



Phantom

Clear Air Turbulence Workshop Panel Discussion May 30, 2008

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Clear Air Turbulence is an Important Issue for Boeing

Engineering, Operations & Technology | Phantom Works

- **Commercial and military transportation**
 - **Injuries**
 - **Liability**
 - **Customer experience**
 - **Maintenance costs**
- **High energy laser systems**
 - **Directed energy systems have limited wavefront compensation capability**
 - **Propagation through turbulence reduces peak intensity and broadens high energy laser (HEL) beam**
 - **Increases the time it takes to cause HEL effects**
 - **Fewer missiles destroyed**

- **What capabilities**
 - Do we have now?
 - Do we have planned?
 - Are achievable?
 - Are economically feasible?
 - Are robust?
 - May cause unintended consequences?
- **Levels of capability**
 - Moderate to severe turbulence in general area
 - Moderate resolution turbulence map, with holes, updated infrequently
 - High resolution turbulence map updated by the minute
 - Highly accurate turbulence forecast
 - Aircraft routing that minimizes turbulence exposure

Different Approaches

- **Autonomous**

- Each aircraft independently provides the data, processing, and decision making to avoid turbulence along its flight path (or anticipated shot directions for directed energy weapons)
- Con: may be expensive
- Pro: no additional measurements or communication needed

- **Network centric**

- Each aircraft (or ground station, satellite...) provides data to a centralized location for collection, processing, and dissemination as needed
- Pro: may be inexpensive
- Con: coverage may be incomplete

