

*Distributed Processing*  
*for a Free Flight Future*



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# *Agenda*



- Problem
- Guiding Principles
- Assumptions
- Distributed Processing Concept
- Benefits
- Enabling Technologies
- Enabling Procedures
- Discussion

# *Current Problems*



- **Constraints:**

- < **Flexibility**
- < **Capacity**
- < **Schedule**
- < **Scalability**
- < **Economic**



- **Limited or No System Redundancy**
- **Expensive Ground Support Infrastructure**
- **Slow Modernization**
- **Limited Growth Capability**

# *Guiding Principles*



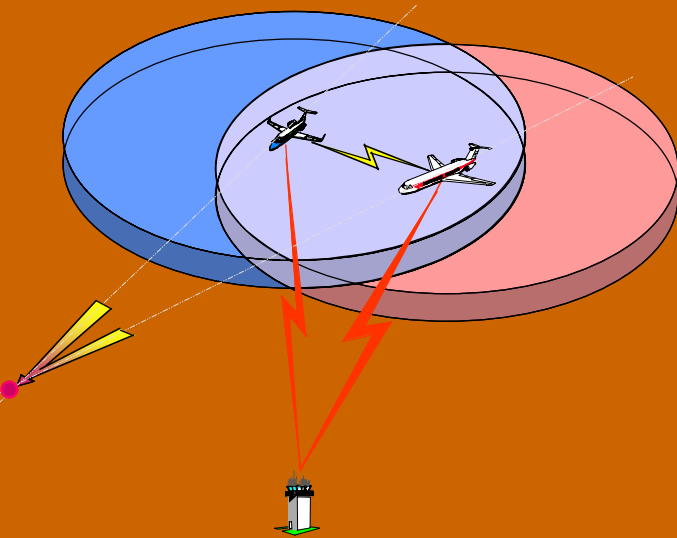
1. Flight safety will not be compromised.
2. Technology will not replace human operators.
3. The role of the human operator will change from controlling the ATM environment to making management-level decisions.
4. A transition from flight path separation to tactical separation will occur.
5. The flexibility of VFR operations with IFR protection are sought.
6. The system will accommodate all users (i.e. air carrier, air taxi, GA, military).
7. Restrictions will be placed on the aircraft flight path only:
  - a. If safety of flight is at risk
  - b. To avoid conflict with other aircraft
  - c. For terminal flow management
  - d. To avoid special use airspace or air traffic control assigned airspace

# Assumptions



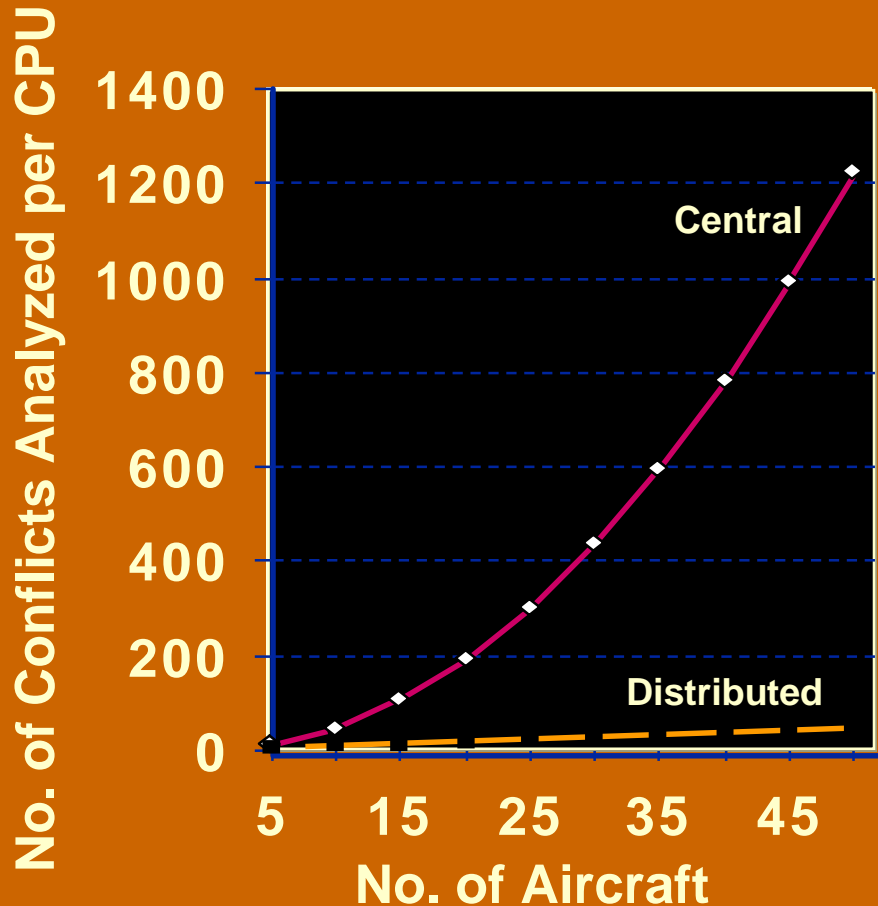
1. Current airspace class designations will remain unchanged.
2. Cooperating system elements consist of:
  - a. Flight Deck (FD)
  - b. Operation Centers (OC)
  - c. Air Traffic Service Provider (ATSP)
3. The CNS capability includes:
  - a. Communication: digital voice and data link via satellite, HF, VHF, and landline subnetworks utilizing ATN protocols and standards.
  - b. Navigation: space-based GNSS capability (augmented as required).
  - c. Surveillance: identification, position, velocity, and intent broadcast from FD either automatically or on command.
4. Class, type, and amount of equipage classify aircraft capability.
5. Airports are classified by type of service.
6. Rules and responsibilities are clearly defined and described.
7. A distributed database exists that is accessible by all users containing, as a minimum:
  - a. Local, national, and global weather
  - b. Airport capacity and dynamic loading
  - c. Airport-peculiar information/regulations
  - d. Special Use Airspace (SUA) and dynamic status
  - e. Scheduled flights
  - f. NOTAMs
8. The Aeronautical Telecommunications Network (ATN) is functional, providing global connectivity between the FD, OC, and ATSP.

# *Distributed Processing Concept*



- Aircraft communicate aircraft-to-aircraft and with ground
- Equipped aircraft use surveillance zone to identify conflicts
- Equipped aircraft identify conflicts and provide for self-separation
- Equipped aircraft operations are coordinated with ground system
- Ground system provides tactical separation for unequipped aircraft
- Ground systems provide strategic planning

# *Distributed Processing Advantage*



- **Distributed computing allows for system growth as demand increases!**
- **Each aircraft brings additional resources**
- **Each aircraft provides system redundancy**

# *Distributed Processing Benefits*



- **\$4.7 B annual reduction in user direct operating cost plus \$8.8 B efficiency improvements**
- **17% + capacity improvement at Chicago O'Hara**
- **Controller workload reduction:**
  - < **airborne separation resolution allows lower separation standards**
  - < **3 nm. separation yielded 79% reduction in conflicts**
- **Reduction in ground computing resources**
- **Graceful evolutionary growth path**

# *Enabling Technology*



- **Communications**
  - < Airborne Networking
  - < Airborne Relaying
  - < Airborne Repeating
  - < Air/ground Networks
- **Surveillance**
- **Intelligent Systems**
  - < Filter Communication Data
  - < In-flight Planning
  - < Cockpit Displays



# *Enabling Procedures*



- **Flow Control using Speed Adjustments to Minimize Arrival Restrictions**
- **Approach and Departure Methods**
- **Sector Sizing and Coordination**
- **Unrestricted En Route Trajectories**
- **Negotiated use of Special Use Airspace**



# *Discussion*

