

Shared Displays

An Overview of Perceptual and Cognitive Issues

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Overview



Defining Shared Displays

Perceptual Issues

Cognitive Issues

Current AFRL/HE Research





Defining Shared Displays



What are they?

Computer information systems designed to facilitate situation awareness and provide decision support





Defining Shared Displays



Characteristics

Computer information systems designed to facilitate situation awareness and provide decision support

- *Electronic media*
- *Display type – LCD, plasma, projection*
- *Interactive v. non-interactive*





Defining Shared Displays



Domains

Computer information systems designed to facilitate situation awareness and provide decision support

- *Military*
- *Public access*
- *Academics*
- *Industry*





Defining Shared Displays



Display Size

Computer information systems designed to facilitate situation awareness and provide decision support

- *Small group – 8 people or fewer*
- *Large group – 8 to 20 people*
- *Very large group – 20+*





Defining Shared Displays



Small Group

Computer information s
situation awareness an

- *8 people or fewer*
 - *Usually interactive*
 - *Collaborative*
 - *Mounted or portable*



www.tekpanel.com





Defining Shared Displays



Large Group

Computer information
situation awareness

- 8 – 20 people
 - Tiled display
 - Collaborative
 - Interactive
 - Portable
 - Summary tool





Defining Shared Displays



Large Group

Computer information
situation awareness

- 8 – 20 people
 - Seamless display
 - Collaborative
 - Interactive
 - Handhelds
 - Voice
 - Touch





Defining Shared Displays



Very Large Group

Computer information system
situation awareness and

- *20+ people*
 - *C2 environment*
 - *Summary tool*
 - *Non-interactive*
 - *Repeaters*





Defining Shared Displays



Very Large Group

Computer information systems de
situation awareness and provide

- *20+ people*

- *“Data” Wall*

- Generic term for wall display

- *“Knowledge” Wall*

- A concept for *the application of decision support tools to a data wall* that supports group decision making & collaboration





Perceptual Issues



Can I see it? Can I read it?

- Location of the display
- Viewing angle and distance
 - *Head rotation*
 - *Eye rotation*
 - *Text size*
- Contrast
 - *Ambient illumination*
- Readability
- Color selection

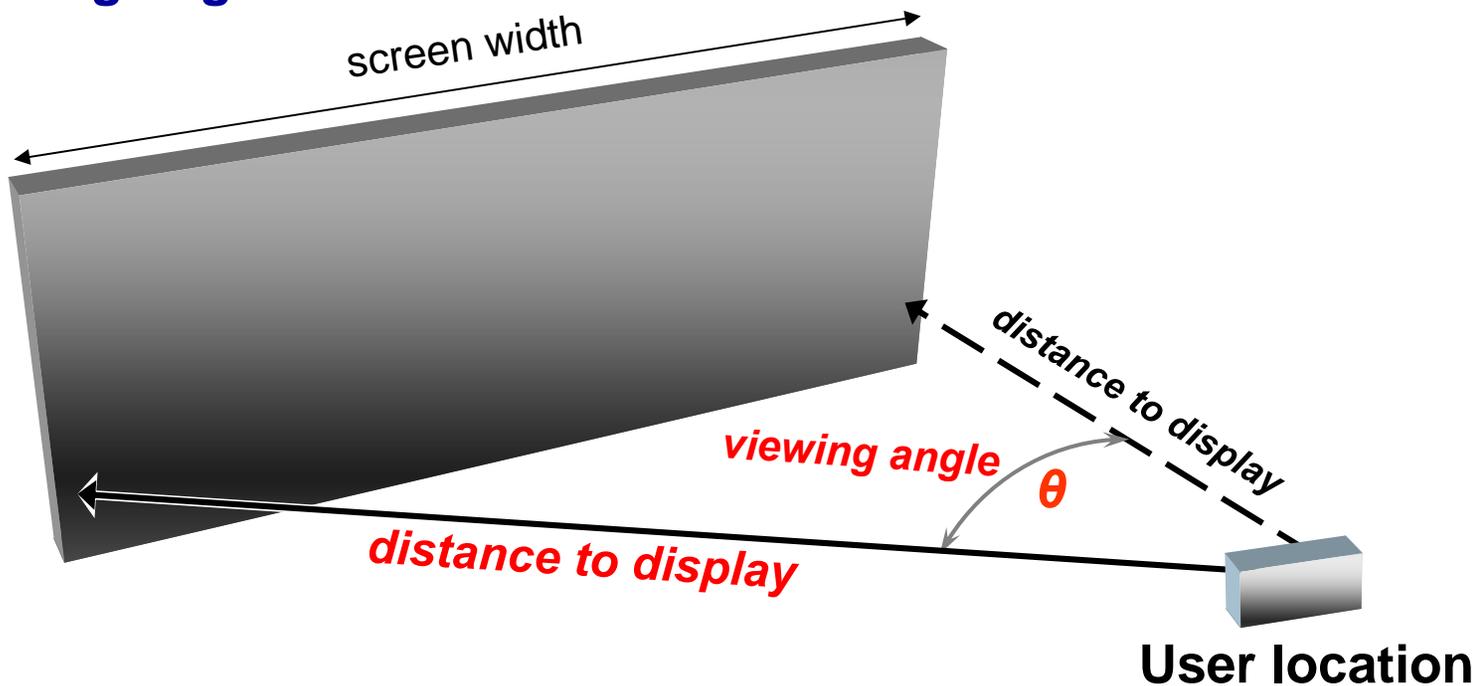




Location of the Display



- Viewing distance
- Viewing angle



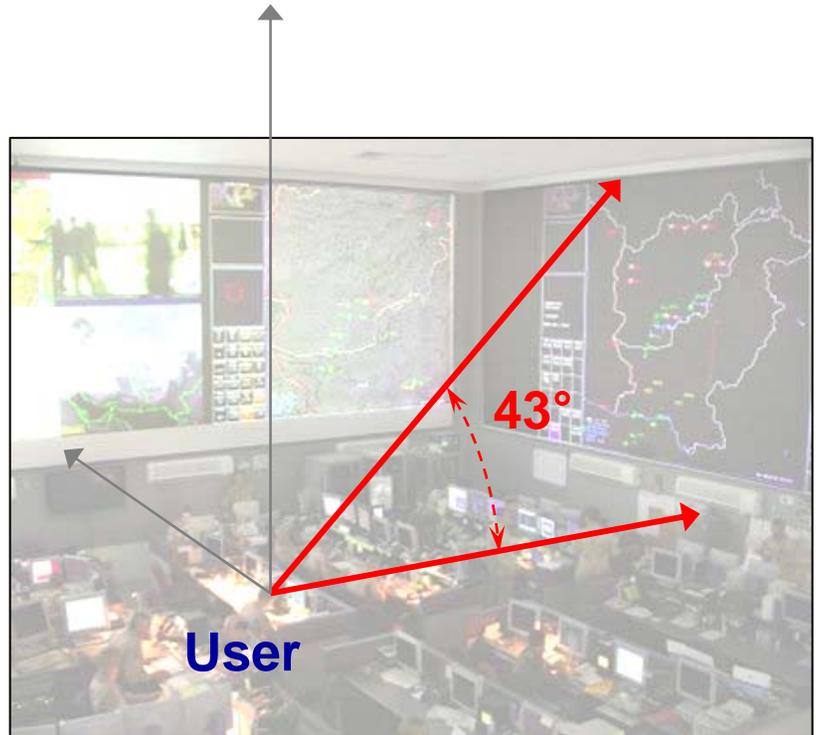


Location of the Display



Eye Rotation

- Optimum – 15° left to right
- Maximum – 35° left to right
- Optimum – parallel down 30°
- Maximum - 25° up, 35° down



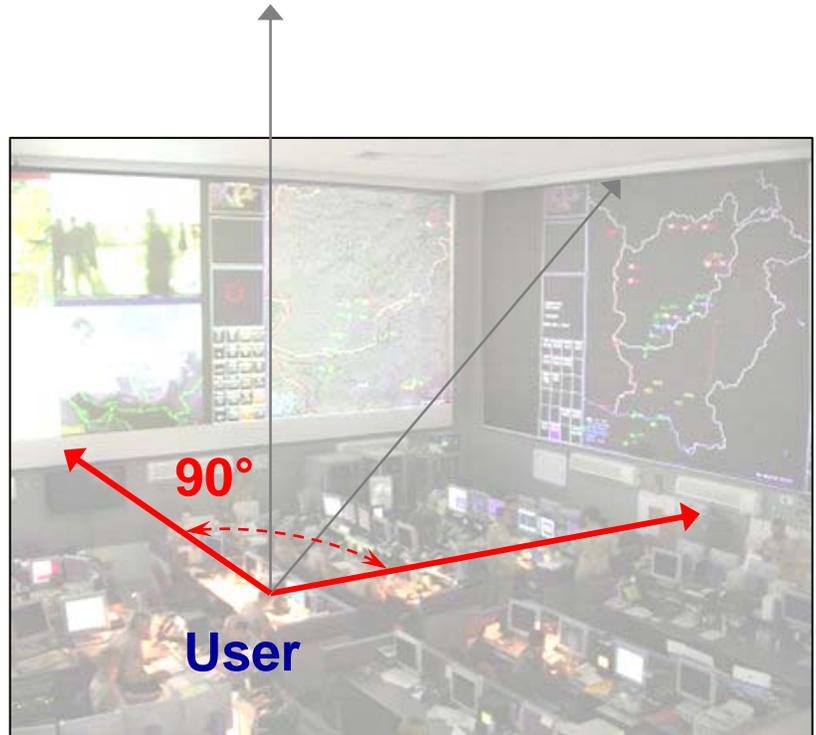


Location of the Display



Head Rotation

- Optimum – straight ahead
- Maximum – 60° left to right
- Optimum – 50° up or down

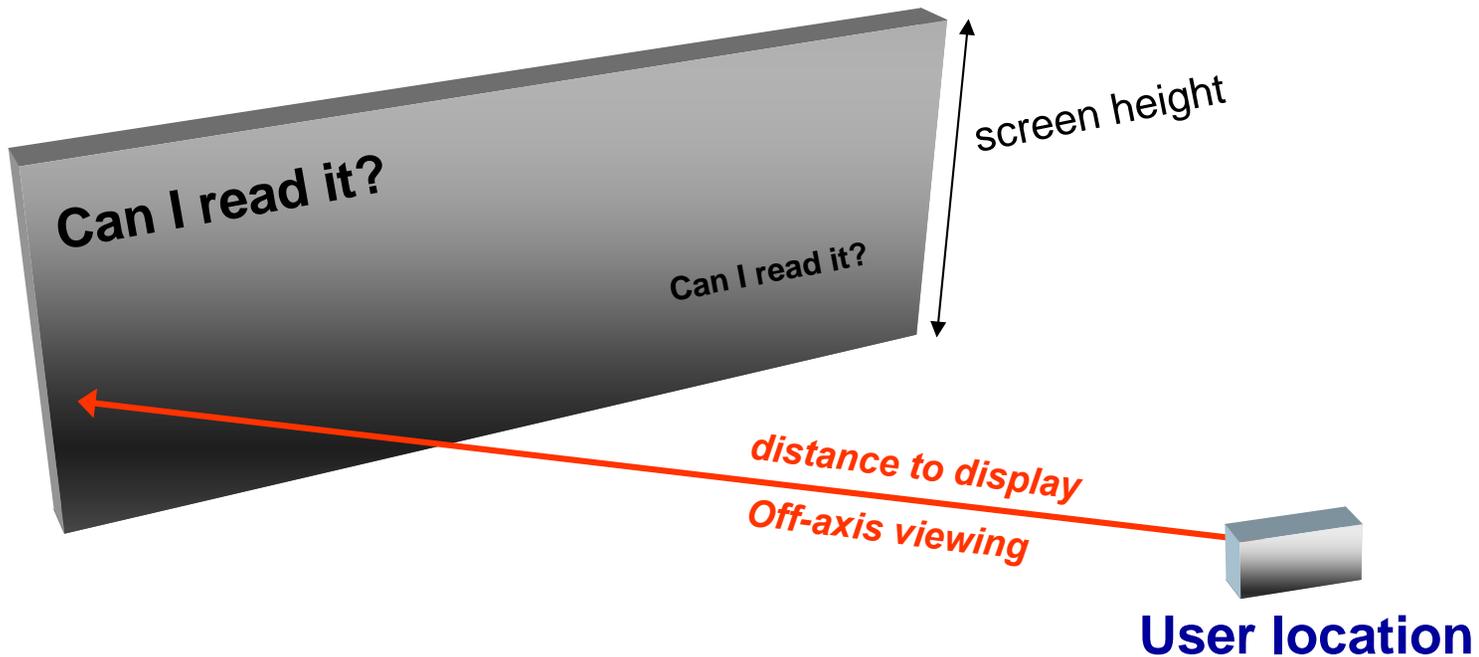




Text Size



- On-axis viewing
- Off-axis viewing





Contrast



Is the display bright enough?

- Contrast determines the range of discriminable gray shades
 - *Detail and continuous tone imagery*
- Larger viewing angles distort contrast on some displays
 - *+/- 30° horizontal, +/- 15° vertically*
- Contrast ratio is measured by the difference between full screen black and full screen white





Ambient Illumination



Non-task lighting

- Display interaction
 - *May reflect off display to viewer*
 - Can affect pupil aperture
 - *Can affect contrast by diluting full screen black*
 - *Can produce glare*
 - *Typical and hi-ambient lighting situations should be measured*





Readability



Can I see it? Can I read it?

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- Readability
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Readability



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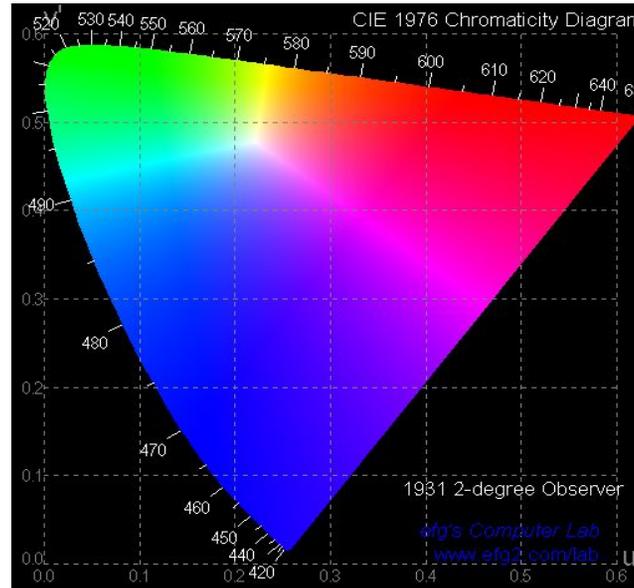




Color Selection



The range and combination of colors that can be seen by the *human eye*



CIE Color Space

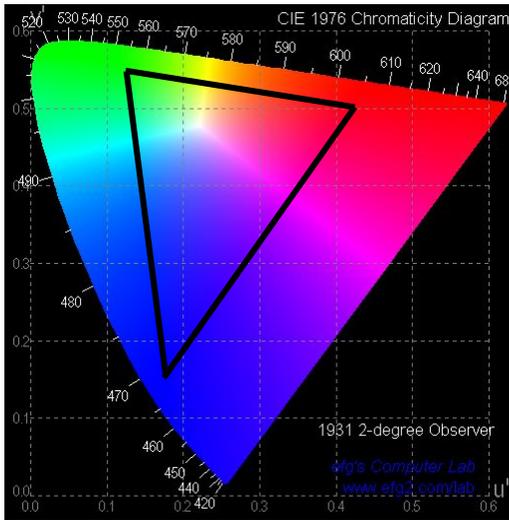




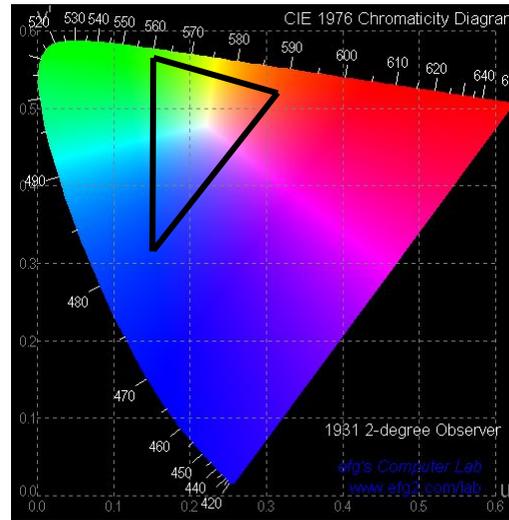
Color Selection



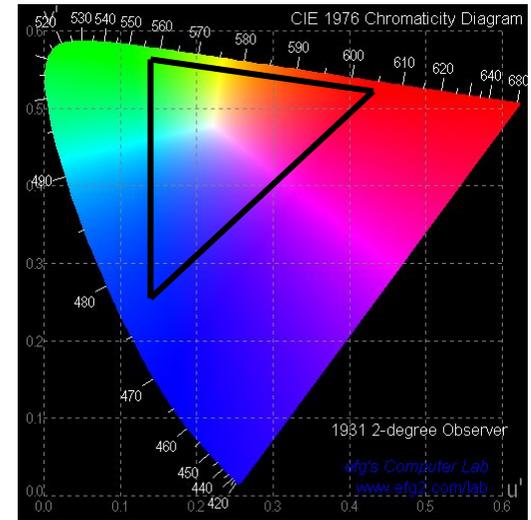
The range and combination of colors that can be produced by a *display system*



LCD



Projection



Plasma





Recent Observations



Joint Expeditionary Force Exercise 2006

- Legibility problems
 - *Repeater displays; scaling problems*
- Color reproduction problems
 - *Red threat icons, brown map*



Workstation LCD

Shared projection display





Cognitive Issues



Can I use it?

- Defining group situation awareness
- Decision quality information

Computer information systems designed to facilitate **situation awareness** and **provide decision support**





Situation Awareness



Definition (Endsley, 1988)

- Perception of elements in a situation
- Understanding the elements
- Projecting future states





Situation Awareness



Global 2000 War Games

- Structured interviews with command elements
 - *All agreed – SA is a high priority**

C2 exercise

- Joint Force Air Component Commander's Headquarters (JFAC HQ)
 - *Large shared display v. small desktop†*
 - *Subjective ratings for mental workload and SA*
 - *No significant differences as a function of display size*

*Smallman, Oonk, & Moore (2000)

†Emery, Catchpole, Mackin, Dudfield, & Myers (2001)





Situation Awareness



Obstacles to achieving SA

- Defining group SA
- Relevant data
- Easy to understand

Path to facilitating SA

- Cognitive Task Analysis





Cognitive Task Analysis



Normative analytical tool

- Clarifying tasks and goals
 - *What tasks need to be performed?*
 - *What decisions needs to be made?*
 - *What information is needed to make those decisions?*
 - *Who will collaborate to complete task?*
- Observations are not enough
 - *Subject matter experts (SMEs)*
 - Interviews
- How shared display will support task performance





Information Sharing



Vital function of C2 environment

- Display communication/interaction*
 - *Pushing information*
 - *Pulling information*
- Multiple users
 - *Cognitive demands*
 - *Network overload*
 - *Recognizing simultaneous input*





Display Control



Less is more

- Individual or small team
- Possibly eliminate direct access

Guidelines for display control*

- Automation when possible to reduce error
- Someone to override automation
- Override should be identified
- Create and implement pre-sets





Recent Observations



Joint Expeditionary Force Exercise 2006

- **Cognitive issues**

- *Display was under-utilized*
- *Users felt information was useless to them*
- *Some never even look at display (JEFX '04)**





Current AFRL/HE Research



Change awareness & detection

3D Display

Tailored COP (common operating picture)





Current Research



Change detection

- When did it change
 - *Alerts*
 - Location
 - Uni-sensory or multi-modal

Change awareness

- What has changed
 - *Color, structure, new information, missing information*
 - *Time variable*

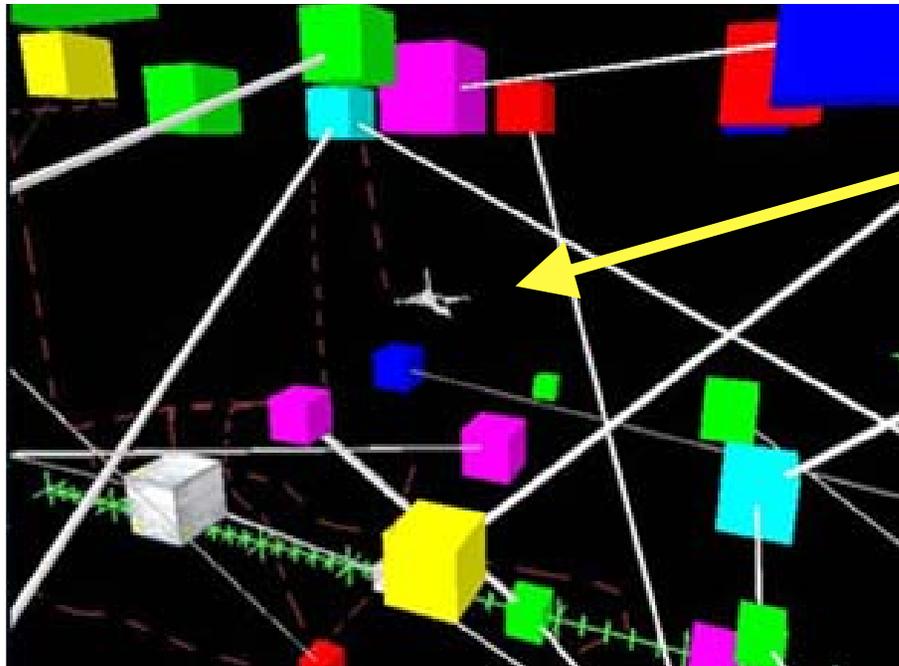


Current Research



3D displays

- What tasks will benefit from 3D displays?
 - 2D
 - 2.5D
 - 3D

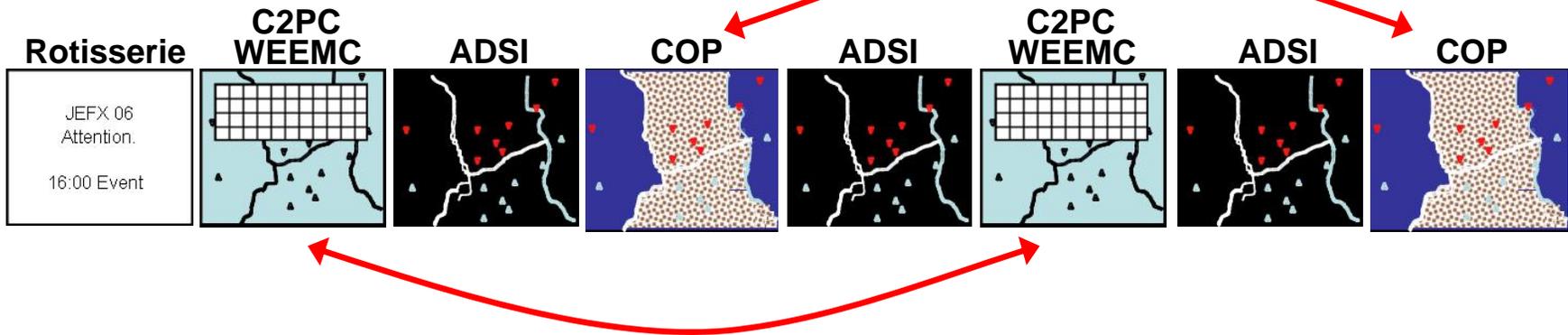




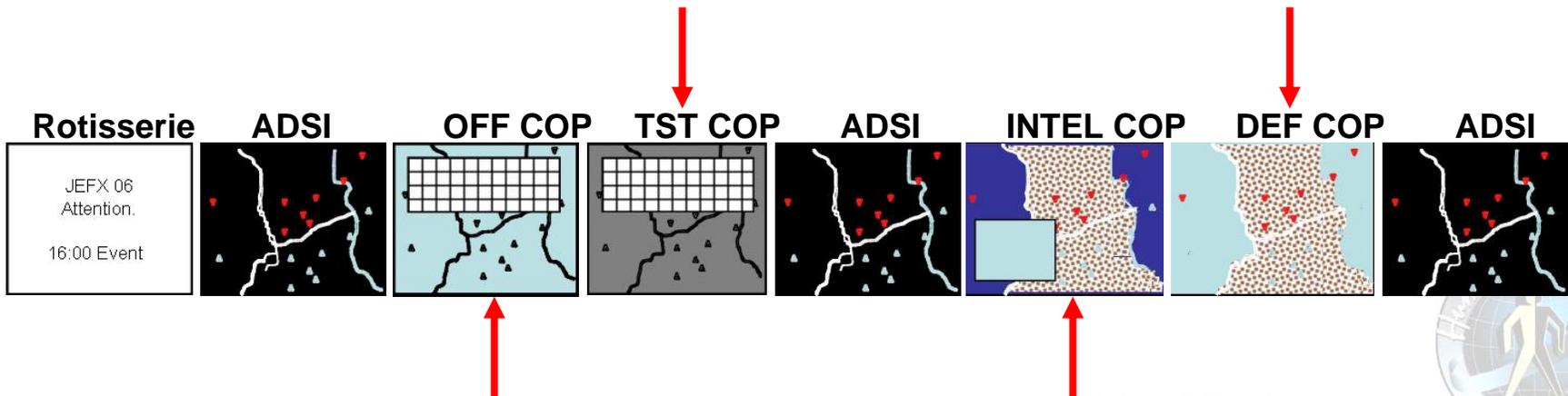
Tailored COP



JEFX '06 Combat Ops Data Wall



A Possible Solution



12th ICCRTS June 2007





Summary



Perceptual issues

- The easier part

Cognitive issues

- The harder part
 - *Facilitating situation awareness*
 - *Providing decision quality information*
 - *Supporting decision making in a very complex environment*



Questions?

