

Why an Eye Limiting Display Resolution Matters



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Program Background

- Program: Operationally Based Vision Assessment (OBVA)
- NASA Task: Build Research Stimulator for USAF to Study Human Vision and Testing Standards in Operationally Relevant Test Environments
 - USAF School of Aerospace Medicine (USAFSAM) Sponsored Research Project





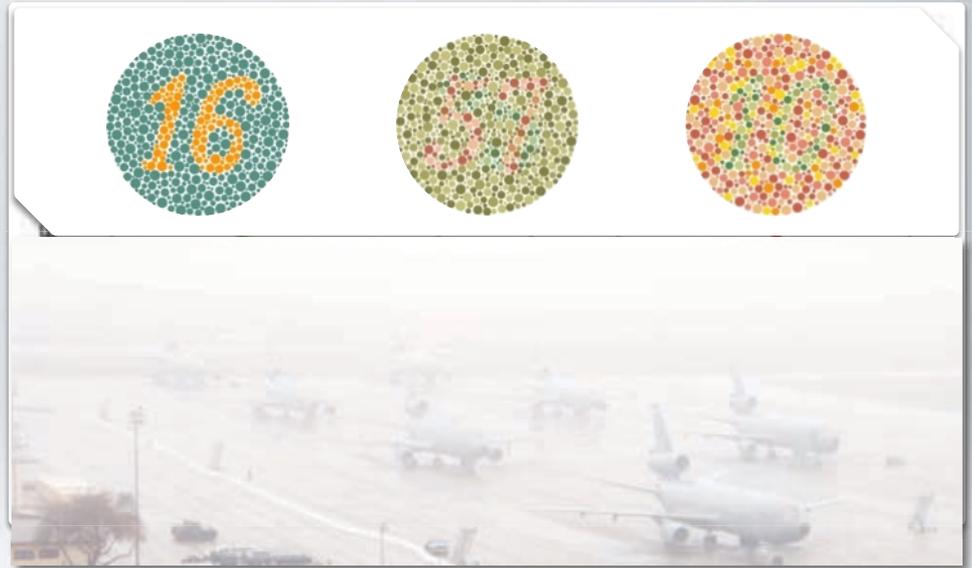
Acuity Test for Future Aviators

| | | |
|--------------------------|----|--------|
| E | 1 | 20/200 |
| F P | 2 | 20/100 |
| T O Z | 3 | 20/70 |
| L P E D | 4 | 20/50 |
| P E C F D | 5 | 20/40 |
| E D F C Z P | 6 | 20/30 |
| F E L O P Z D | 7 | 20/25 |
| D E F P O T E C | 8 | 20/20 |
| L E F O D P C T | 9 | |
| F D F L T C E O | 10 | |
| F E E O L C F T S | 11 | |



More Background Info

- Young USAF pilots have an average of 20/13 visual acuity
- Average FAA flight simulator today has a visual acuity of 20/40
- Most vision testing focus on acuity, while color and contrast differential testing are limited at best



20/80



20/40



20/20



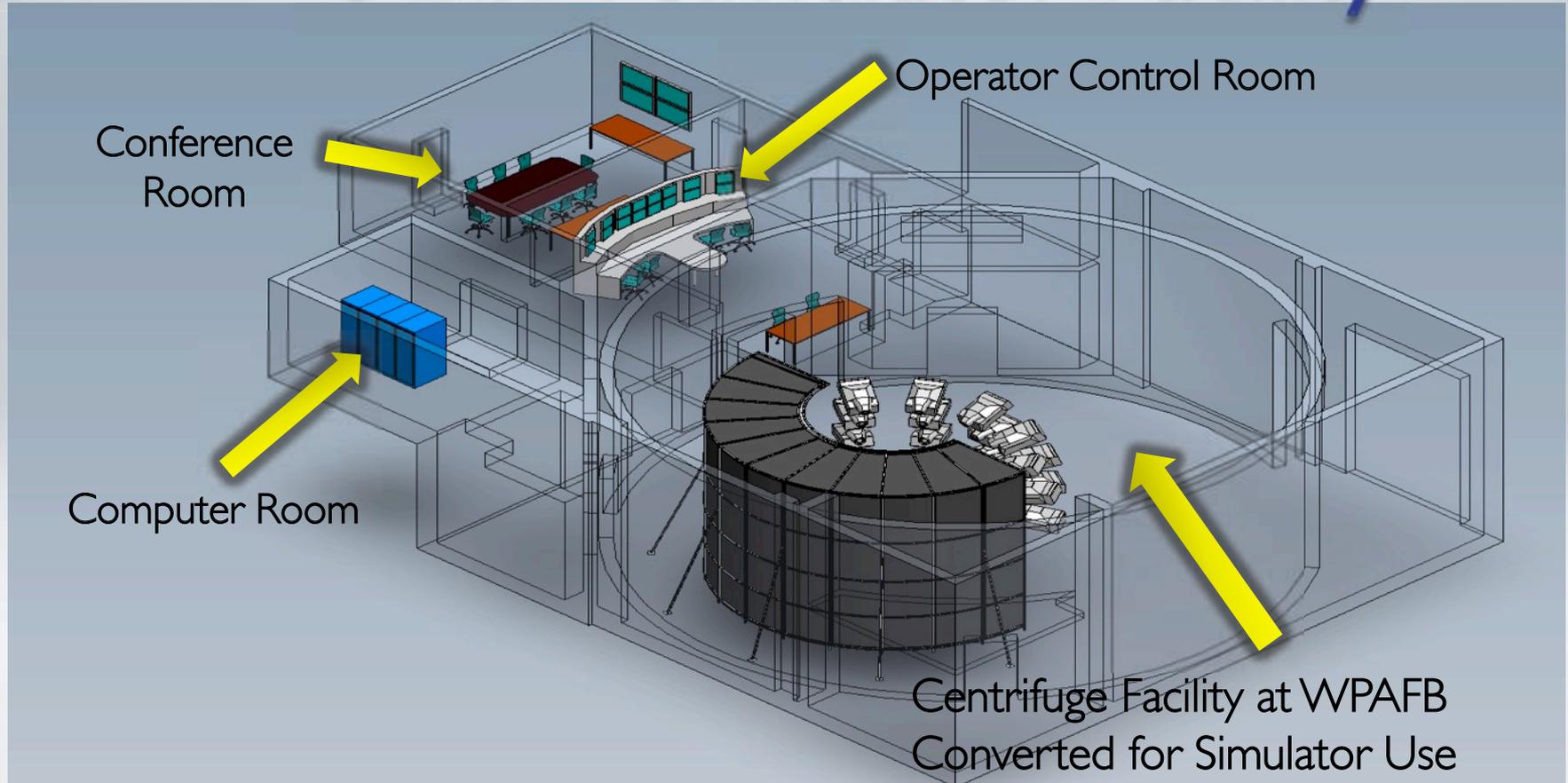


Eye Limited Visual System

- NASA Task: Build Eye Limited Image Generator
 - 12288 × 7200 pixels (~88-million pixels) “retina display” on a 4-meter spherical dome
 - Max ~160° horizontally and ~80° vertically once fully populated
- ~6000 lumen brightness
- Color space meets or exceeded aviation RGB
- 60 Hz refresh rate minimum
 - Desired: 120 Hz or higher optimal to minimize motion artifacts



OBVA Simulator Facility





Display Subsystem

- 9 Quad-HD (4K) projectors in place today
- Expanding to 15 Quad-HD projectors in 2013
- Support up to 25 Quad-HD projectors in future

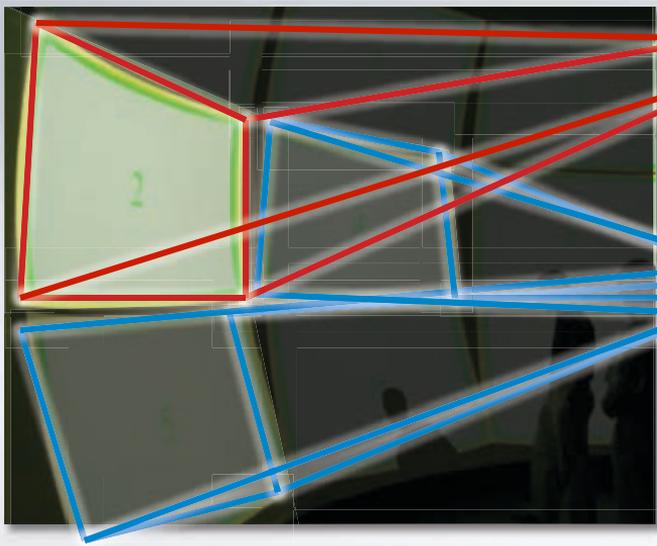




One BIG Desktop

- Each Out The Window IGR Can Drive Two Quad-HD Projectors

8192x4800 Horizontal Desktop



4K Projectors

4096x4800 Vertical Desktop

4 DVI-D cables to each projector

Dual NVIDIA Quadro GPUs

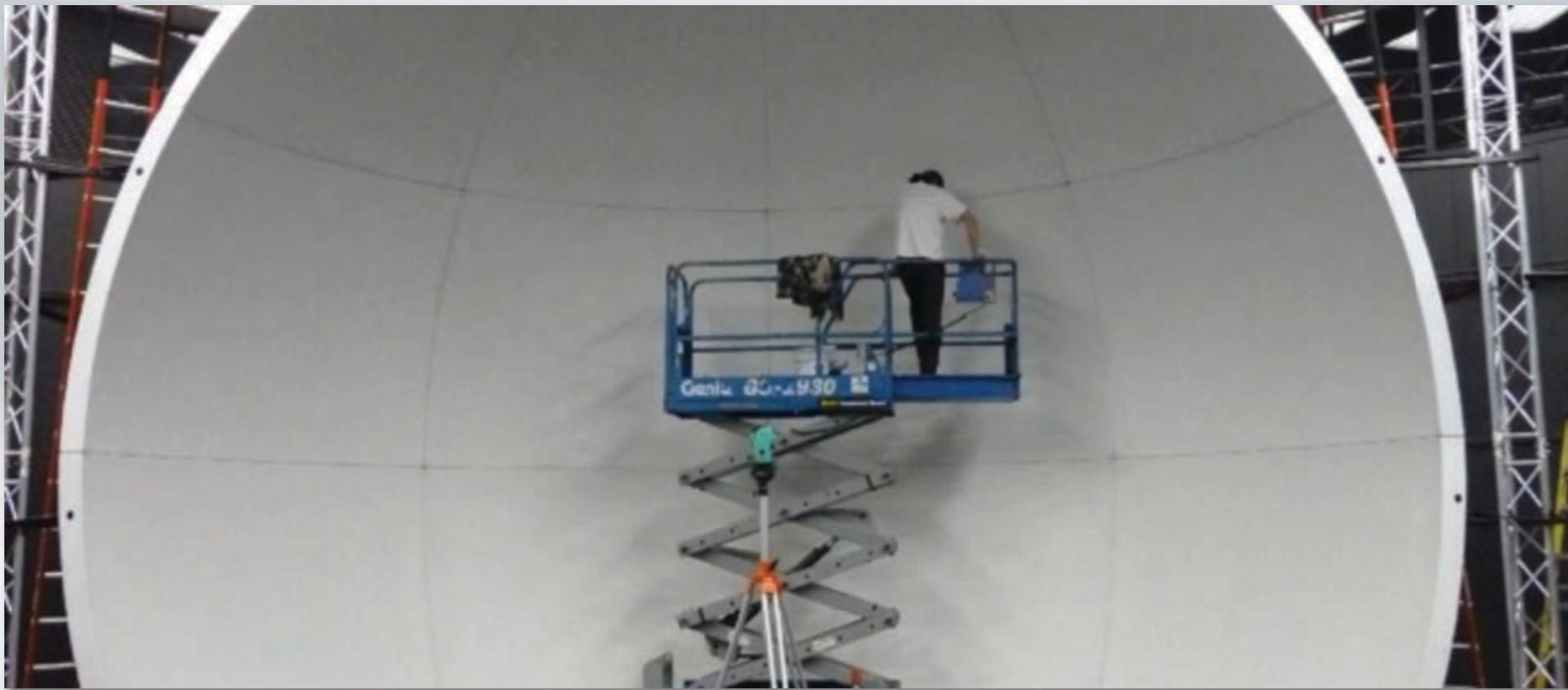
HIC cables

IGR: IU PC with Dual-HIC





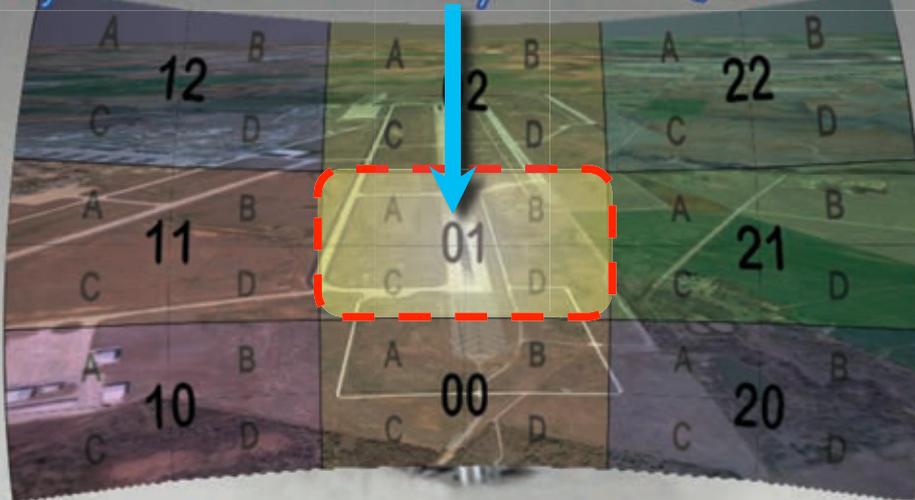
4-Meter Dome at WPAFB





4-Meter Dome at WPAFB

Each ABCD Quad
represents a
4K projector driven by NV Quadro GPU(s)





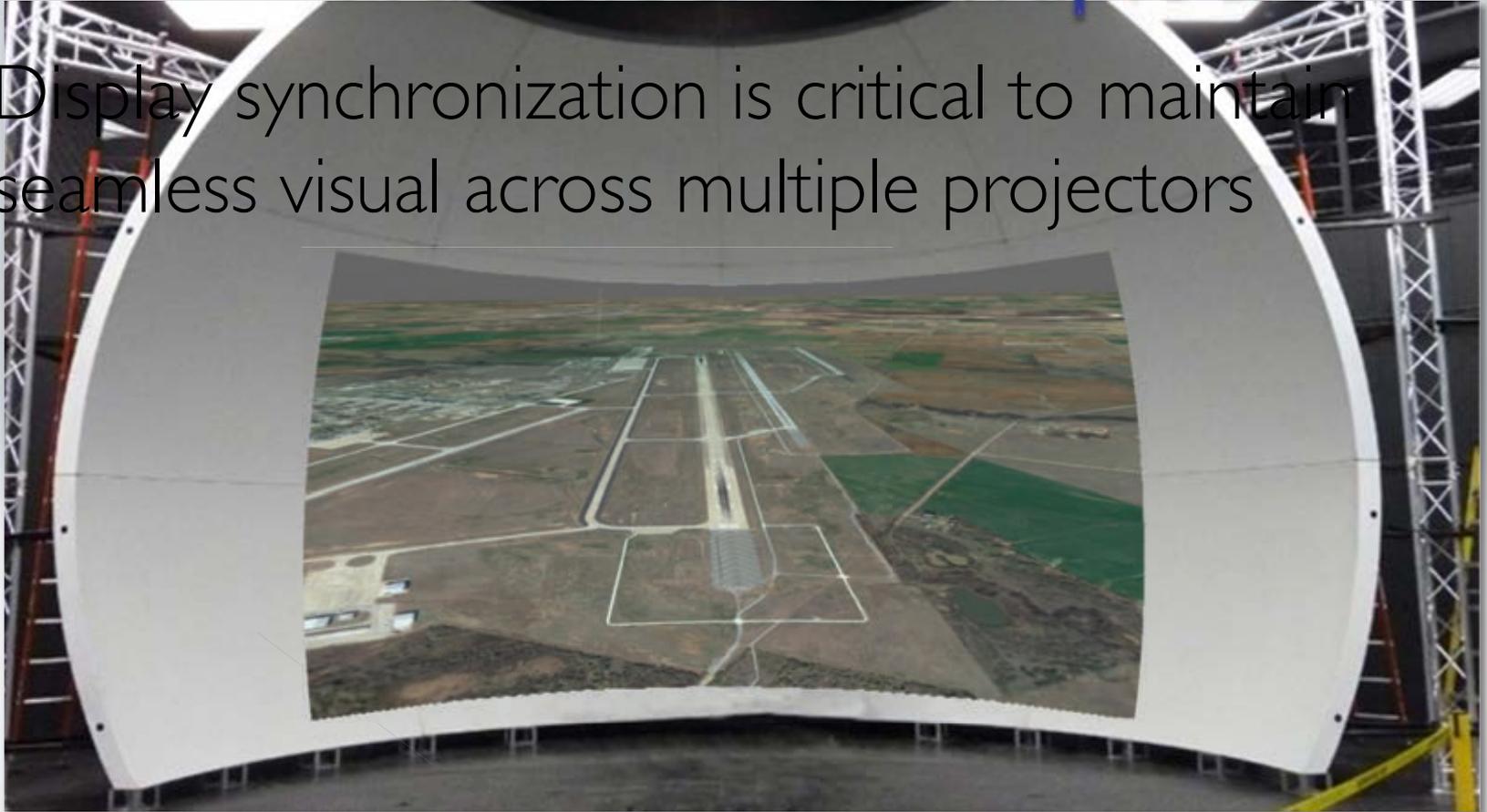
4-Meter Dome at WPAFB





Frame Lock & Swaplock

- Display synchronization is critical to maintain seamless visual across multiple projectors





FrameLock & Swaplock

- Nvidia Quadro Sync
 - Host and IG synced from master digital signal clock

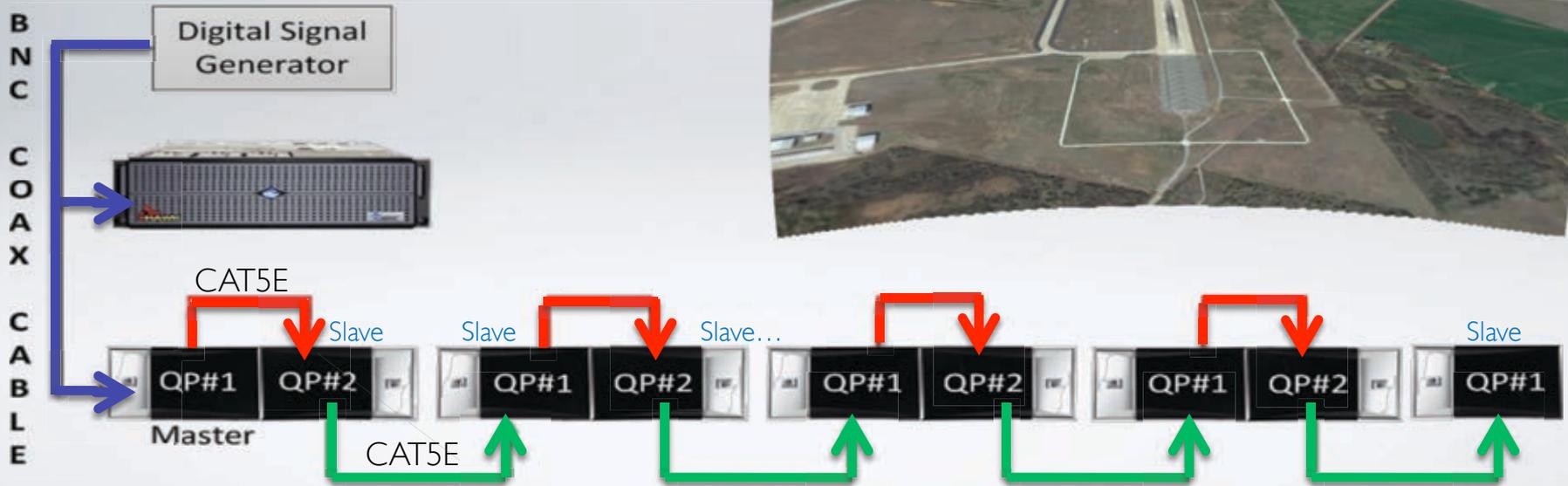




Image Generator Software

- IG Manager (IGM) Application
- IG Renderer (IGR) Applications
 - Windows 7 Ultimate 64-bit Operating System
 - Out-the-Window
 - NVIDIA SceniX scene manager software (OpenGL)
 - Scalable Display Technologies Easyblend SDK for distortion correction and edge blending
 - Sundog SilverLining Atmosphere Special Effects SDK



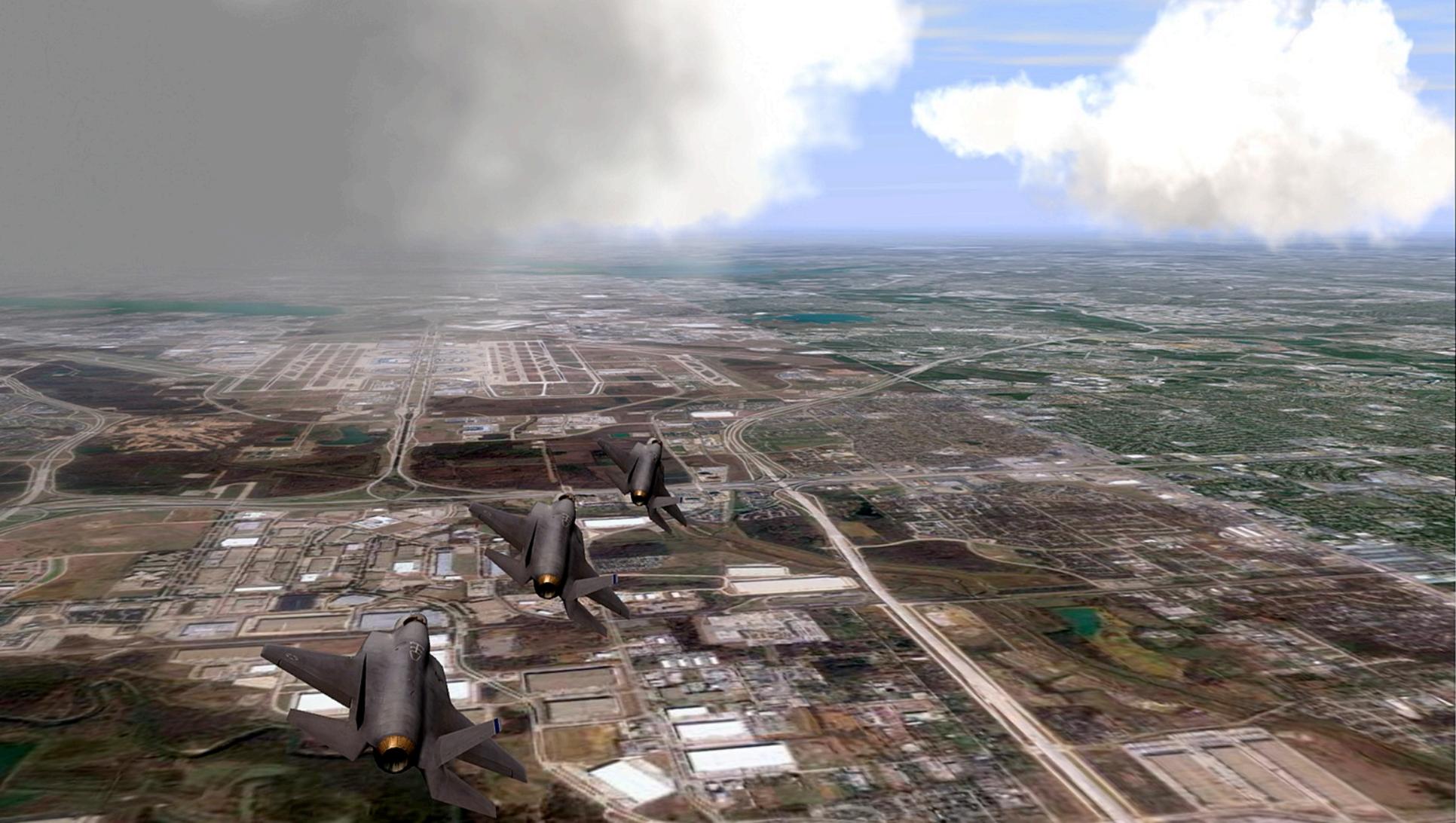


Results: 20/10 Visual Acuity











Results: Latency

With Synchronized Host

| Display / Projector | Refresh / Update Rate | Native Resolution | Total System Latency |
|---|-----------------------|----------------------------|----------------------|
| Sony SXRD S110 Digital Cinema Projector | 60 | 4096x2160 (4-2048x1080) | 56-milliseconds |
| Christie Mirage WU-L (pre-production) Digital Projector | 120 | 1920x1200 | 28-milliseconds |
| Asus VGS36H Digital LCD Panel | 120 | 1920x1080 | 20-milliseconds |
| Sony Trinitron E210 Analog CRT | 60 | 1600x1200 | 28-milliseconds |



Questions?



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