Improving Coalition Interoperability through Networking Military/Civil Air Traffic Control Systems

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Overview

- Air situation awareness (SA), safety of flight operations, and sovereignty are coalition goals
- Military and civil sharing of airspace is essential
- Cost of air surveillance remains high – cost of air data distribution is declining
  - COTS solutions and data/communications standards exist to enable interoperability
  - COTS-based networks are pervasive and provide broad area interoperable coverage
- Can we exploit expensive coalition surveillance assets to improve situation awareness and air sovereignty?
  - What are national and regional requirements?
  - What are the issues? What is the way ahead?

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Regional Security and Air Sovereignty

- Overall security in NATO and Europe relys on regional security in the Central/Eastern European (CEE) area
- CEE countries also need to ensure national and regional air sovereignty in support of Partnership for Peace (PfP) goals and international coalition operations combating global terrorism
- PfP program goals include
  - More open access to airspace (less reliance on “corridors”)
  - Improved air traffic detection, identification, assessment, and response
- Coalition air operations centers must have complete and up-to-date knowledge of regional military and civil air operations – a “common air picture”

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The Air Picture Objective

- A timely and accurate Coalition Common Air Picture (CCAP) provides improved SA and the capability to better manage friendly air assets by;
  - Integrating "standalone" assets, such as mobile radars, into the CCAP
  - Enhancing detection and identification of "unknown" aircraft
  - Providing military surveillance data to civil centers for sharing airspace
- Widespread availability of data can enable and maintain more effective identification and control of air traffic across system boundaries without requiring additional long-range Air Traffic Control (ATC) surveillance and navigation systems
- A CCAP could provide real-time dynamic airspace allocation, precision ingress and egress, reduction of overlapping sensors and associated errors, and open more available airspace

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Capabilities Needed

- In any global regional airspace, there are five phases of military and civil flight supported by ATC functions;
  - Aircraft Launch and Recovery phases controlled by local tower and landing ATC systems
  - Terminal phases at the departing and arriving airfields controlled by a Terminal Radar Approach Control (TRACON) facility
  - Enroute and theater phase controlled by an Air Route Traffic Control Center (ARTCC) or an Area Control Center (ACC)
- For an aircraft to transit this airspace safely and efficiently under effective control, several key capabilities are needed;
  - Positive aircraft identification – done today using interrogators/transponders
  - System-to-system data communication – mostly verbal today with some data
  - Shared use of interrogators – overinterrogation, interference and errors today
  - Build and maintain a CCAP – most systems today are standalone (no data sharing)

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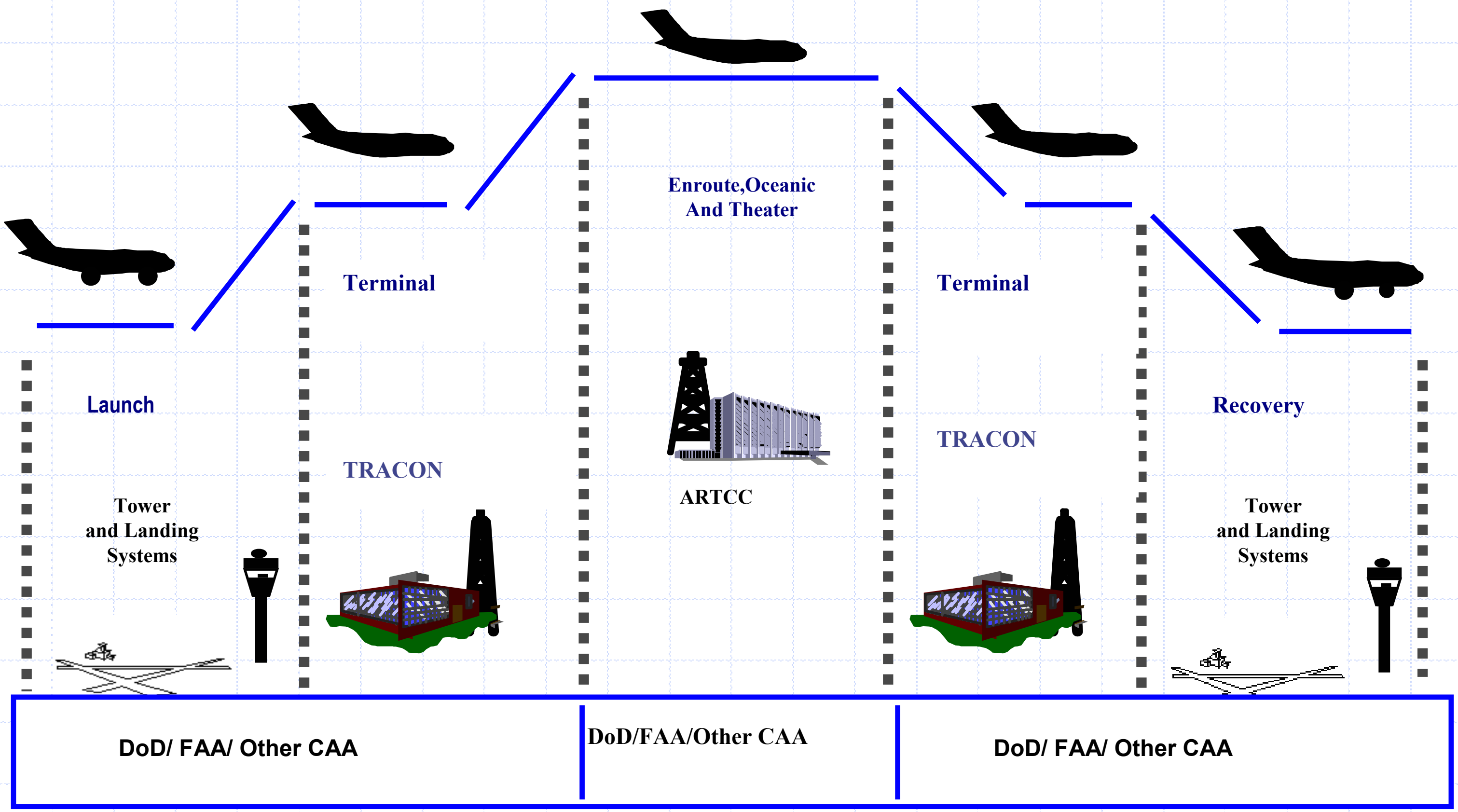
Phases of Flight



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Challenges

- Coalition partner ATC capability vary significantly
- Obsolete ATC system designs, proprietary designs and data formats, and doctrine limit data distribution and interoperability
- National approaches to ATC improvement may not provide for common air pictures
- National ATC implementations may not be common, interoperable, or meet NATO standards
- Funding sources may be limited for national radar data networks or cross-border exchanges
- Traditions or historical events may limit free exchange of information between coalition partners

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Trends

- Coalitions must be more dynamic and adaptable, be established rapidly, employ interoperable standards, and minimize system/personnel assets needed.
- Coalition assets may also be widely distributed within a region or beyond.
- Many CEE countries are replacing legacy ATC systems with ones that offer standardized, digital intranet capabilities. Internet Protocol (IP)-based nets provide the means to distribute ATC data beyond system boundaries.
- Navaids and Regional Airspace Initiative studies conducted by US DoD in several PfP countries have resulted in regional radar data sharing systems such as BALTNET.

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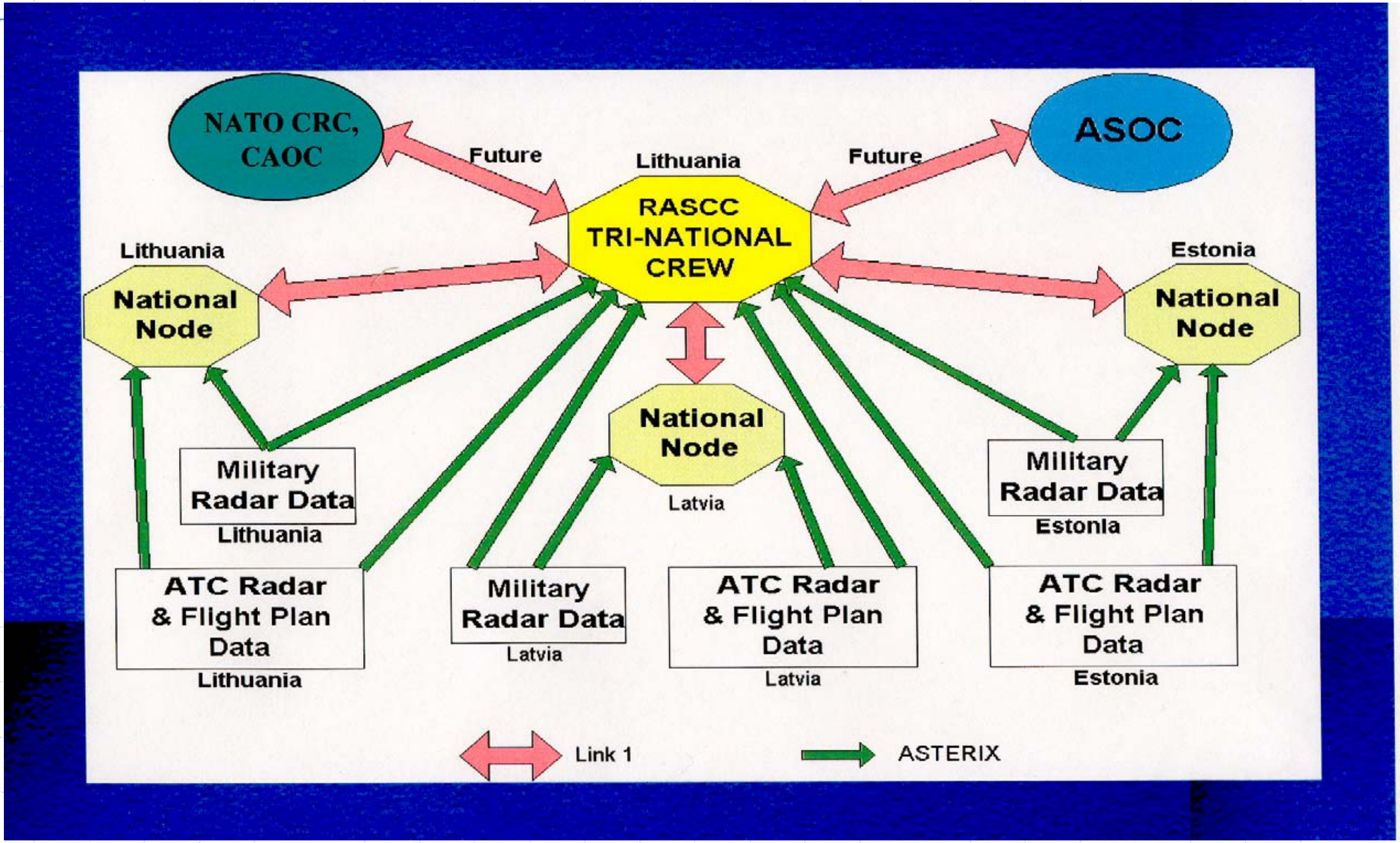
BALTNET Architecture



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BALTNET Summary

- BALTNET is a peacetime data/communications network infrastructure of radar sensors in 3 participating nations, national nodes and a regional airspace surveillance coordination center.
- BALTNET is now integrated into the NATO CRC and CAOC architectures for operations in times of crisis.
- Although BALTNET is a highly capable system, there are some limitations;
  - Not designed for dynamic environments
  - Complexity limits wide deployment
  - Defense budget restrictions and priorities in many CEE countries limit acquisition of systems like ASOCs and BALTNET
- A simpler, less expensive option is proposed as "the way ahead".

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The Way Ahead

- Implement the equivalent of civil aviation's "launch to recovery" airspace coverage;
  - Provide better prediction, planning and execution of C2 and ATC for military aircraft
  - Share military surveillance data and ATC coordination with civil aviation facilities
- Leverage technologies and standards provided by some COTS systems.
- Explore low cost ways to expand system data distribution.
- Look for innovative, non-proprietary solutions to interface challenges such as legacy analog systems and non-standard or obsolete data formats.

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Data and Data Formats

- Often there is information common to all systems, e.g., position, Mode-A (identity) and Mode-C (altitude)
- All Purpose Structured Eurocontrol Surveillance Information Exchange (ASTERIX)
  - Formatting of the surveillance-related data exchanged between sensors and processing systems, and between surveillance data processing systems
    - Allows a meaningful transfer of information between two application entities using a mutually agreed representation of the data to be exchanged.
  - Continuously refined and extended, is being adopted as a *de facto* world-wide surveillance data standard
  - For more info: http://www.eurocontrol.int/asterix/

CCAP Architectures

- A high-level notional architecture is proposed which;
  - Is conceptual in nature and uses a hypothetical 3-country region
  - Is further broken down into conceptual national airfield, national center, and partial CAOC sub-architectures
  - Does not address national, regional or CAOC CCAP detailed requirements
- National military or civil airfields are connected to national centers, national centers are interconnected, and one or more national centers are connected to a regional CAOC
  - Via landlines, microwave links, or mobile satellite communications
  - National ATC centers could also be connected to the network

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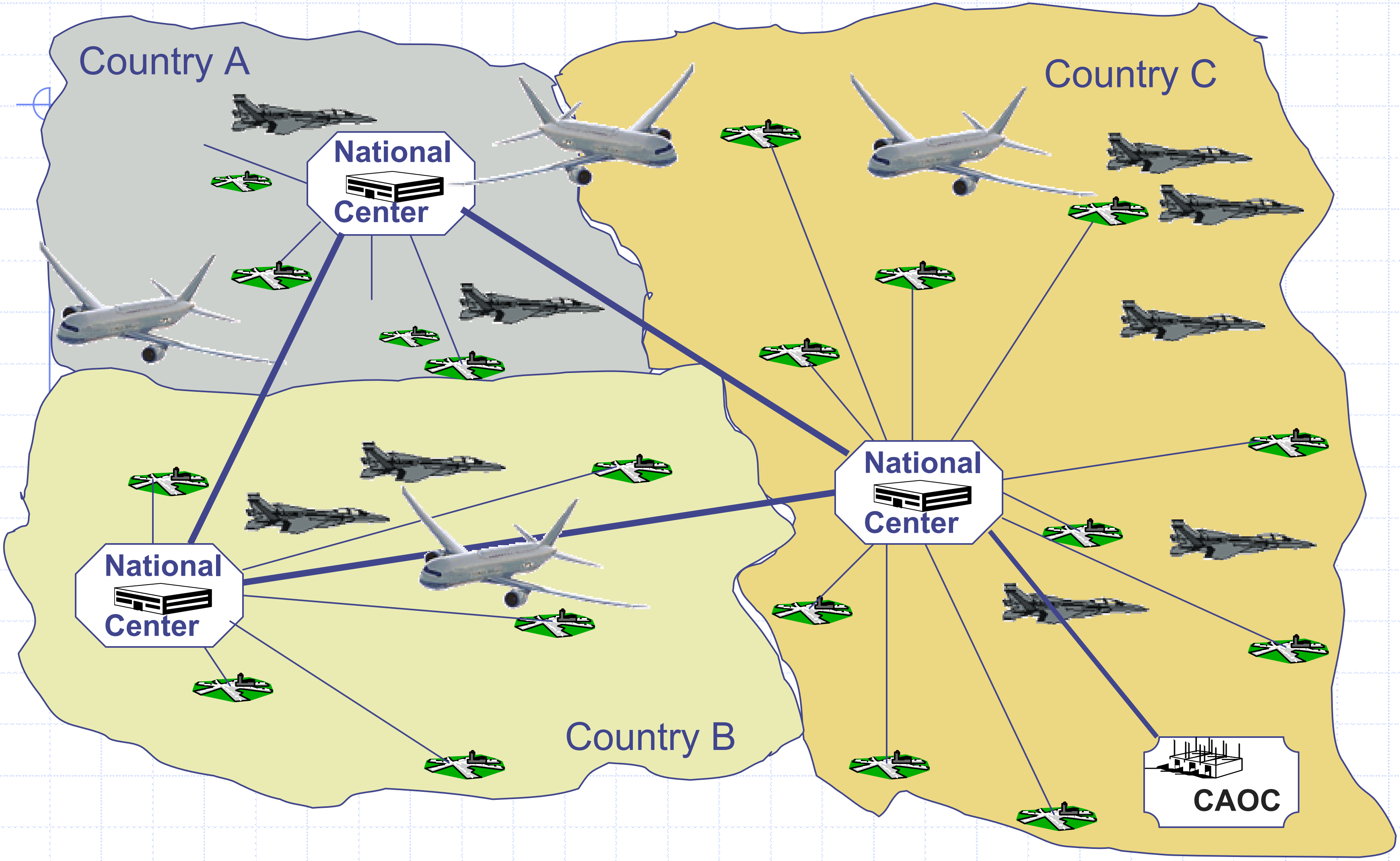
Notional Regional CCAP Architecture



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National Airfield CCAP Sub-architecture

- This notional sub-architecture includes;
  - A large, fixed airfield Airport Surveillance Radar (ASR) with a range of approximately 100 nautical miles (nm) including a Secondary Surveillance Radar (SSR) with a range of approximately 200 nm
  - A fixed/transportable Ground Control Approach (GCA) system which includes a Primary Surveillance Radar (PSR) with a range of approximately 40 nm and a SSR with a range of approximately 120 nm
- Both the ASR and GCA operators communicate with enroute and approaching aircraft via VHF and UHF voice radios.
- ASR and GCA PSR/SSR processed data is provided to the control tower for display and could be distributed from there to a national center via landline, microwave relay, or mobile satellite communications systems.

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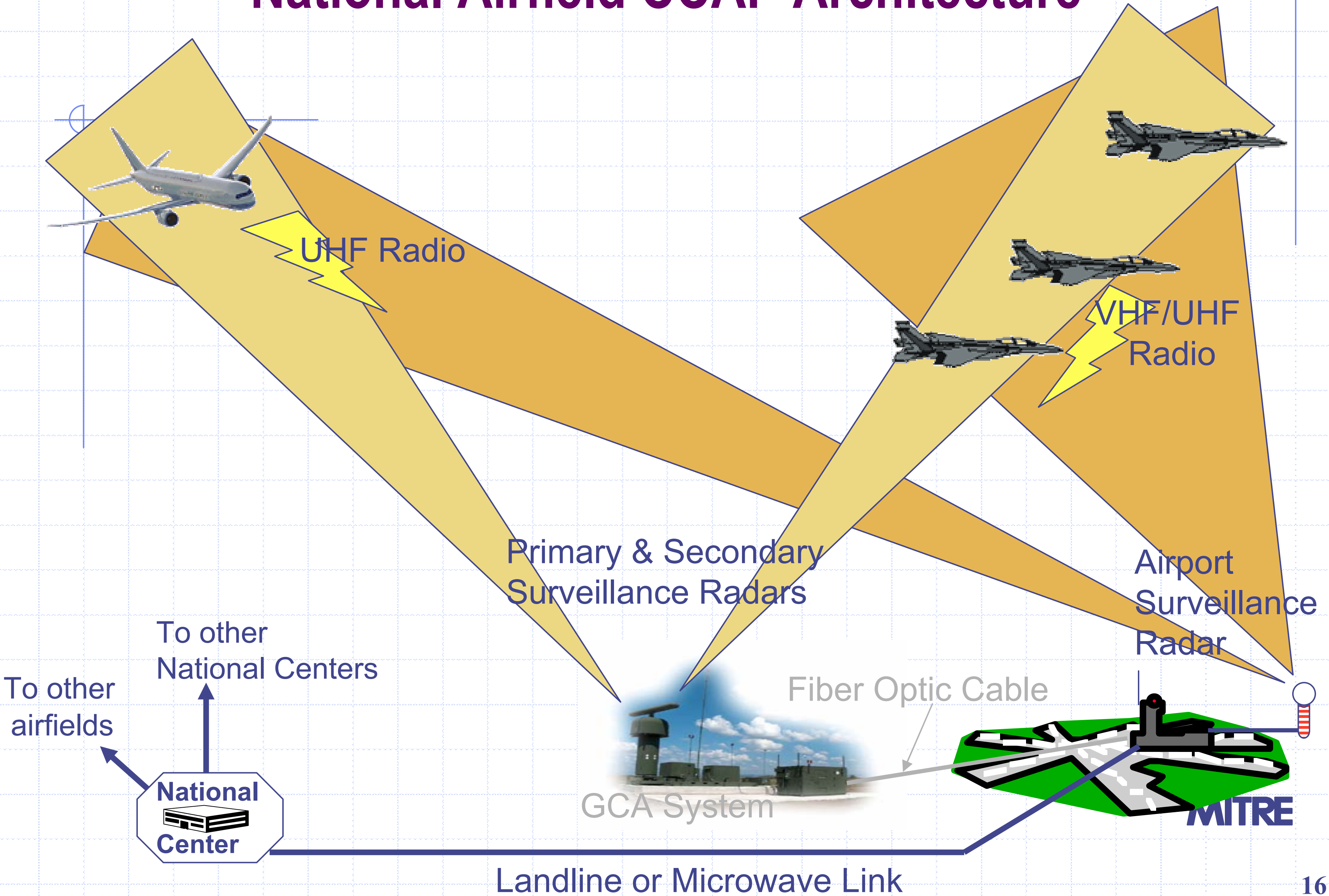
National Airfield CCAP Architecture



National Center CCAP Sub-architecture

- Could be set up as part of an existing ASOC, or in any secure location with access to communications
- National Air Picture (NAP) workstations get ATC data from a database, router/server, and communications interface via a local area network (LAN)
- NAP workstations could also get data from (and share their data with) other country National Centers, ASOCs, or a CAOC
- NAP workstation operators would review, annotate and filter data before sending it to other recipients

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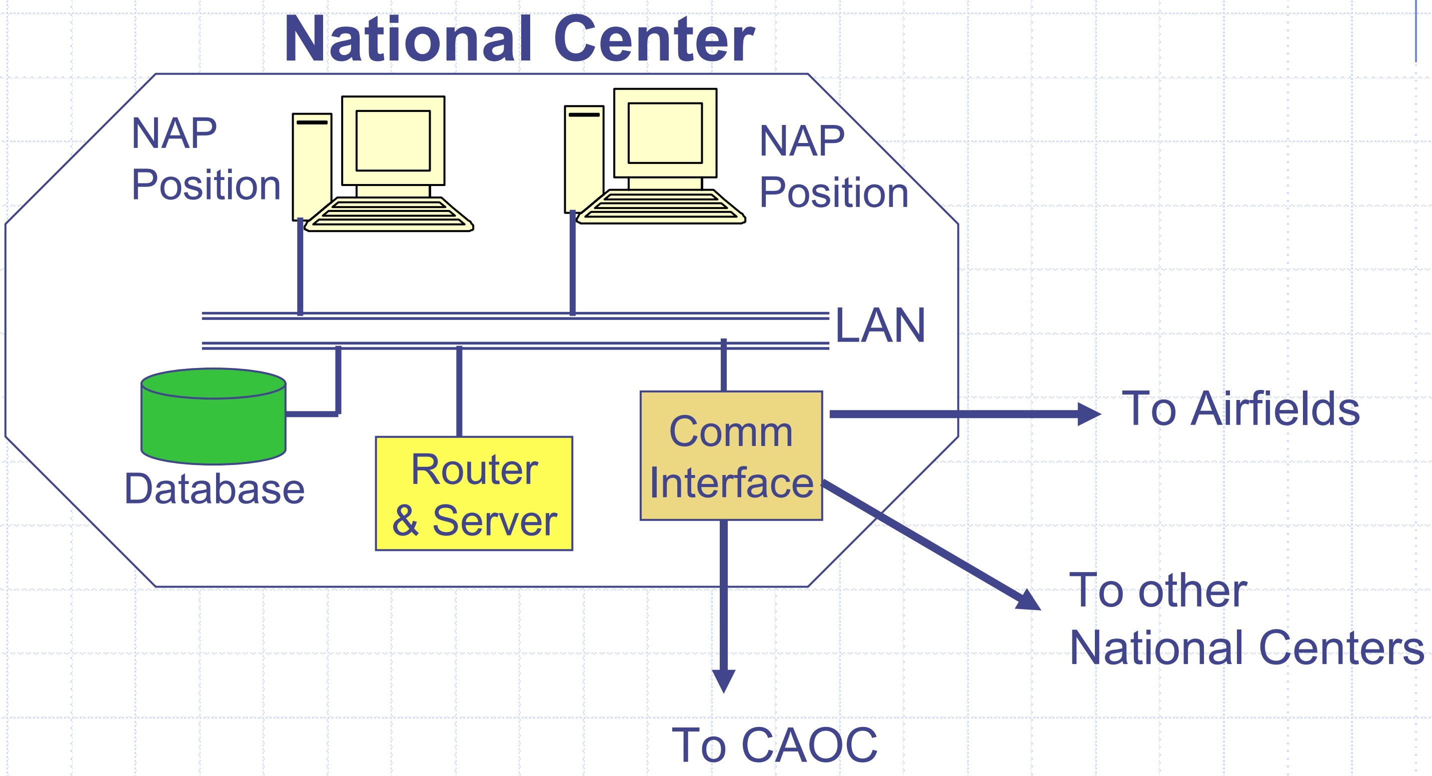
National Center CCAP Architecture



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Partial CAOC CCAP Sub-architecture

- This architecture is highly notional and would only involve a portion of a CAOC.
- National Centers and/or ASOCs could provide ATC data to a CAOC to become part of the Common Air Picture (CAP).
- National workstations could be set up for each member country, connected to a common LAN;
  - National operators could review, annotate and filter data before sending it to other national workstations or to the CAOC CAP – data "push"
  - National operators could "pull" data from the CAP
- A communications interface would also have to be provided to support receipt of regional information and to translate formats, if needed.

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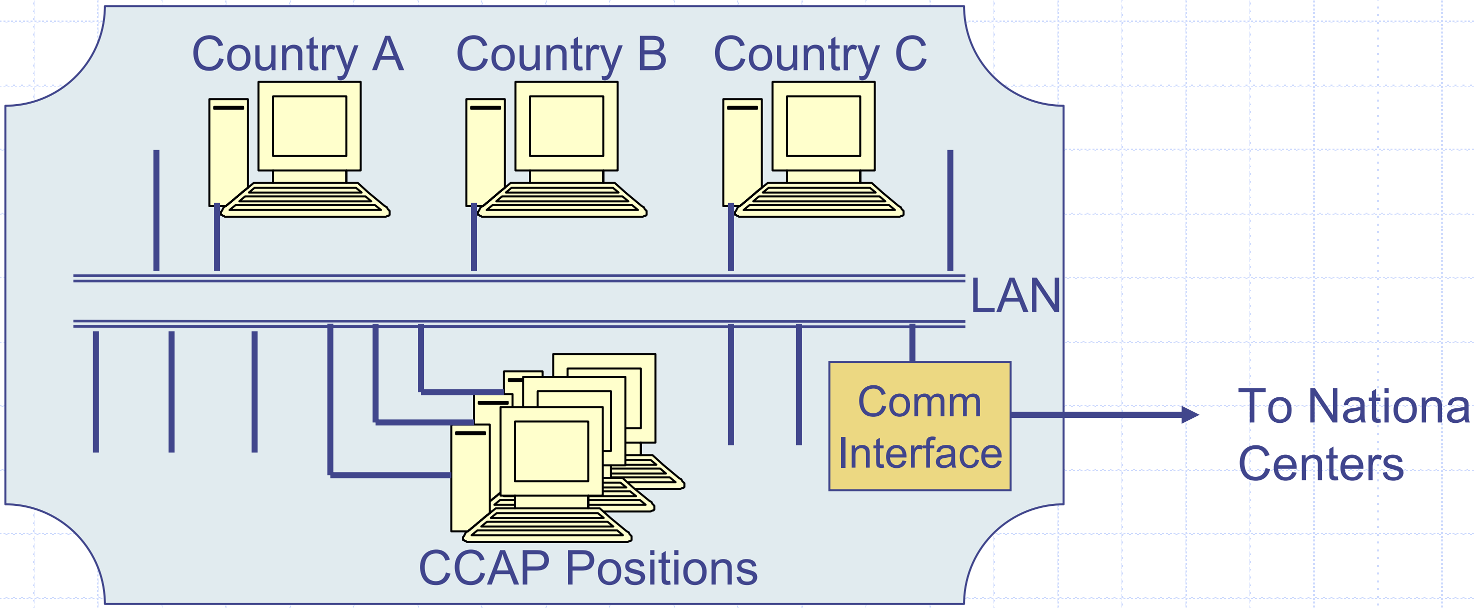
CAOC CCAP Architecture



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Roadmap

- CCAP support requires a set of essential national capabilities determined by a definition of requirements and achieved through system acquisition.
- Three architectural elements have identified for implementation; a national airfield, a national center, and a portion of a CAOC.
- The proposed roadmap consists of basic phases needed:
  - To initiate the requirements definition process
  - To acquire, install and test the necessary sensor systems and communications network components
- The following roadmap chart details the steps and milestones needed to implement the architectures

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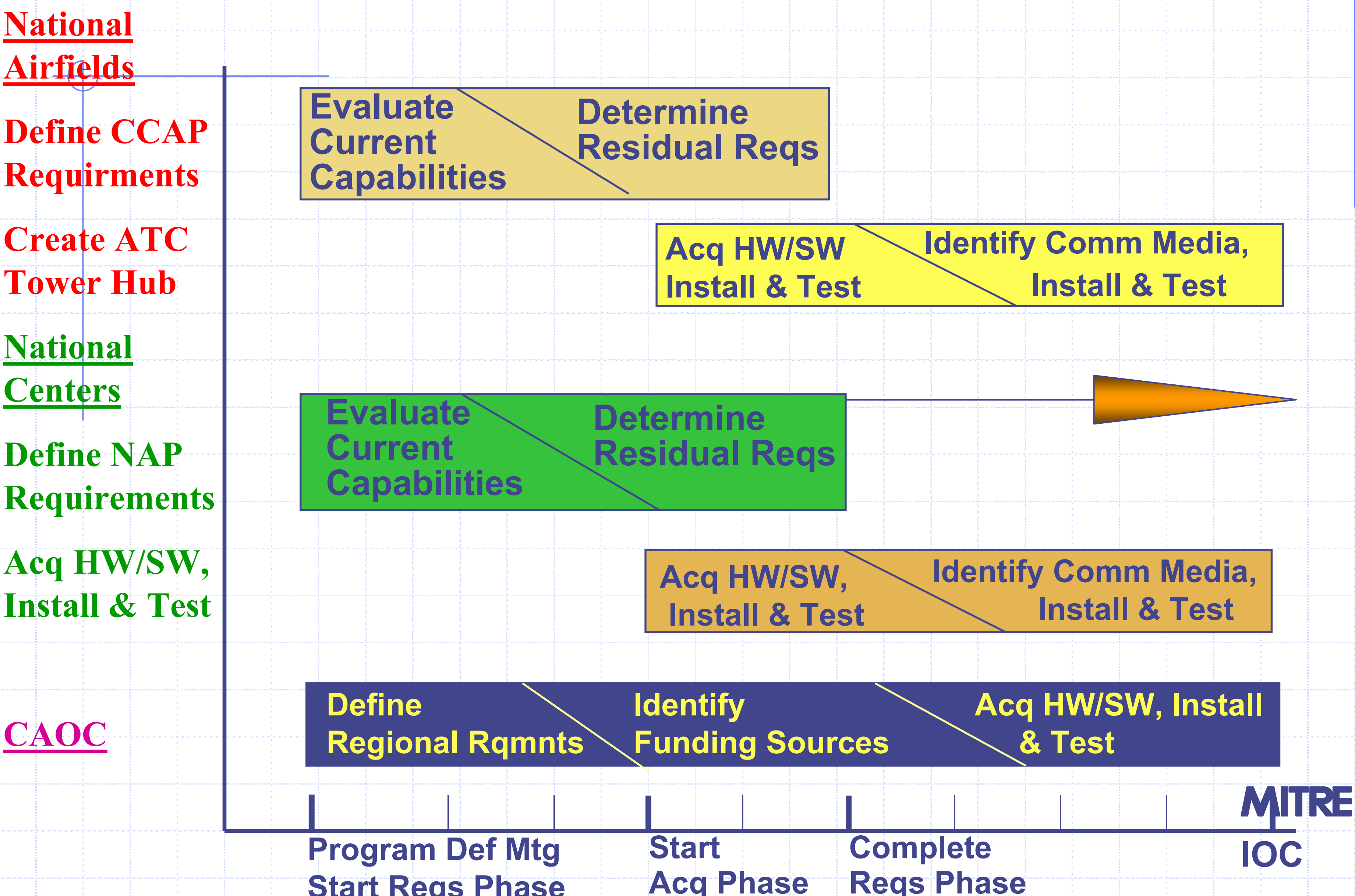
Proposed CCAP Roadmap



Recommendations

- Establish a multinational working group to:
  - Determine key air picture requirements
  - Determine essential national capabilities to meet requirements
- Obtain funding for an architectural research and design tradeoff effort
- Develop a detailed architecture
- Develop an associated system and component acquisition roadmap
- Work with coalition partners to develop Letter of Request (LOR) documents (statements of national requirements) if Foreign Military Sales (FMS) initiative

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