation.

6 High Refresh Rates



UMiniIIIPro supports high frame rate applications of 120HZ and 240HZ which makes the display content smoother.

7 Human-friendly Experience



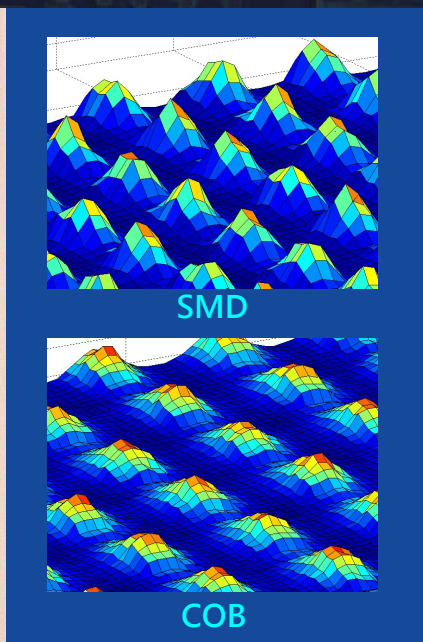
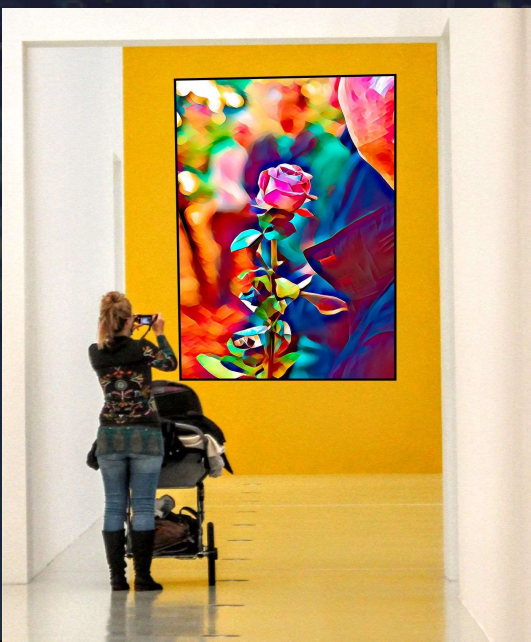
EMC Class B






UL LISTED Certification

Qualified EMC Class B, UMiniIIIPro's anti-interference is consumer level. In addition, UL LISTED certification provides confidence that UMiniIIIPro was designed with all safety considerations while providing the most captivating imagery possibility.

8 Comprehensive Eye Protection



-  Area light source design, reduce negative effects on eyes
-  Nano-optical materials with diffusion process ensures uniform light and filter out stray light
-  Best-in-class LEDs ensure less than 5% harmful blue rays.

Utilizing multiple technologies to minimize health hazards caused by long-term use of the screen, UMicro has been certified by TUV for its visual comfort display performance.

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IT-Based Content Management

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Introduction to
Userful Corporation



Mohammad Bani Salameh
Regional VP – META
mohammad.salameh@userful.com

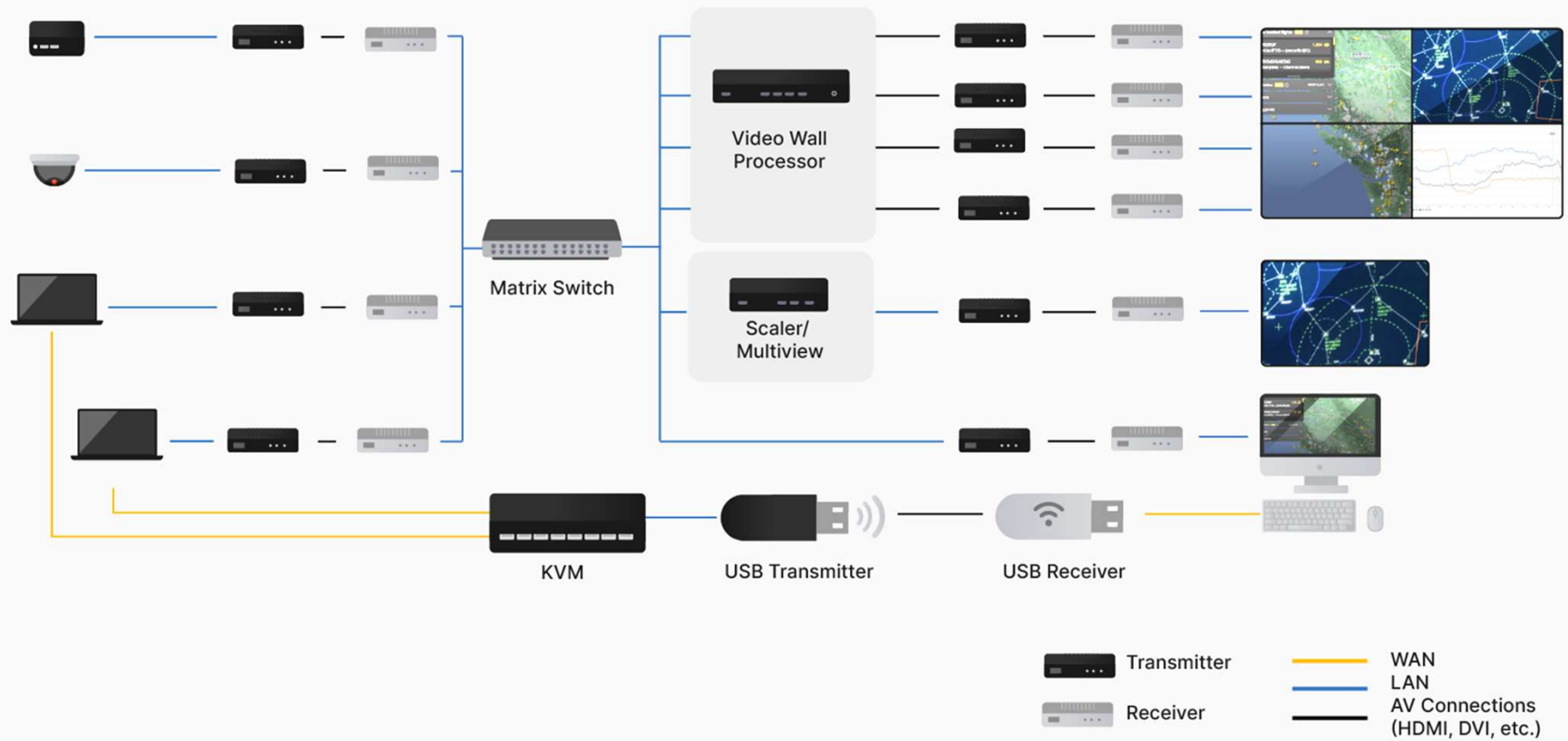


Operation Center Solution

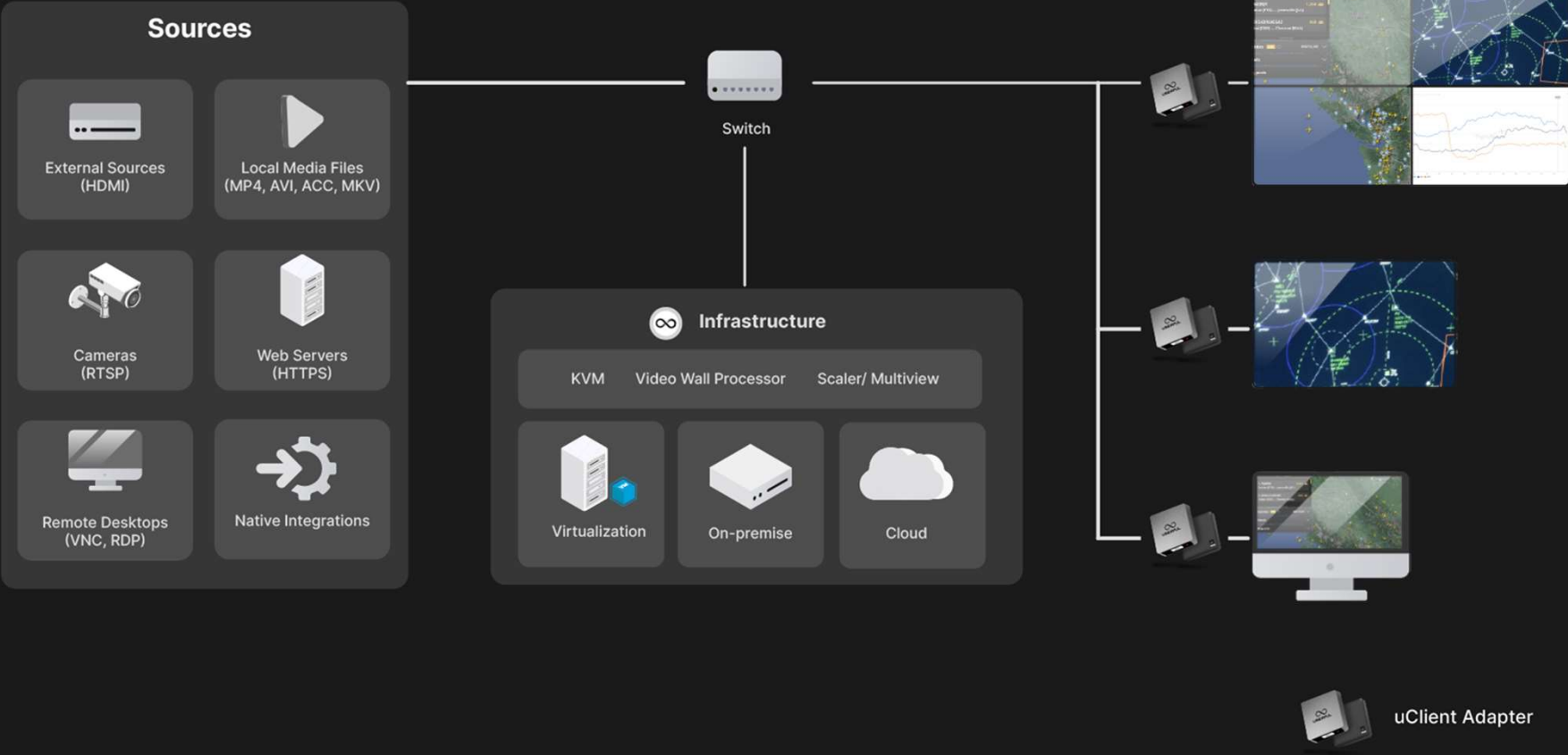
An all-in-one complete solution for
situational awareness and
operational efficiency.



Traditional AV Services

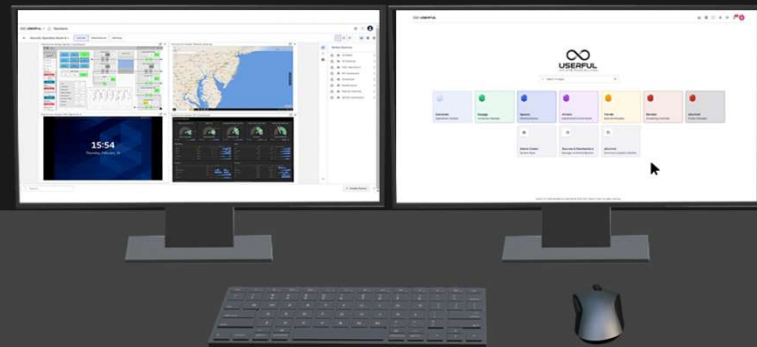
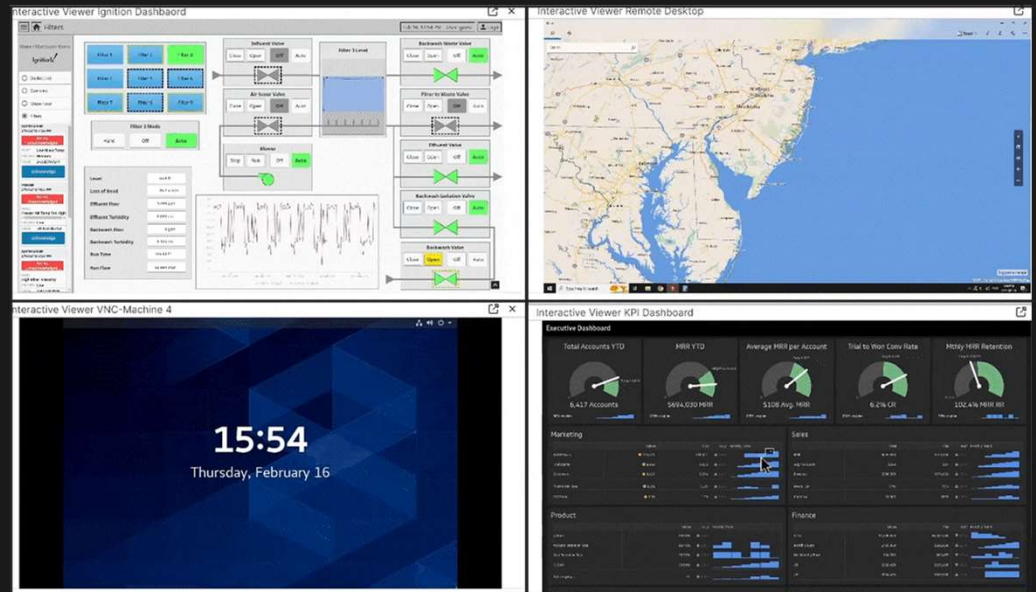


Evolved: Useful Software



Video Walls for Operation Centers

- Integrate a complicated array of AV and IoT and data metrics sources into their operation centers.
- Leverage API triggers to help operators identify issues and take action.
- Ensure multiple operations centers around the globe can share the same data in real time.
- Up to 8K resolution



Software KVM

- Split-screen and interact with sources via KVM control using a virtual canvas on the operator workstation.
- Configure virtual video walls locally on the operator workstation screens, or in an adjacent meeting room display.
- Manage any source configured and hosted within Userful's platform.



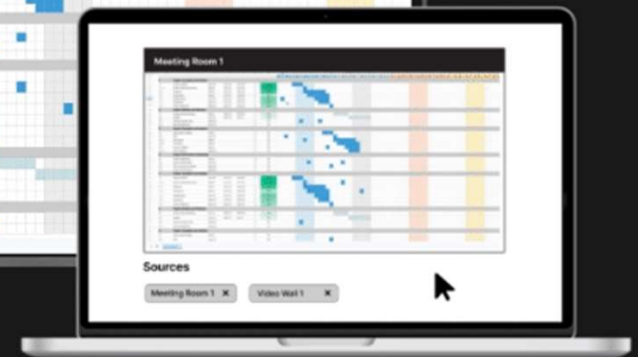
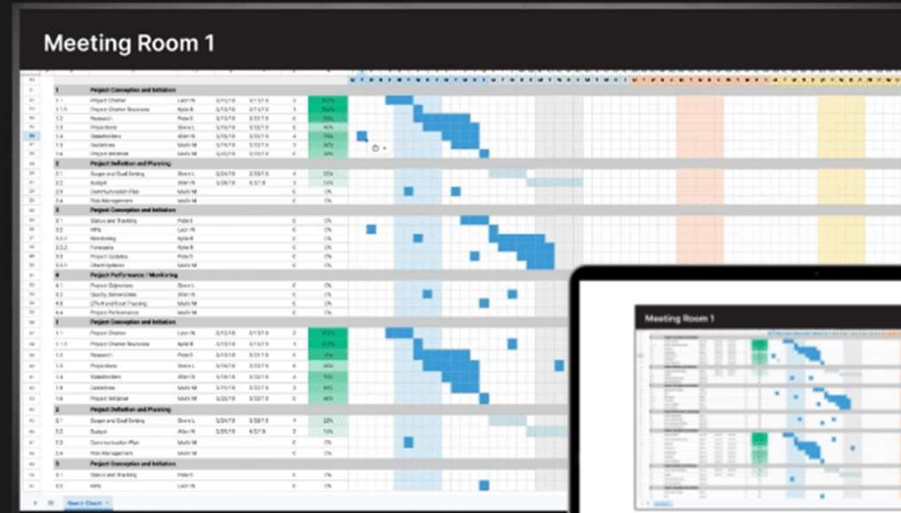
uControl

- Easy to navigate touch interface for executives, visitors, and non-admin users.
- Use existing operations centers and designated destinations to generate uControl buttons.
- Assign and remove content from uControl. If the content is removed or unassigned, the original source becomes active again.



War Rooms

- Quick and secure way to transform a regular conference room into a War room.
- Multicast and collaboration from multiple members.....
- Immediate access to all functionality and sources within the same interface.



Sources

Meeting Room 1 X

Mass Broadcast

- Enable operators to communicate effectively during an emergency
- Broadcast custom text alerts on every connected display
- Custom templates to create and easily modified for any number of scenarios

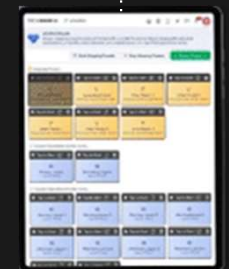


Streams

- Easy to navigate touch interface for executives, visitors, and non-admin users.
- Use existing operations centers and designated destinations to generate uControl buttons.
- Assign and remove content from uControl. If the content is removed or unassigned, the original source becomes active again.



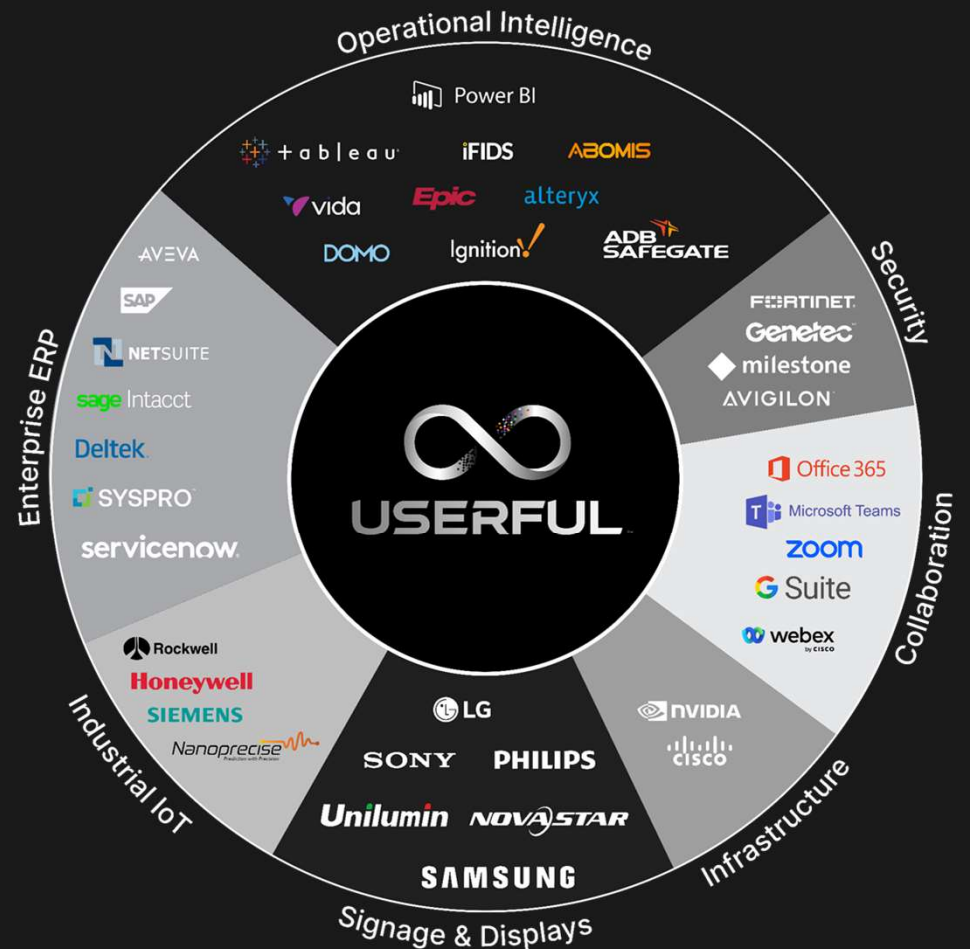
HLS Stream



Connect Your Tech Stack

Userful Infinity Platform offers native software capturing, enabling full interactivity without additional hardware.

- Web browser Persistent login | Connect anything
- Native Integrations Like PowerBI, Tableau, EPIC Health
- RESTful API for seamless third-party integration
- MQTT/IFTTT for IoT connectivity



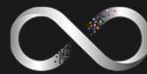
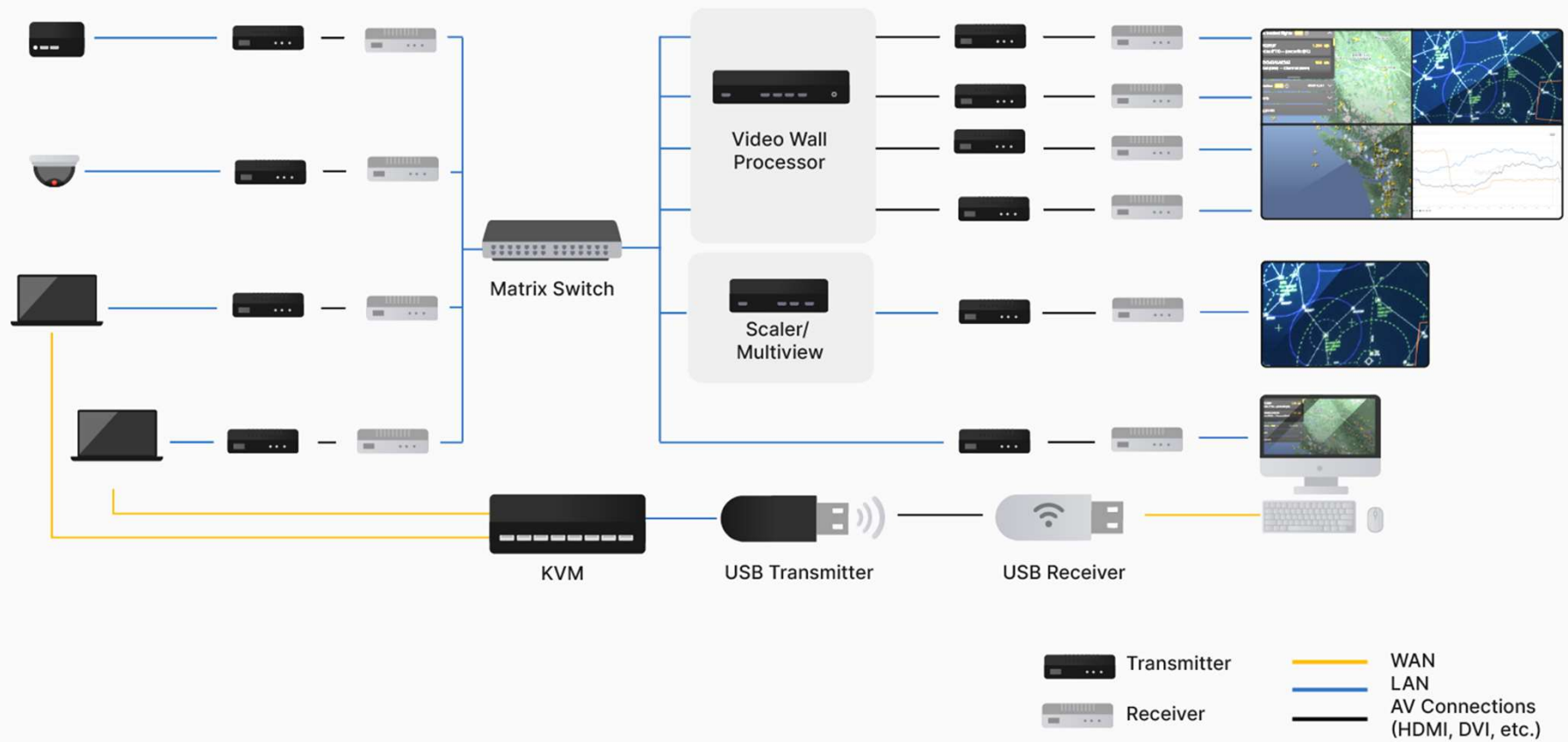


Data Dashboard Solution

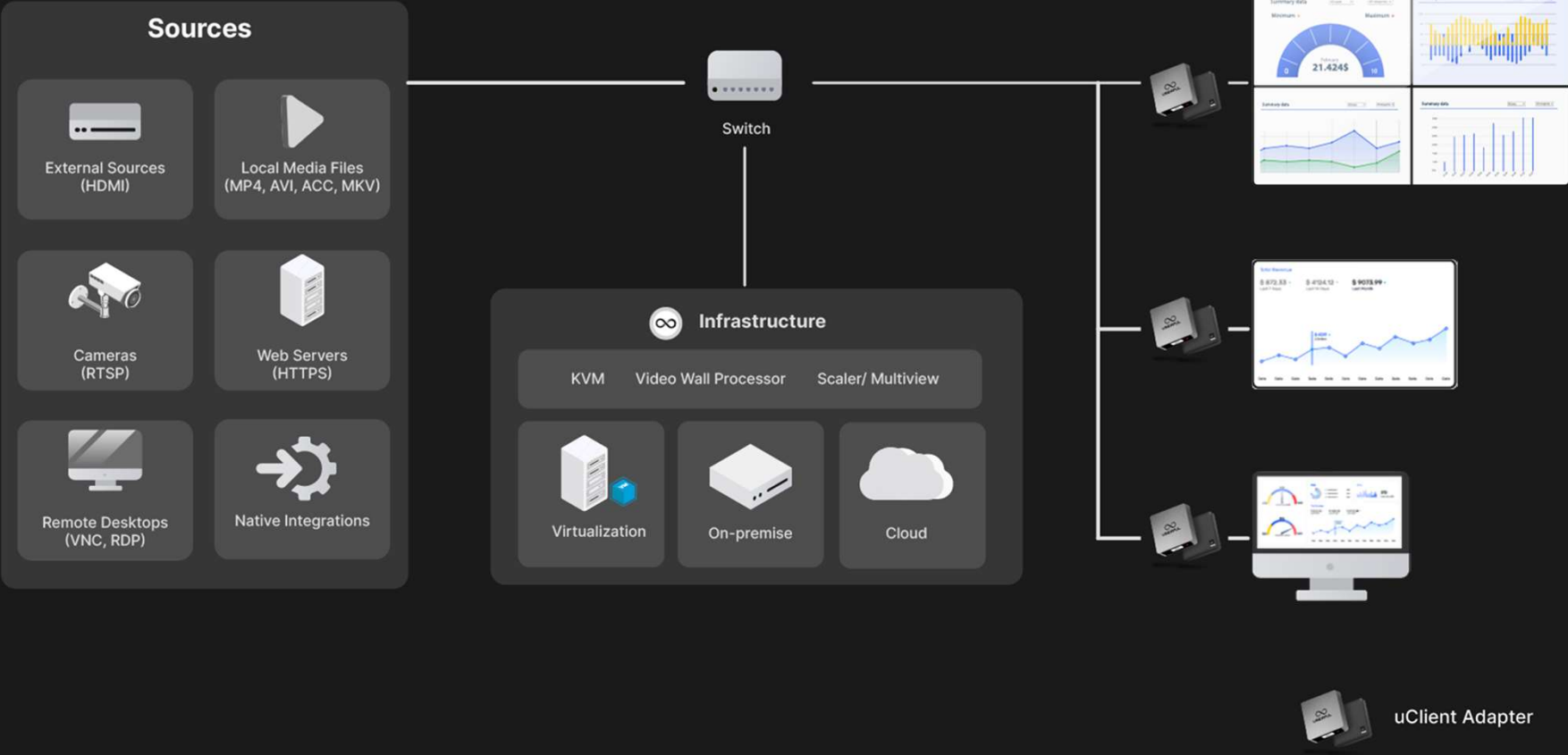
An all-in-one complete solution for integrating multiple sources and distributing data analytics.



Traditional AV Services



Evolved: Useful Software



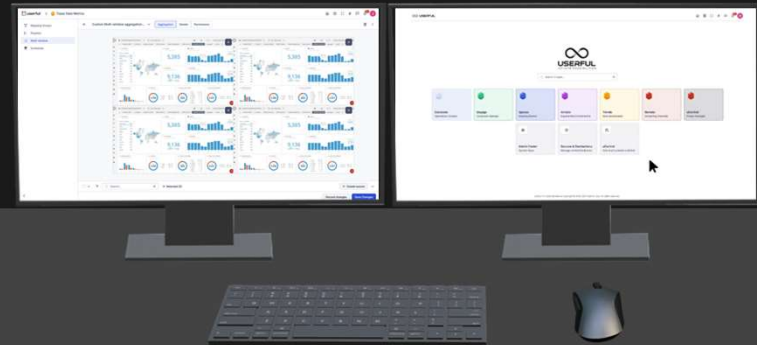
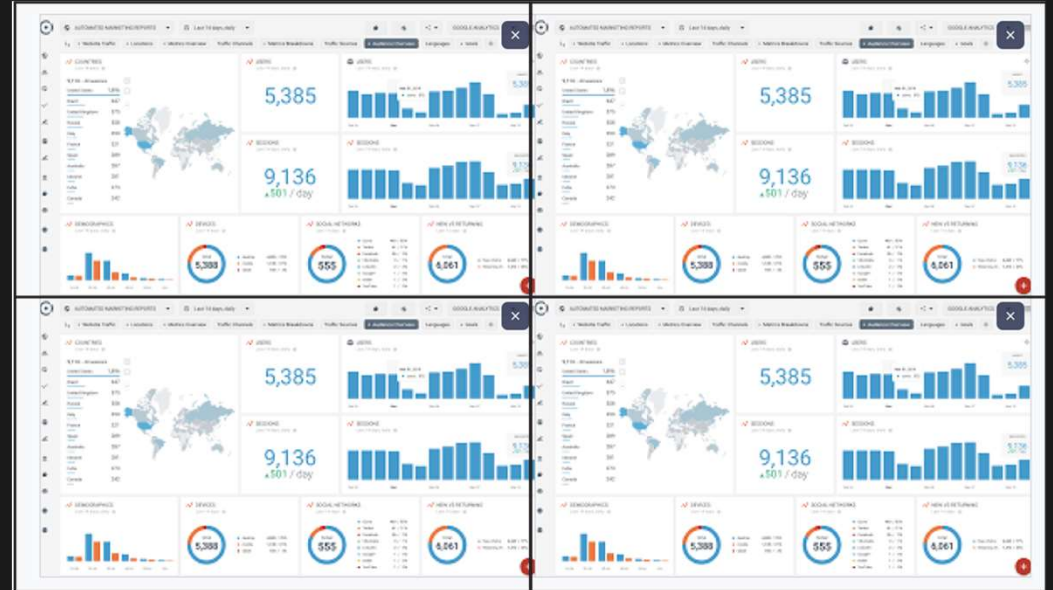
Distribute KPI's Securely

- Persistent and secure access to data from enterprise leading applications
- Authentication at the server and encrypted dissemination to the edge.
- Share dashboards without updating individual screens, storing passwords or creating public URLs.



Multi-window View

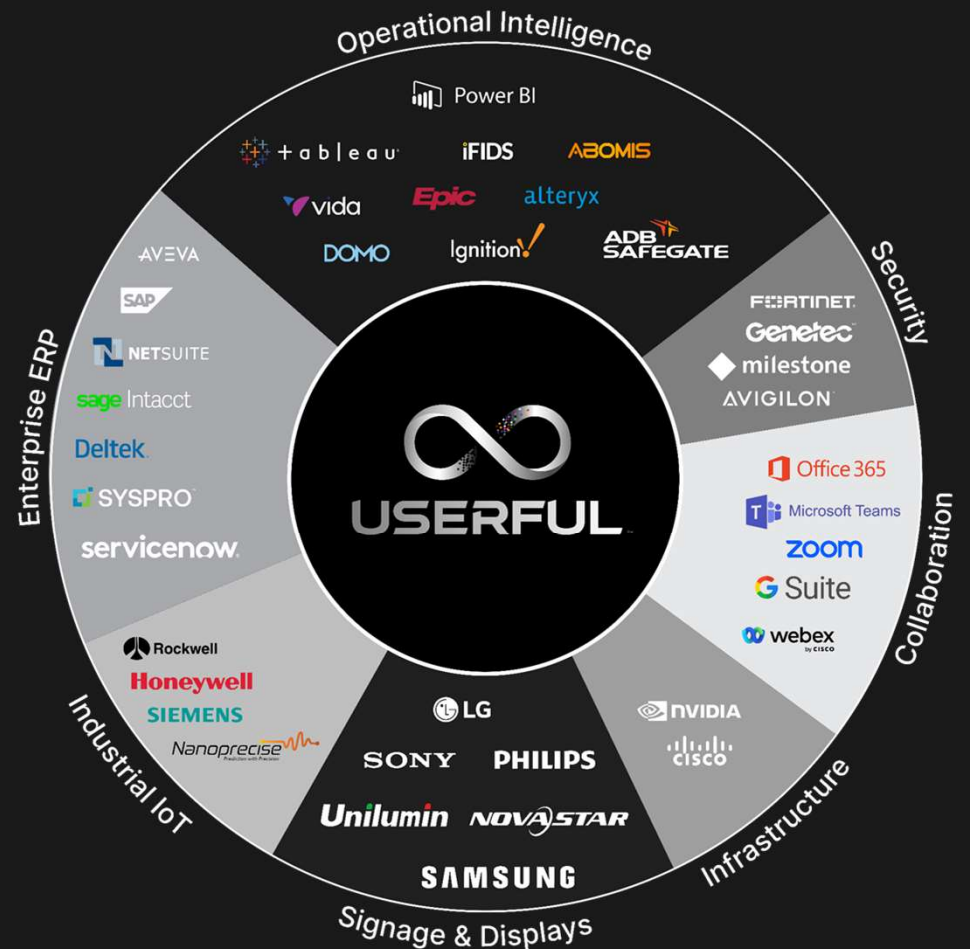
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Connect Your Tech Stack

Userful Infinity Platform offers native software capturing, enabling full interactivity without additional hardware.

- Native Integrations (PowerBI, Tableau, EPIC Health)
- REST API for seamless third-party integration
- MQTT for IoT connectivity
- Web-Persistent login



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A person is seen from behind, sitting in a control room. They are surrounded by several computer monitors displaying various data and charts. In the background, a large window shows a world map with glowing points, suggesting global connectivity or data analysis. The overall atmosphere is futuristic and high-tech, with blue and orange lighting.

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