Renewing the Controller Workforce
Challenges and Opportunities

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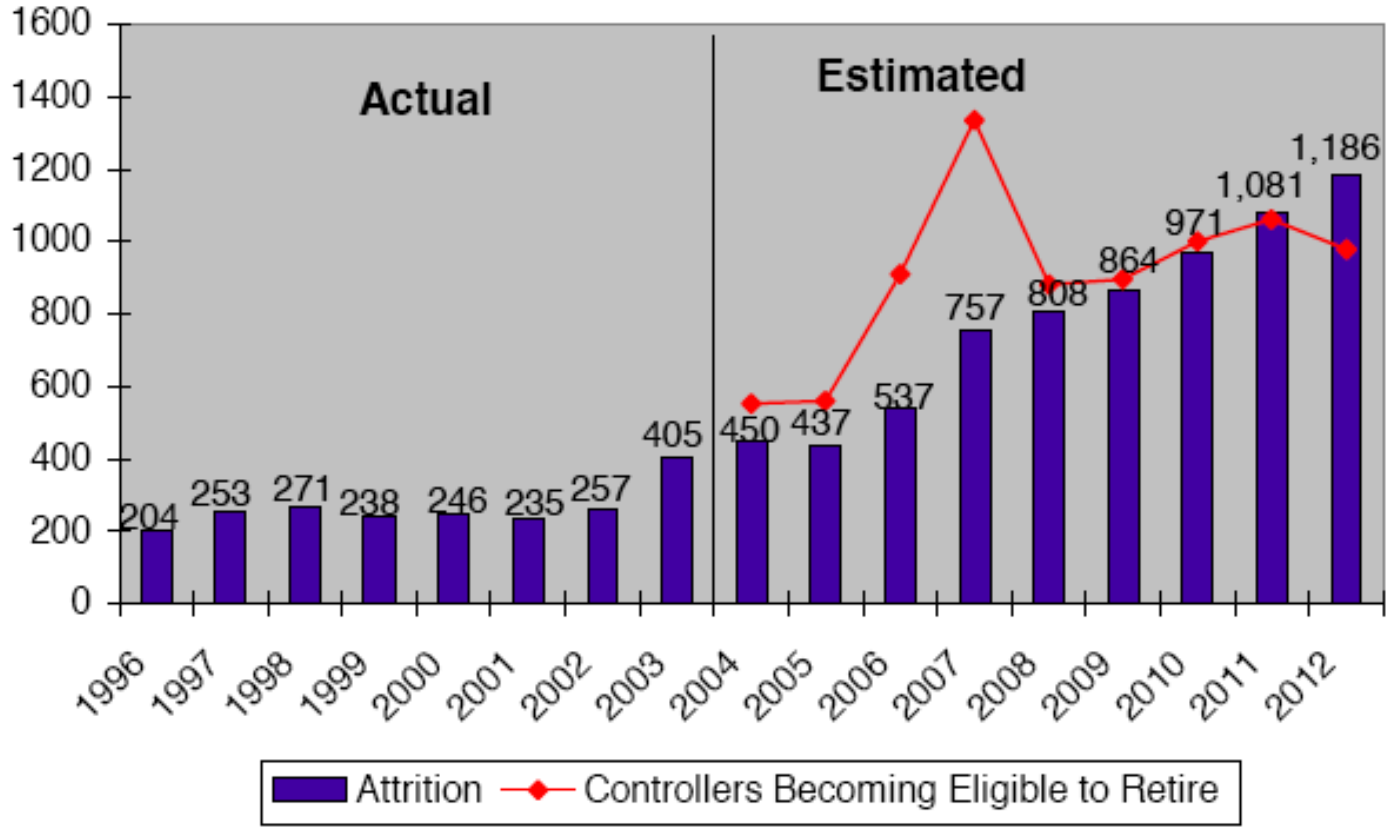
Overview

- **Challenges**
  - Retirement of demographic bulge resulting from the PATCO strike in 1981
  - Long Training Times
    - ab-initio
    - Cross Facility
  - Site Specific Staffing Shortfalls
  - Exacerbated by:
    - Growth in Traffic
    - Need for New Technology Implementation
    - Need for New Procedures
    - Financial Pressures
- Opportunities
  - Renewed workforce (Knowledge, Skills, Attributes)
  - New Training Approaches
    - Efficiency
    - Groundwork for future capability
  - Stimulates review of current practices and opportunities to improve efficiency
  - This generation will operate the NGATS

Air Traffic Controller Attrition and Retirement Eligibility



* Attrition data are as of May 2004. The number of controllers becoming eligible includes only those controllers reaching retirement eligibility in that year and does not include prior years. Retirement eligibility estimates are as of December 31, 2003.

Source: FAA (2004) Opportunities To Improve FAA's Process For Placing And Training Air Traffic Controllers In Light Of Pending Retirements, Report Number: AV-2004-060

Report available at http://www.natca.org/assets/Documents/legislationcenter/IG_report_ATC_retirement.pdf

Retirement Eligibility for Controllers

Type of Retirement	Controller Age	Years of Service
Special	50	20
Special	Any Age	25
Mandatory	56	20

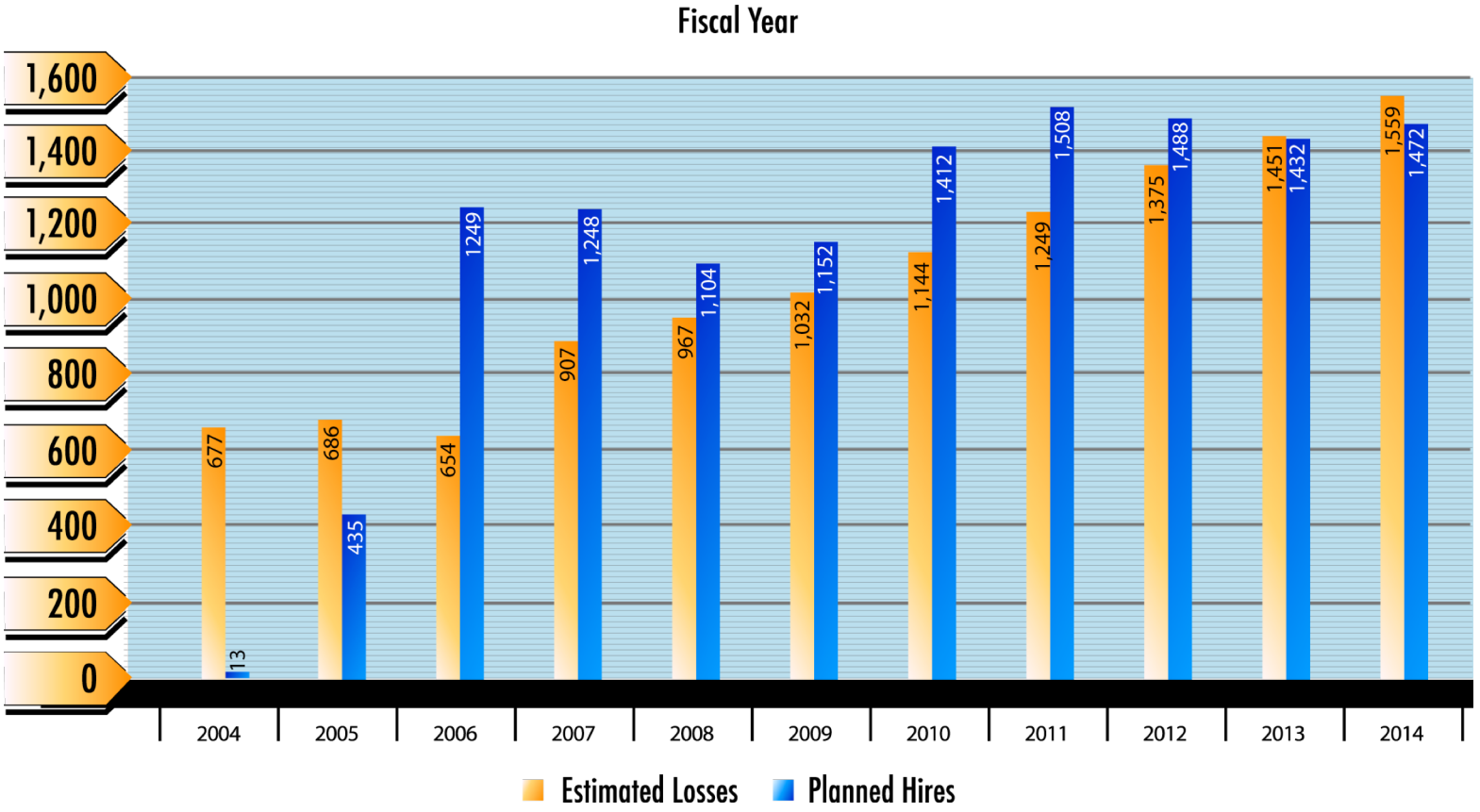
Exemption of Mandatory Retirement for "Exceptional" Controllers

Source: FAA (2004) Opportunities To Improve Faa's Process For Placing And Training Air Traffic Controllers In Light Of Pending Retirements, Report Number: AV-2004-060

Report available at http://www.natca.org/assets/Documents/legislationcenter/IG_report_ATC_retirement.pdf

Motivation - Significant Training Process Efficiencies Required to Avoid Staffing Vulnerabilities

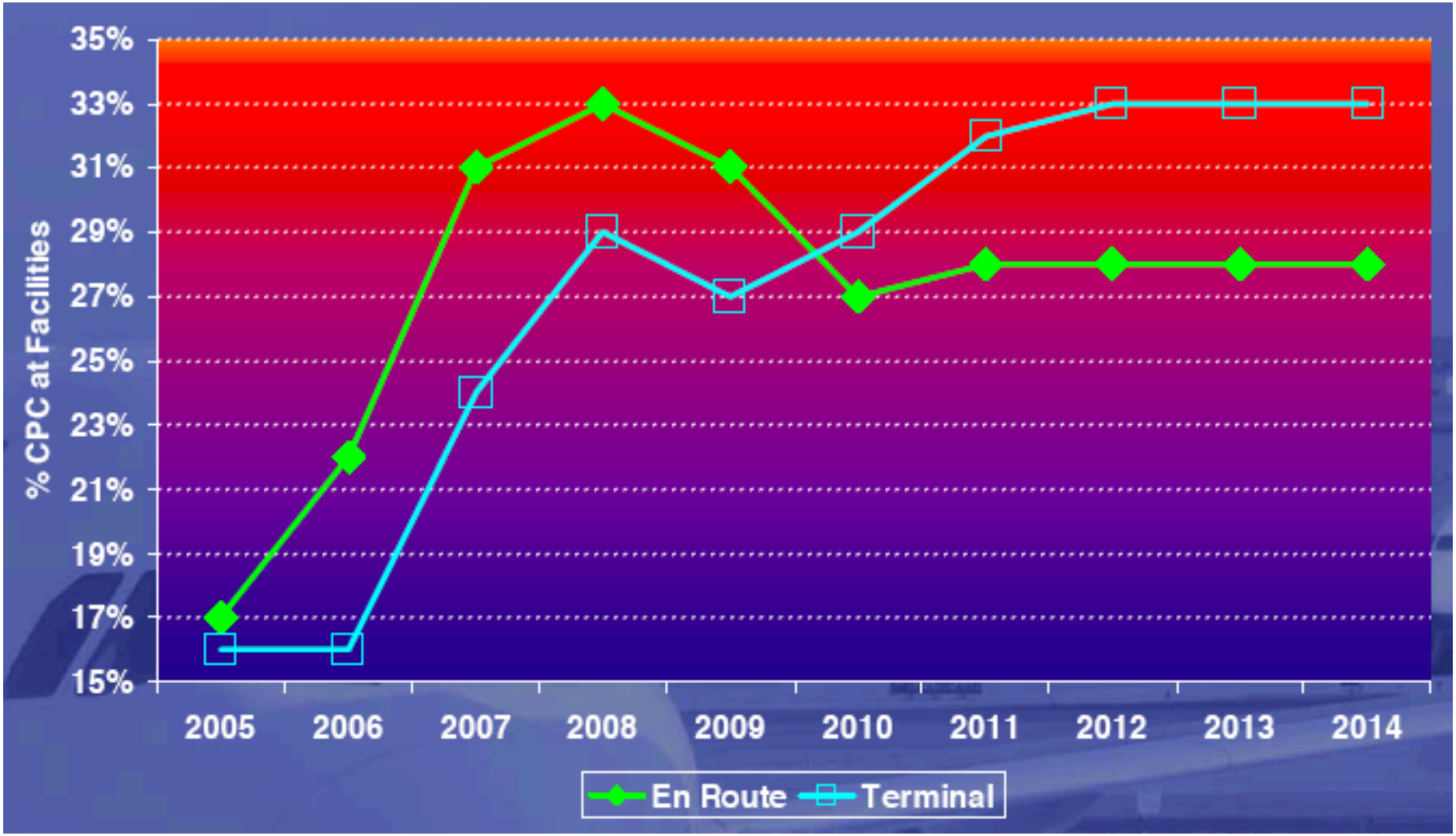
ATO Hiring Forecast vs. Losses



Time to CPC (Certified Professional Controller)
Terminal; 8 - 24 months
Enroute: 36 - 60

Source: ***Air Traffic Controller Workforce Plan - 2004***

Projected % Developmental Controllers



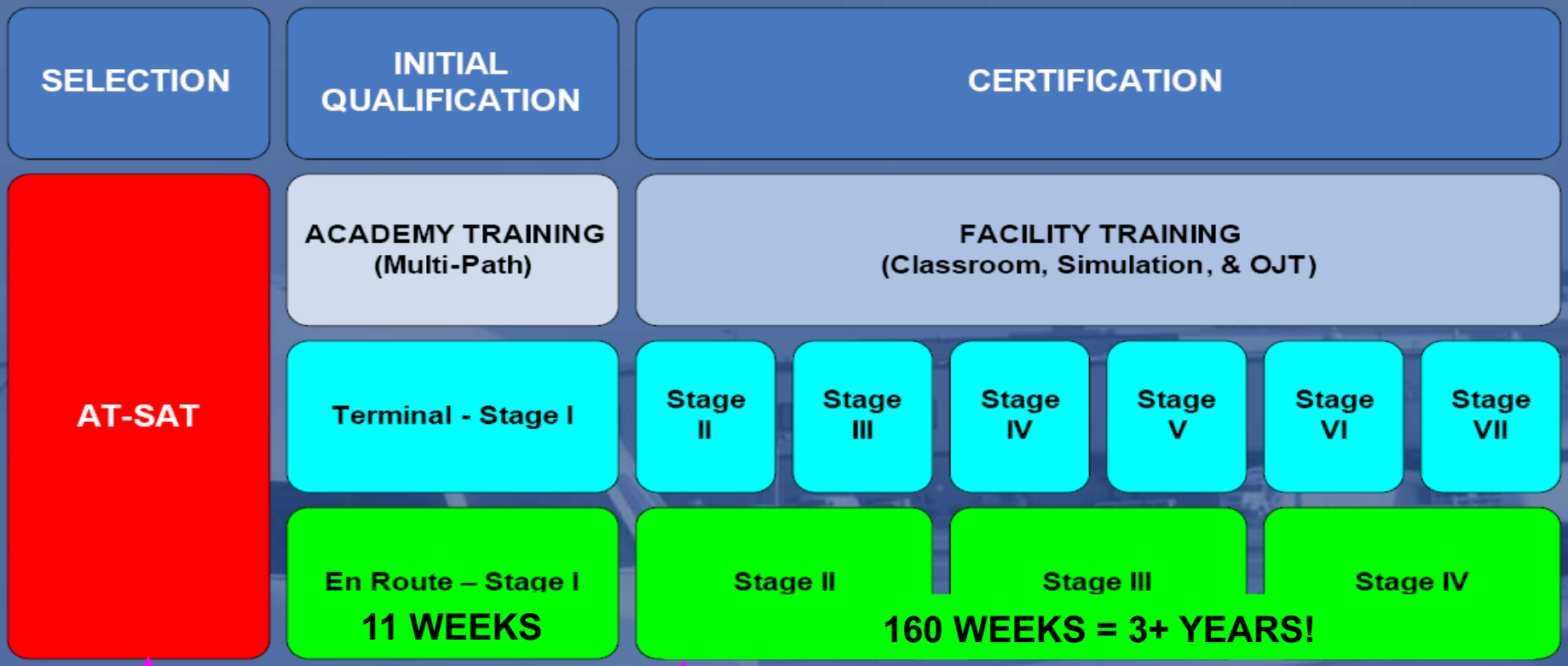
From: ATCS Workforce Plan Briefing

Time to CPC

	Post-Strike (1981-1995)	Current (1996-2005)	Target
Low-Level Terminal	<12 months	~8 months	~8 months
Mid-Level Terminal	~24 months	~24 months	~24 months
High-Level Terminal	~36 months	~36 months	~36 months
En Route	~36 months	36-60 months	~36 months

From: ATCS Workforce Plan Briefing

ATCS training program overview

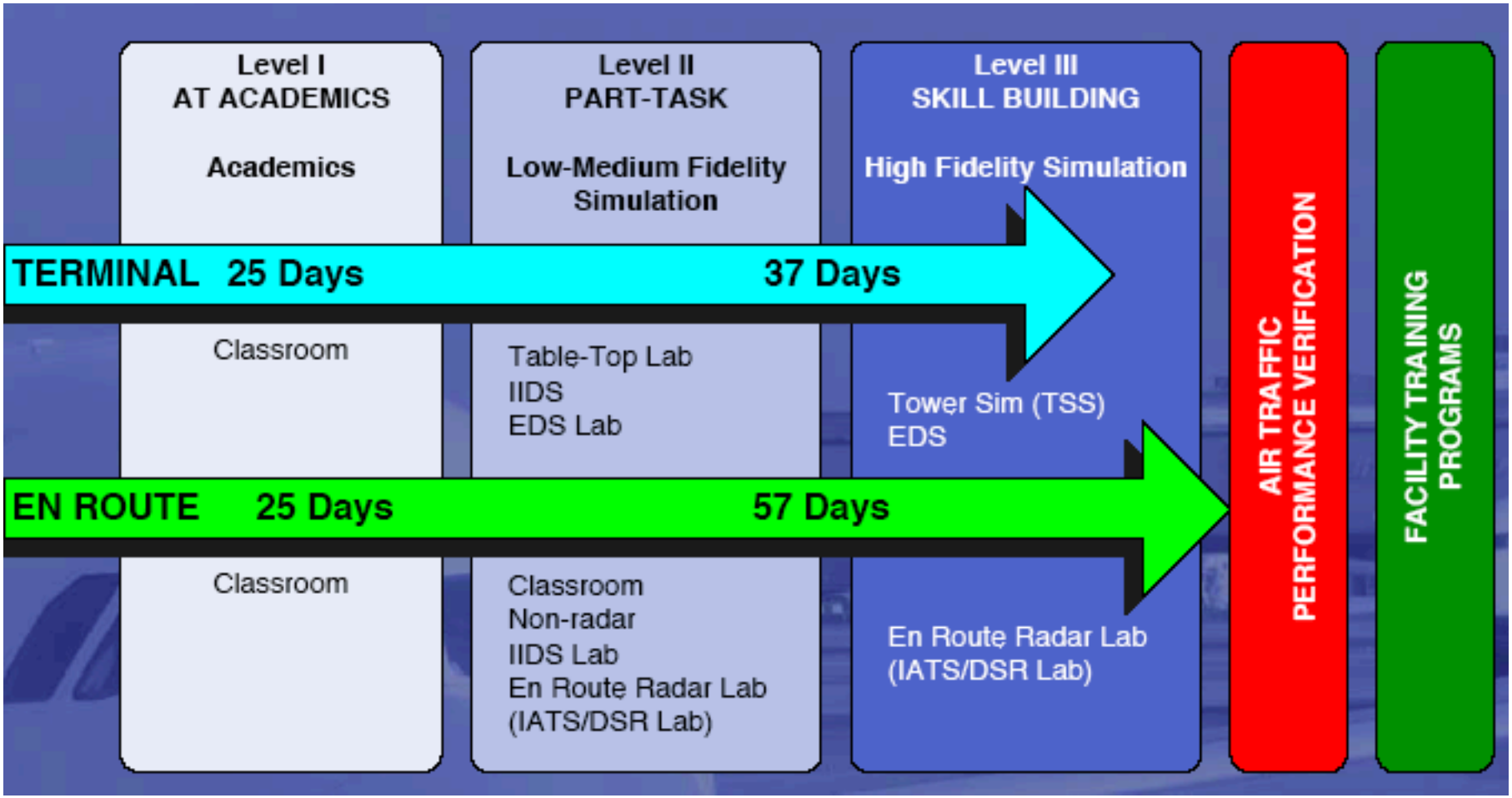


New Hire

Facility Transfer

Adapted from: RE&DAC HF Subcommittee Briefing (2005) "ATCS Workforce Plan (2004)"

FAA Academy Training Overview



From: ATCS Workforce Plan Briefing

Average Years to CPC (2002-2003)

Facility	Facility Level	Training Failures	Number of Newly Certified Controllers	Average Years to Certify as a Controller*	Average Hours Training on Live Traffic*
Atlanta Center	12	11	36	2.1	666
Chicago Center	12	5	28	3.5	905
Cleveland Center	12	2	26	2.7	677
Jacksonville Center	11	1	28	1.5	402
Los Angeles Center	11	20	26	2.5	847
Minneapolis Center	11	1	22	1.3	434
New York Center	12	15	31	3.8	696
Oakland Center	11	6	14	3.4	655
Washington Center	12	4	12	2.0	492
Atlanta TRACON	12	18	3	Excluded because of recent consolidation	Excluded because of recent consolidation
Chicago TRACON	12	14	3	1.8	462
Minneapolis TRACON	11	1	12	1.7	721
New York TRACON	12	35	16	1.7	Average data not available. Data available by individual.
Southern California TRACON	12	3	8	1.0	299
LaGuardia Tower	10	0	2	1.8	291
Los Angeles Tower	12	1	8	1.3	425
Minneapolis Tower	11	1	5	.6	316

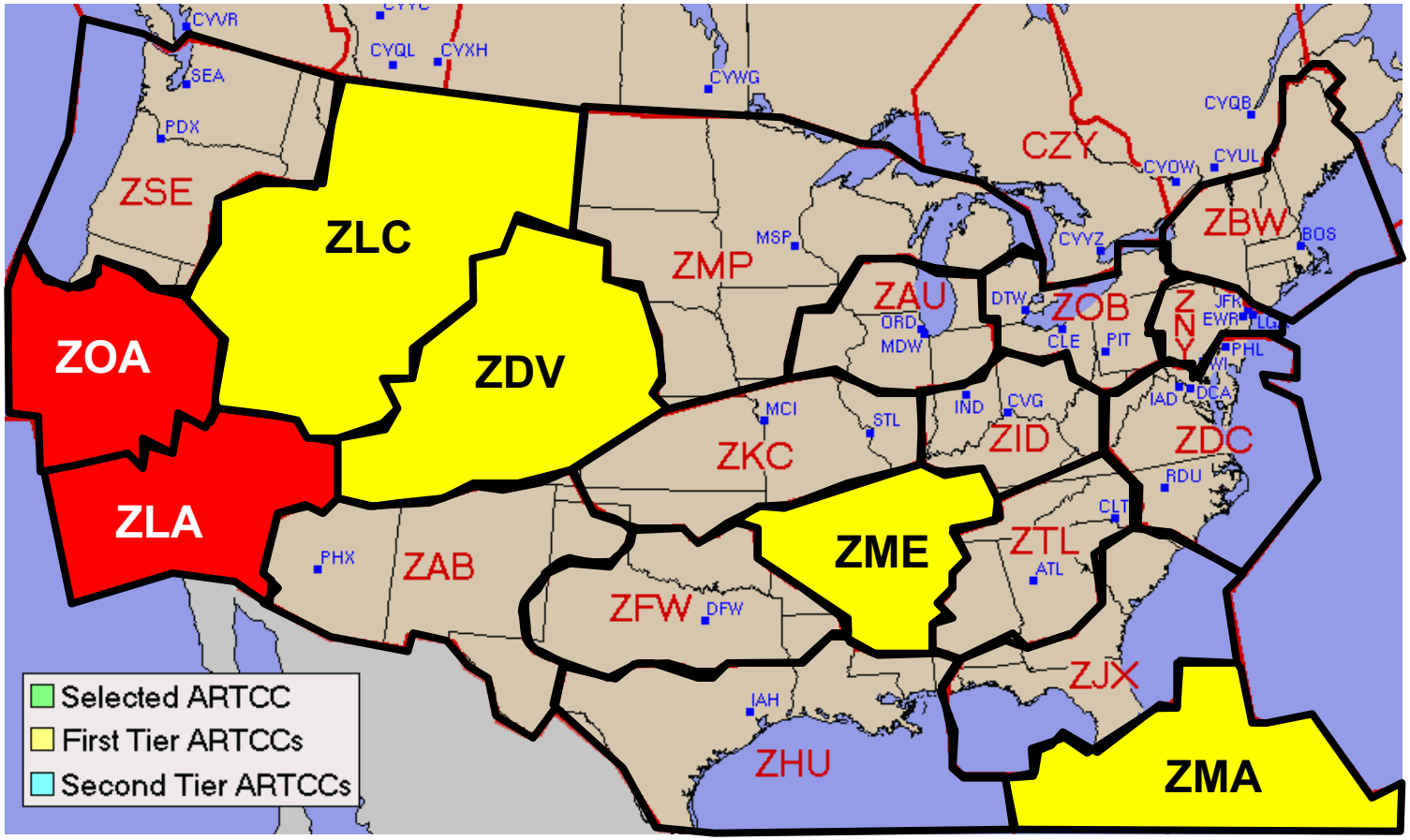
*Statistics are for CPCs that certified during FYs 2002 and 2003 and do not include data from training failures or developmentals who have not certified.

Source: FAA (2004) Opportunities To Improve FAA's Process For Placing And Training Air Traffic Controllers In Light Of Pending Retirements, Report Number: AV-2004-060

Centers Currently Below Staffing Standard

More than 30% below staffing standard

More than 20 % below staffing standard



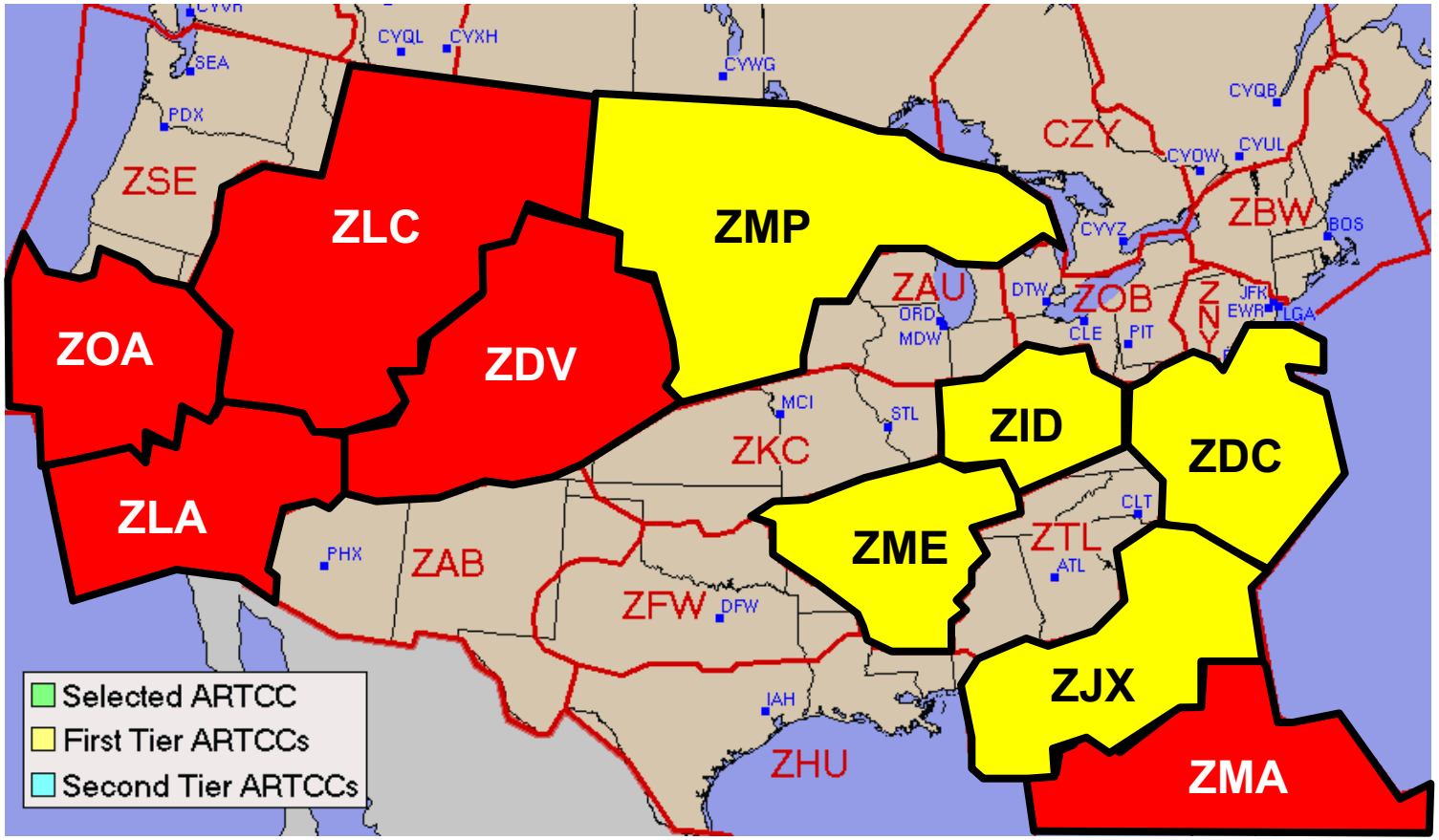
Source: MITRE (2005) Integrating Advanced Simulation Technologies into Controller Training, Presentation to FAA REDAC Meeting, February, 2005

Image from www.faa.gov

Centers With Greatest Projected Staffing Needs (End of FY08)

Top 5

6-10

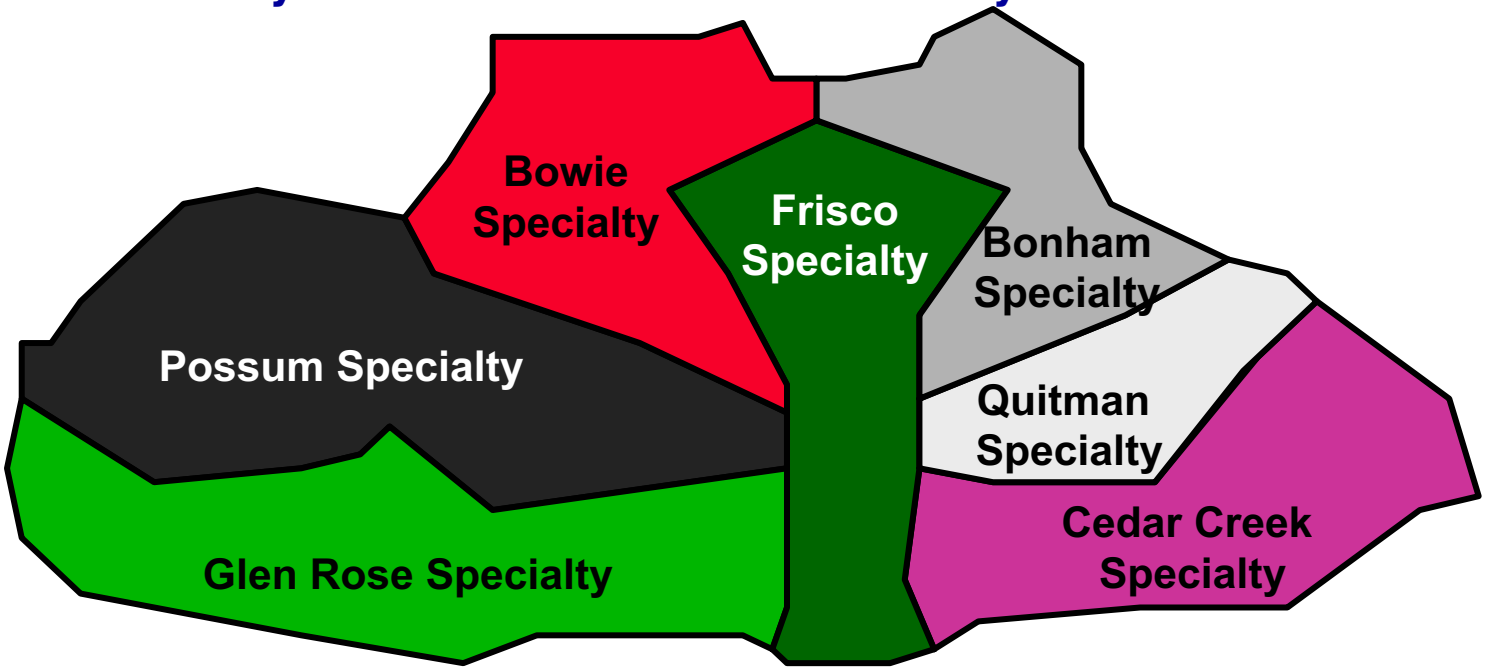


Source: MITRE (2005) Integrating Advanced Simulation Technologies into Controller Training, Presentation to FAA REDAC Meeting, February, 2005

Image from www.faa.gov

Controller Qualification is Facility Specific

- **Controllers are not interchangeable between (or even within) facilities**
  - ❑ Enroute controllers certified across 5-7 sectors within area / speciality in each Center
  - ❑ Lengthy retraining – 3+ years!
- **Cannot easily move controllers to where they are most needed**



ZFW 7 Areas of Specialization

Source: Eshow, Michelle (2000) Overview of Air Traffic Control, Software Design Workshop: Redesigning Air Traffic Control, http://sdg.lcs.mit.edu/workshop/

MIT International Center for Air Transportation

FAA REDAC
Human Factors Subcommittee

Chair, Kevin Corker

Report on Controller Workforce Development Efforts

Presented at the FAA

REDAC Meeting

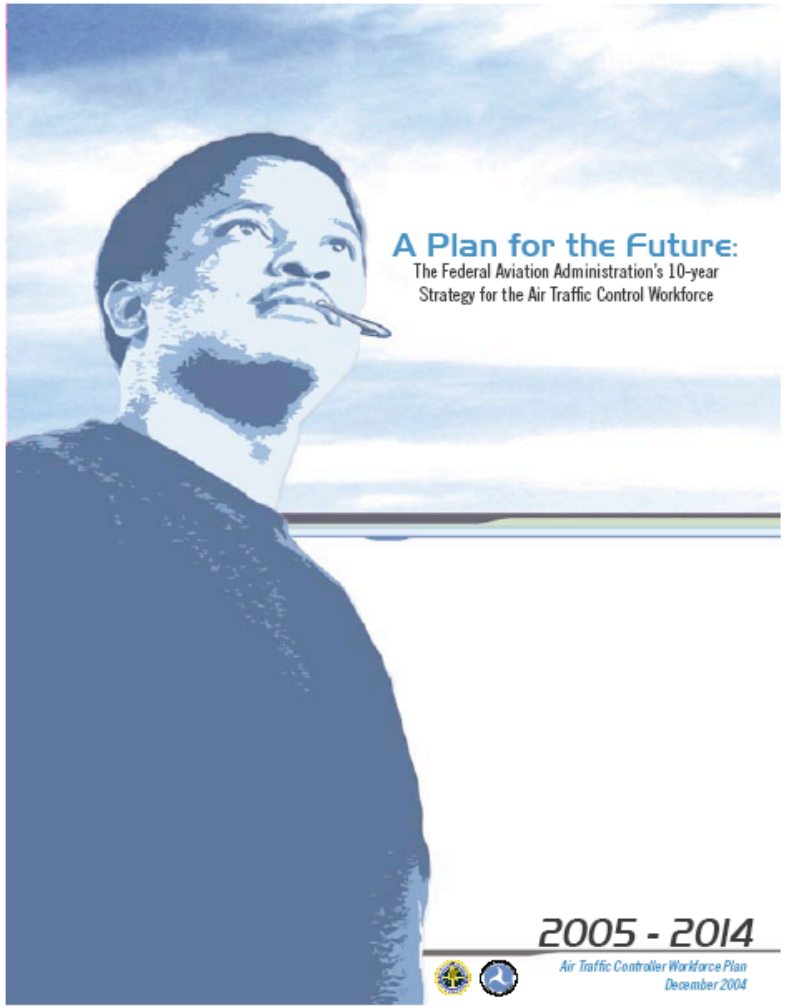
September 20, 2005

Charter

- **Administrator's request to review and assess FAA plans and activities related to the skills training and needs of the next generation controller workforce in anticipation of the upcoming retirement replacement needs**

Summary Findings 1

- **Committee commends the development of the *Plan for the Future: The FAA's 10-Year Strategy for the Air Traffic Control Workforce* but is concerned about implementation.**
  - Near Term: A management focal point and an aggressive *up-tempo* response of the agency are required to meet immediate staffing requirements.
  - Mid Term: The training process should be refined based on a lean (value added) process analysis and clearly defined knowledge, skill and ability performance requirements.
  - Far Term: Agency should seize the opportunity for sustained development of the workforce of the future by new techniques of recruitment, selection and training



Summary Findings 2

- **Committee has significant concerns with the speed and efficiency of current training practice to meet the system wide and facility specific demands over the next 5 years.**
  - Concern is based on the 2-5 year time to train to CPC and the cost/time for position transfer-training to facility specific operations
  - A large portion of the training time is on the job training. This process is of uncertain efficiency and requires significant controller resources.

- **Committee sees an opportunity to improve effectiveness and efficiency of the recruitment, selection and training process (at all stages: Collegiate Training Initiative, Academy, and On The Job (OTJ) training**

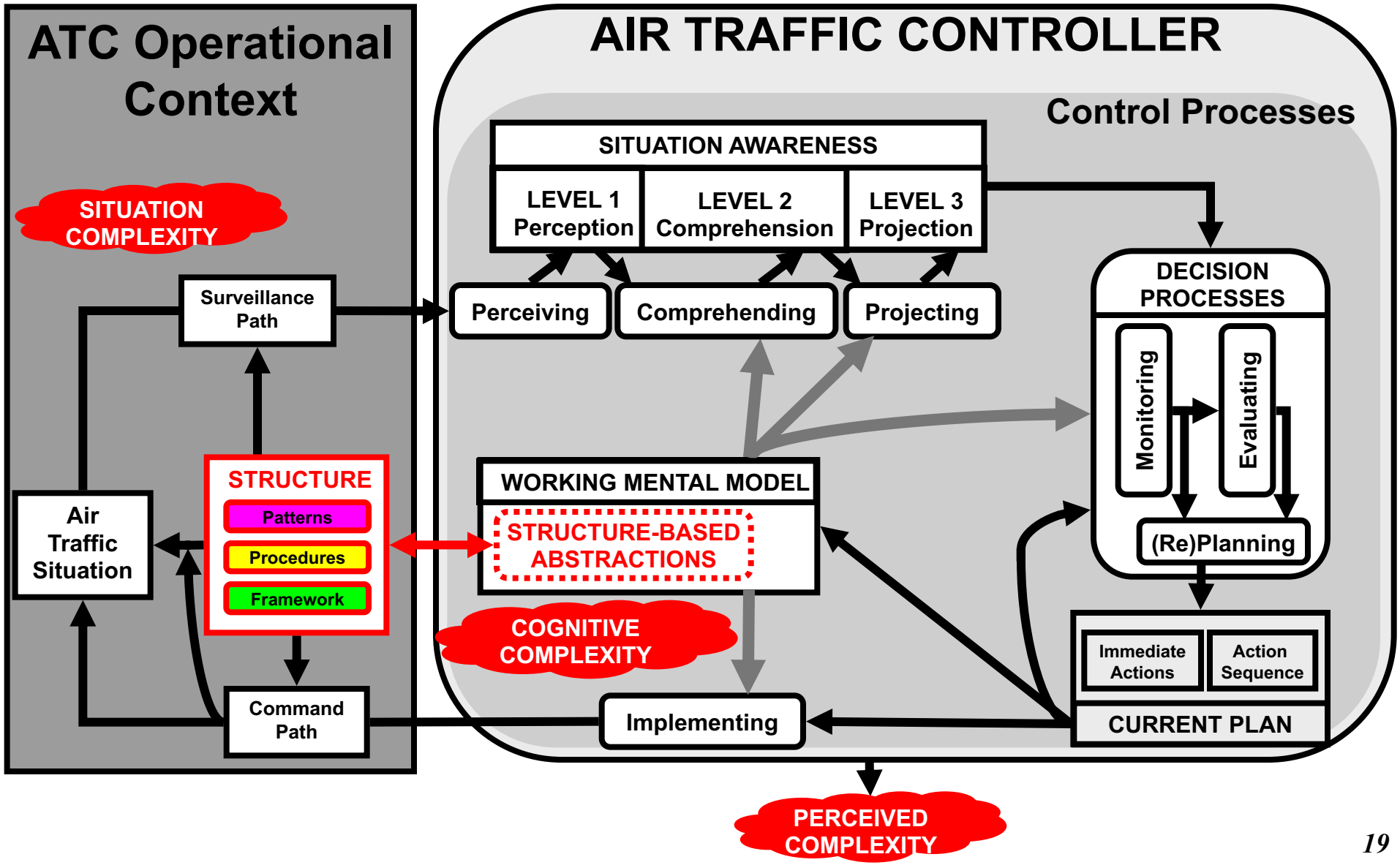
- **More Detail in Following Slides**

Training Process Enhancements

- **Observation: There are a number of initiatives proposed in the "Plan for the Future" focused on achieving gains in efficiencies and effectiveness in the training process with associated reductions in training time and costs. Much less emphasis has been placed on developing the right training program.**

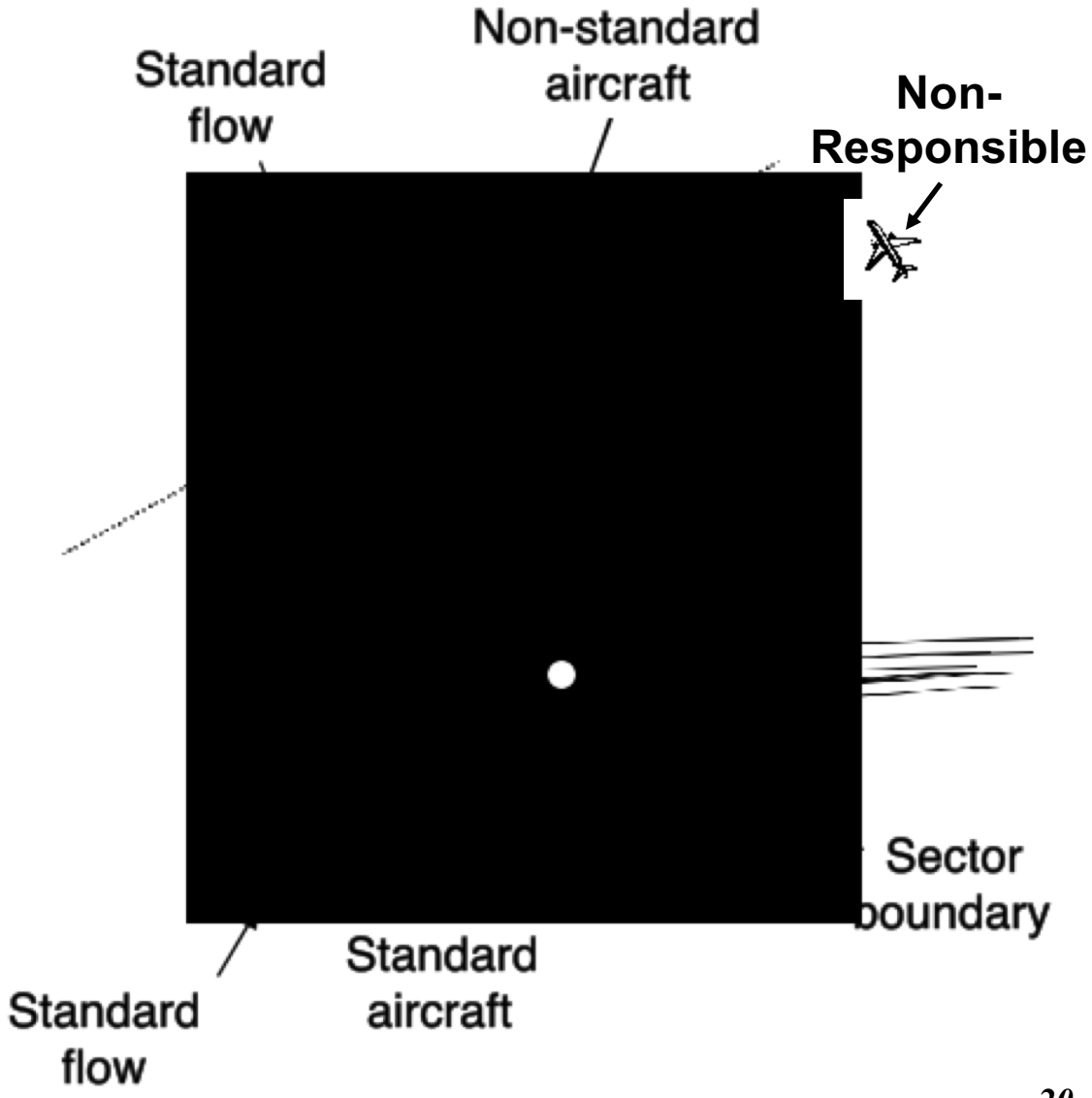
- **Recommendations:**
  - ✓ **The FAA should immediately convene an independent lean process review team to, in the near term, assure the response needed to meet immediate needs and, in the far term, development the training program for the future.**
    - ✓ Conduct a complete review of the current academy training program and facility training programs, and the age 56 exceptional controller process
    - ✓ Consider new training approaches, eg concurrent Radar and Associate Training
    - ✓ Review options on centralized versus decentralized training
    - ✓ Identify requirements and venues for training of advanced controller tools
    - ✓ Support assessments regarding the use of simulation throughout the training process
  - ✓ **Training must be a requirements-driven and performance-based process**
  - ✓ **Training must focus on determined knowledge, skills and abilities to reach CPC**
  - ✓ **The FAA should accelerate current efforts in staffing standards model and functional requirements development**

Structure Based Cognitive Review

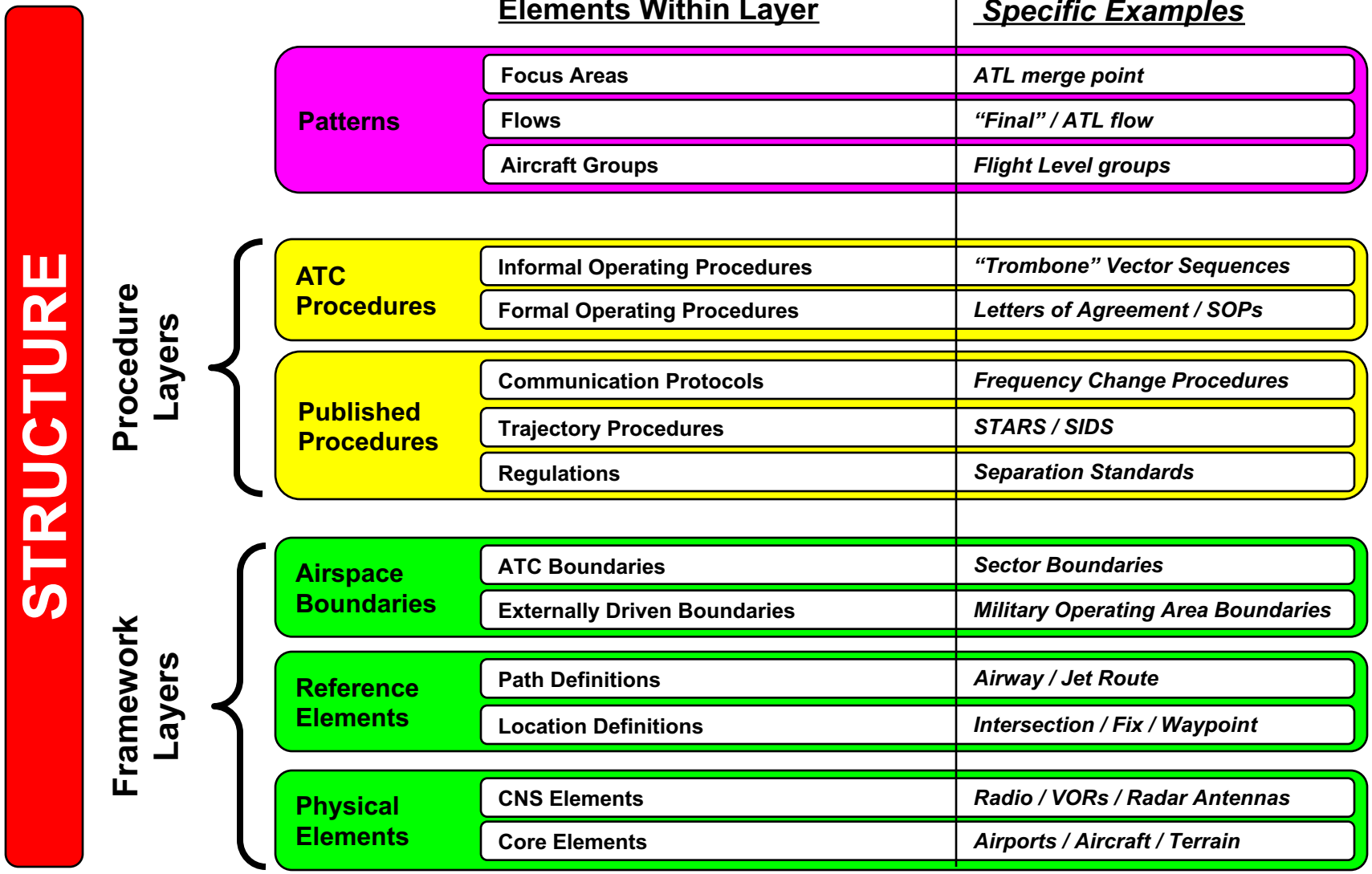


Examples of Structure-Based Abstractions

- **Standard Flows**
  - ❑ Aircraft classified into standard and non-standard classes based on relationship to established flow patterns.
- **Groupings**
  - ❑ Common, shared property, property can define non-interacting groups of aircraft
    - o E.g. non-interacting flight levels
- **Critical Points**
  - ❑ E.g. merge point
  - ❑ Reduce problem from 4D to 1D “time-of-arrival”.
- **Responsibility**
  - ❑ E.g. discounting non-relevant parts of situation
  - ❑ E.g. delegating separation responsibility (“maintain visual separation”)



Structure Layers With Examples



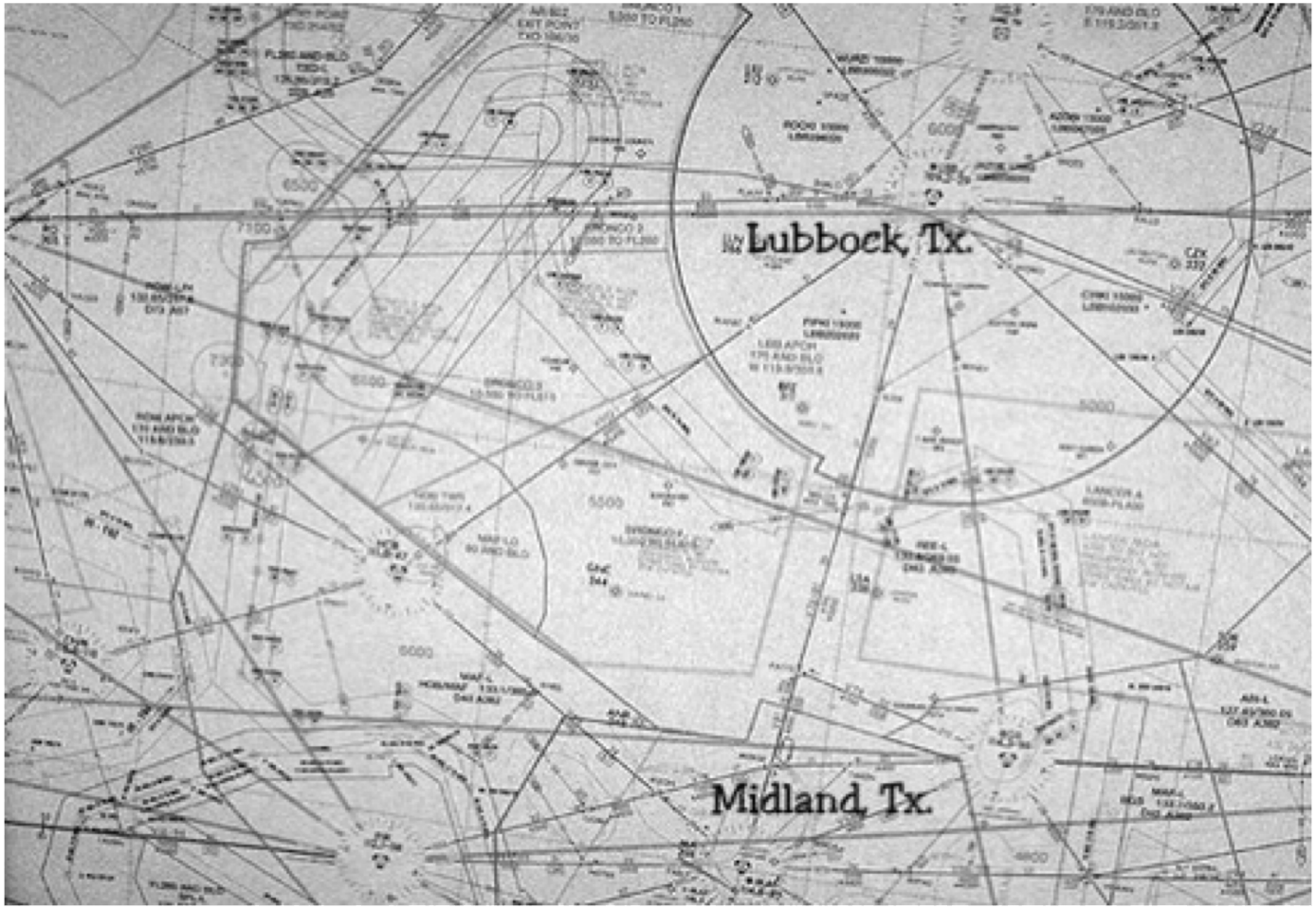
Classroom Training Components

	STAGE II Assistant Controller (Flight Data)	STAGE III Nonradar & Radar Associate	STAGE IV Radar Controller
Structure Knowledge	•Center Area Chart •Area of Specialization Chart	•Area of Specialization Chart + Minimum altitudes + Airport procedure details •Instruction on Letters of Agreement and facility orders •Special Military Operations self-study guide	•Locate & identify radar systems •Describe radar coverage & limitations •Identify radio equipment and landlines associated with radar positions •Explain in Detail Letters of Agreement and Special Procedures
Other	•Operating Communication System •Flight Data Position responsibilities / operations	•Enroute study guide •Phraseology / Strip Marking self-study guide •FAA Academy developed lesson plans	•Radar qualification exam •FAA Academy developed lesson plans

Source: FAA (2005) 3120.4 Air Traffic Technical Training, Appendix 4: En route Instructional Program Guide, Pg 12,16,36-37.

Chart Memorization Pedagogy

- **Reproduce within 5 mile accuracy**
- **~ 5000 items**



Source: Nicola, Joe (2006) ZFW Photo Gallery, http://www.sportsshooter.com/nicola/zfw/pages/17.html

Chart Memorization Requirements

STAGE II
Assistant Controller
(Flight Data)

Center Area Chart.

- Label each NAVAID/fix with its correct identifier (including the first NAVAID outside the area).
- Depict all airways and jet routes extending from the first NAVAID/ fix outside the area and label each.
- Depict and identify sector boundaries.
- Depict and identify special use airspace.
- Identify adjacent center sectors.

STAGE III
Nonradar & Radar Associate
("D-side")

Chart Memorization Requirements

STAGE II
Assistant Controller (Flight Data)

Center Area Chart.

- Label each NAVAID/fix with its correct identifier (including the first NAVAID outside the area).
- Depict all airways and jet routes extending from the first NAVAID/ fix outside the area and label each.
- Depict and identify sector boundaries.
- Depict and identify special use airspace.
- Identify adjacent center sectors.

Area of Specialization Chart

ABOVE AND

- Indicate total mileage between NAVAIDs and/or fix posting.
- Depict and label all intersections.
- Depict and label restricted, prohibited, and warning areas and other special use airspace
- Depict and label all approach control airspace, VFR towers, FSS locations, and class B, C, D, and E airspace.

STAGE III
Nonradar & Radar Associate ("D-side")

Chart Memorization Requirements

STAGE II
Assistant Controller
(Flight Data)

Center Area Chart.

- Label each NAVAID/fix with its correct identifier (including the first NAVAID outside the area).
- Depict all airways and jet routes extending from the first NAVAID/ fix outside the area and label each.
- Depict and identify sector boundaries.
- Depict and identify special use airspace.
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Area of Specialization Chart

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- Depict and label all approach control airspace, VFR towers, FSS locations, and class B, C, D, and E airspace.

STAGE III
Nonradar & Radar Associate
("D-side")

Area of Specialization Chart

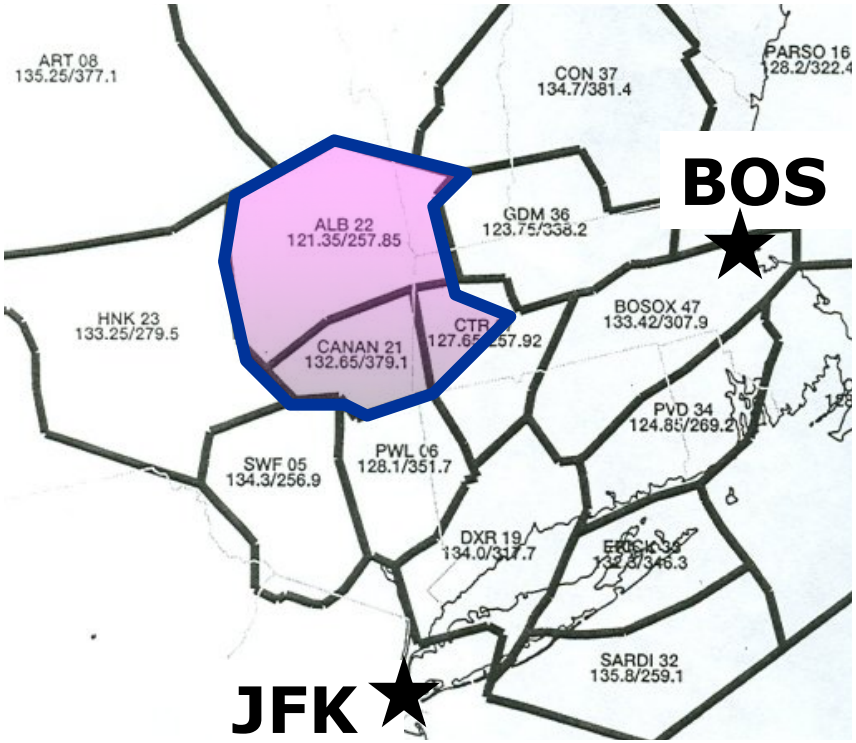
ABOVE AND

- Label all MEAs, MRAs, MOCAs, and MCAs.
- Depict and label … for … airports within the area of specialization …:
  - Published holding pattern direction and turns.
  - Initial penetration/approach altitude.
  - Initial penetration/approach fix.
  - Outbound and inbound heading/bearing/radial.
  - Direction of procedure turn (if applicable).
  - Missed approach procedures and altitudes.

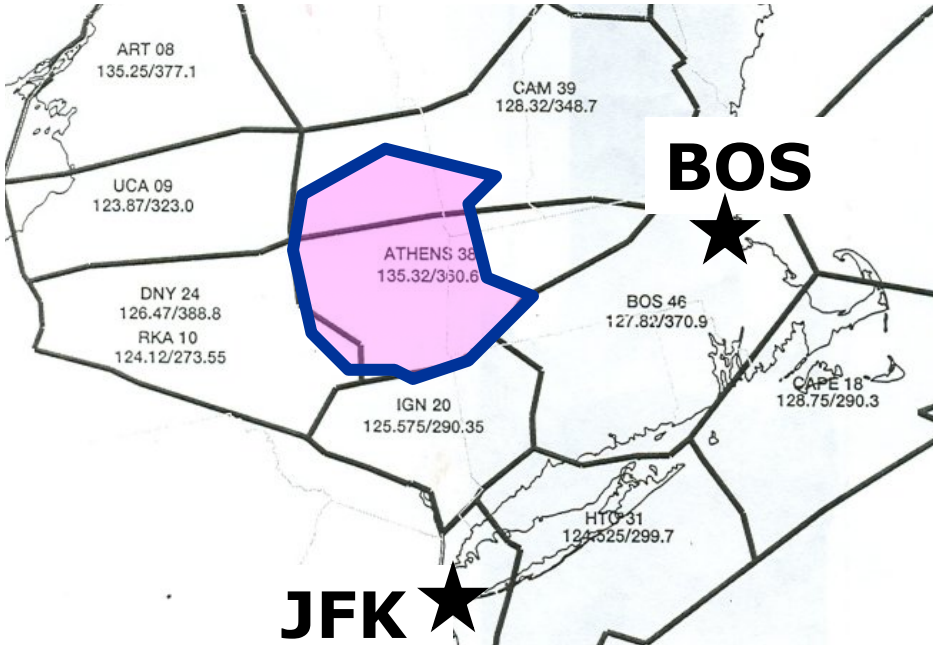
Interface Procedures Are Also Key Structure Knowledge

E.g. ZBW Albany Sector (110 - FL230)

Low Altitude Sectors

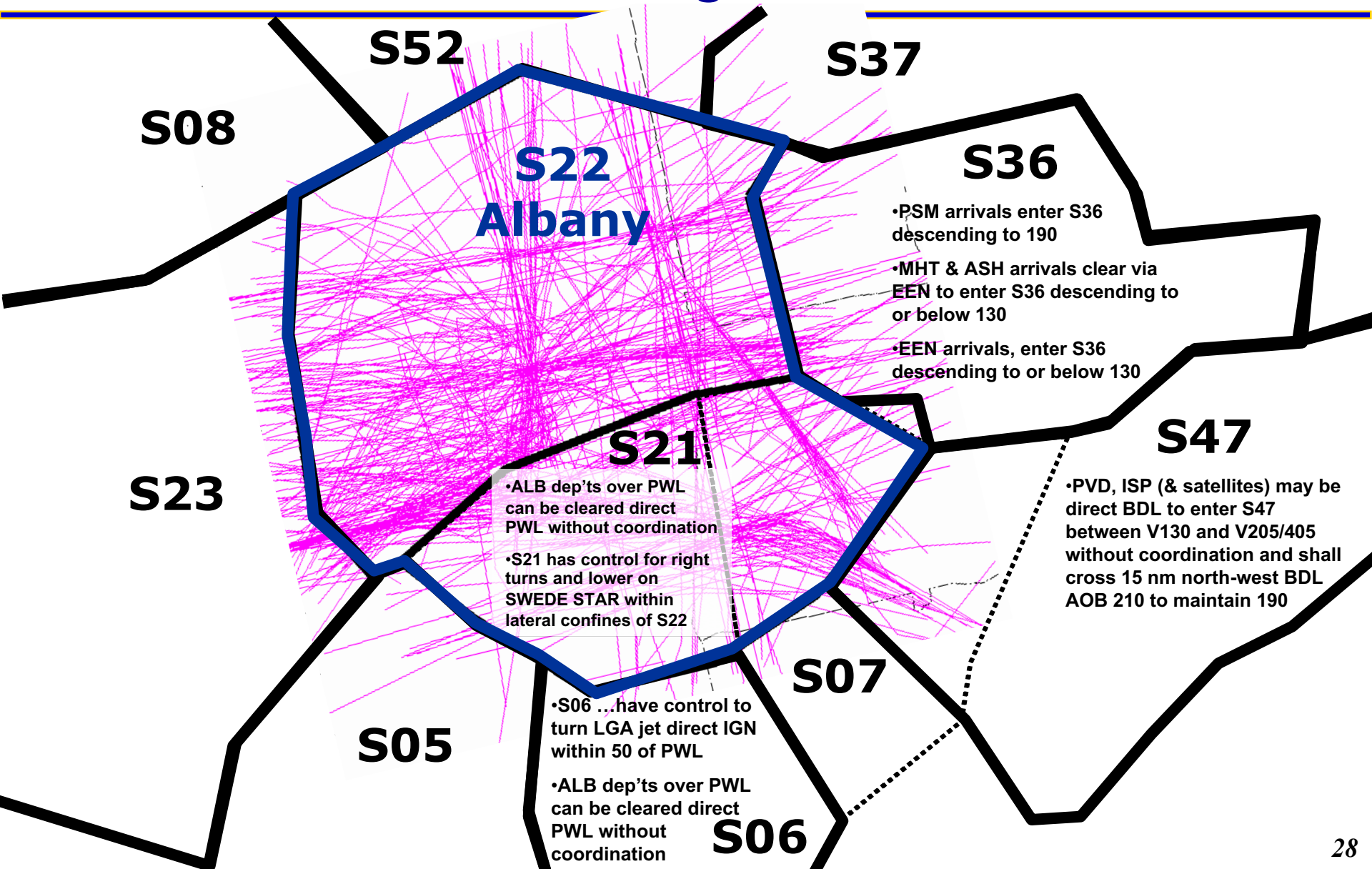


High Altitude Sectors

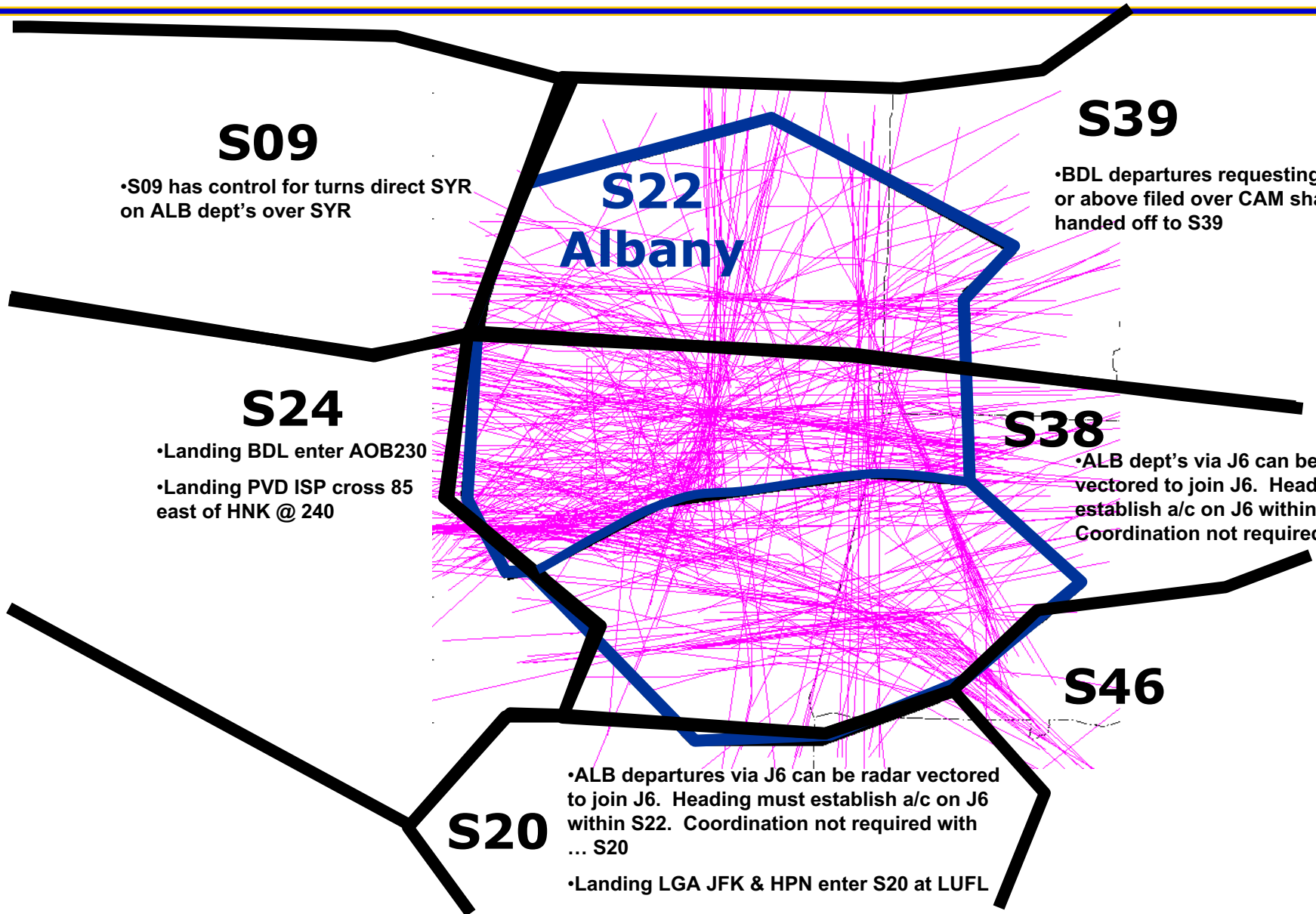


From www.liveatc.net

Interface Procedures – Surrounding Low Altitude Sectors



Interface Procedures – Surrounding High Altitude Sectors



ATCS Performance Measures & Training Effectiveness

- **Observation: The assessment of Academy training and OJT effectiveness are hindered by a lack of metrics to ensure performance competencies, prioritize efforts to address training and remediation, and track controller development. Training seems largely time-based as opposed to performance and results based.**

- **Recommendation:**
  - ✓ **The FAA should immediately and consistently develop and implement performance-based metrics and standards for CTI, Academy, facility airspace, and OJT training entry/exit criteria to assess controller competencies**
  - ✓ **The FAA should seek to standardize, to the extent possible, scenario characteristics for training and exploit advanced simulation technology to converge on a common set of controller skills**
  - ✓ **The FAA should combine the use of objective measures of skill with behaviorally anchored rating scales to ensure effective use of training exit criteria**
  - ✓ **The FAA should examine best practice and lessons learned in training for air transport operations and investigate their application to controller performance**

Use of Simulation

- **Observation: Simulation technology is not properly exploited in ATCS training. The subcommittee observes:**
  - ❑ **An over-reliance on labor intensive full fidelity simulation to mimic the "real world" as opposed to simulation fidelity selected to match training value**
  - ❑ **No basis for what should be trained at varying levels of simulator fidelity**
  - ❑ **Ineffective use of CBT and part-task simulation, which could increase training effectiveness at a lower cost**

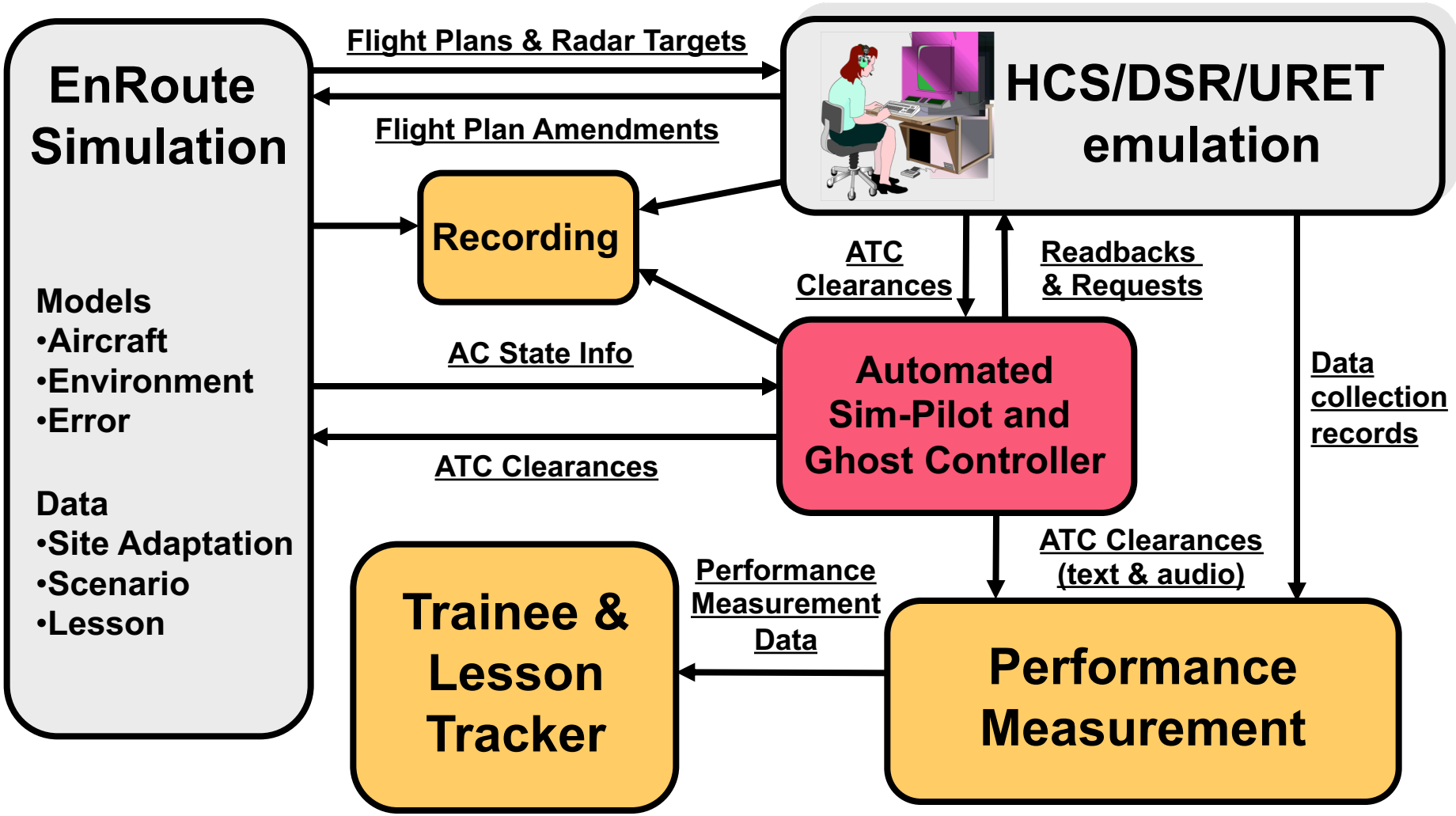
- **Recommendation: In the next six months develop a set of technology requirements:**
  - ✓ **To support performance-based training objectives**
  - ✓ **Identify and map skills to training technologies (CBT, part-task simulators, full fidelity simulation) to training objectives**
  - ✓ **Address scenario and airspace specific development issues**
  - ✓ **Evaluate MITRE (R-SAT) simulation training approach (and others) to be systematically matched with training outcomes for effective training delivery**
  - ✓ **Investigate the use of simulators to provide early practice and testing including on airspace knowledge and communications skills**

MITRE Rapidly-Deployable Stand-Alone ATC Trainer (R-SAT)

- **Stand-alone, dedicated training system at facilities that can supplement Radar and Radar Associate training**
  - ❑ Independent Operation
  - ❑ Automatic assessment of performance
  - ❑ Enable quality training during otherwise non-productive time
  - ❑ Focus on important tasks and abilities
  - ❑ Supplement remedial training
- **Rapidly deployable based on facility needs**
  - ❑ Facilities with a large number of trainees expected to need additional simulation training positions
- **Purpose**
  - ❑ Validation
  - ❑ Demonstration
  - ❑ Near-Term Use

Source: MITRE Briefing

Functional Architecture
Trainee Scenario Runs



Source: MITRE Briefing

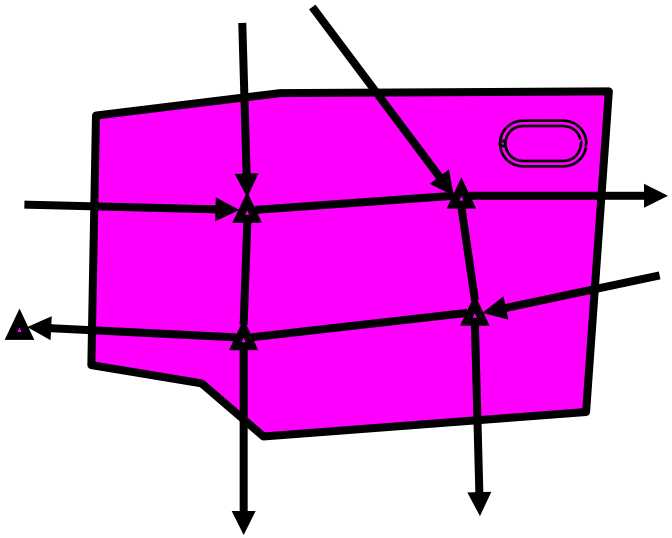
Standardization of Procedures

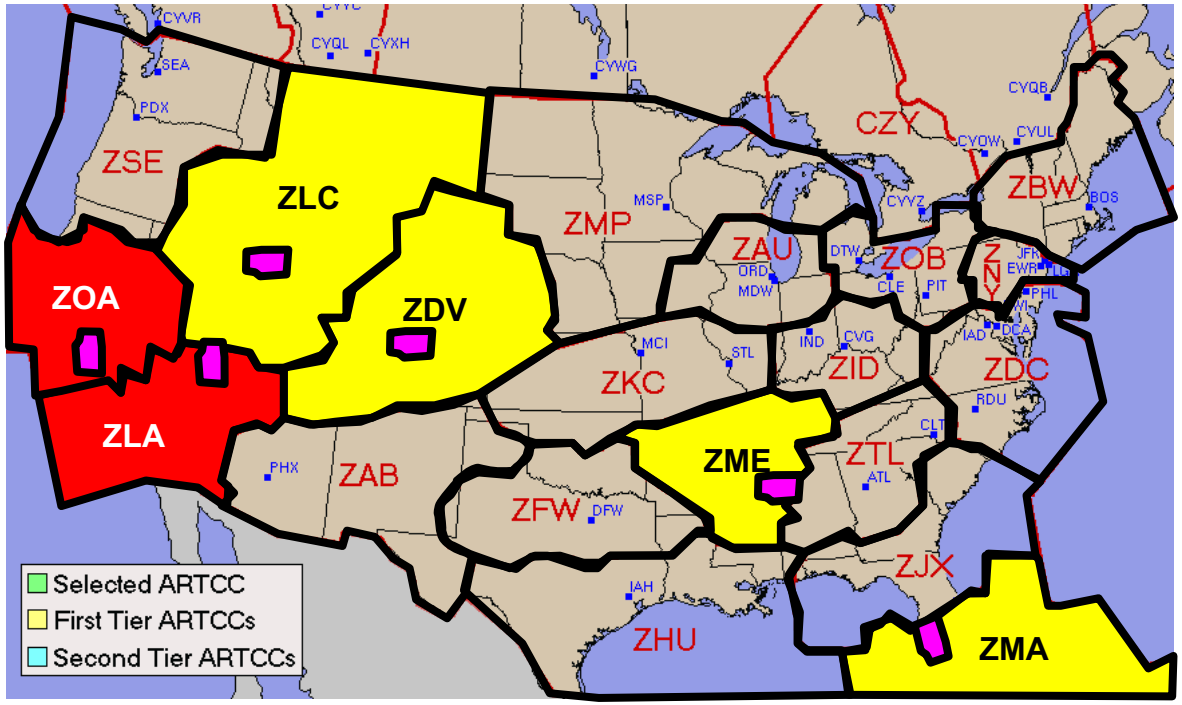
- **Observation: A large portion of training at the facility is dedicated to learning local procedures and memorizing detail which is an artifact of prior technology limits. This is compounded by differences in local practices for use of common ATCS tools such as URET.**

- **Recommendation: Immediately determine how to improve, staffing flexibility, OJT and Academy effectiveness through:**
  - ✓ **Identification of general techniques and consolidation that standardizes procedures and training across facilities such as control techniques for certain operational flows**
  - ✓ **Targeting facilities at risk of personnel shortfall. Focus on procedure simplification and support for controller rapid indoctrination in local techniques**
  - ✓ **Enhancing processes for reducing training effort and off-loading sector-specific requirements to perceptual and decision support tools**
  - ✓ **Anticipating the impact of future initiatives in procedure and equipment to enhance procedural standardization**
  - ✓ **In the next year, determine how standardized procedures could be improved for use of ATCS tools**

Standardized Airspace

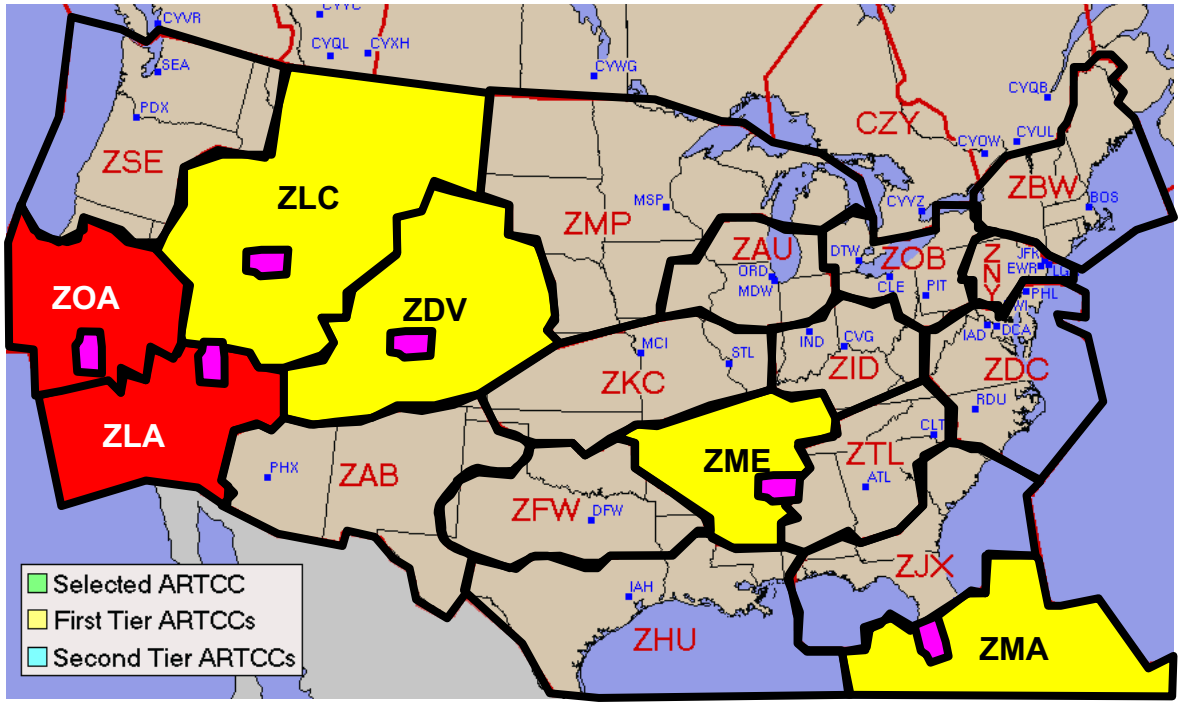
"Sector X"



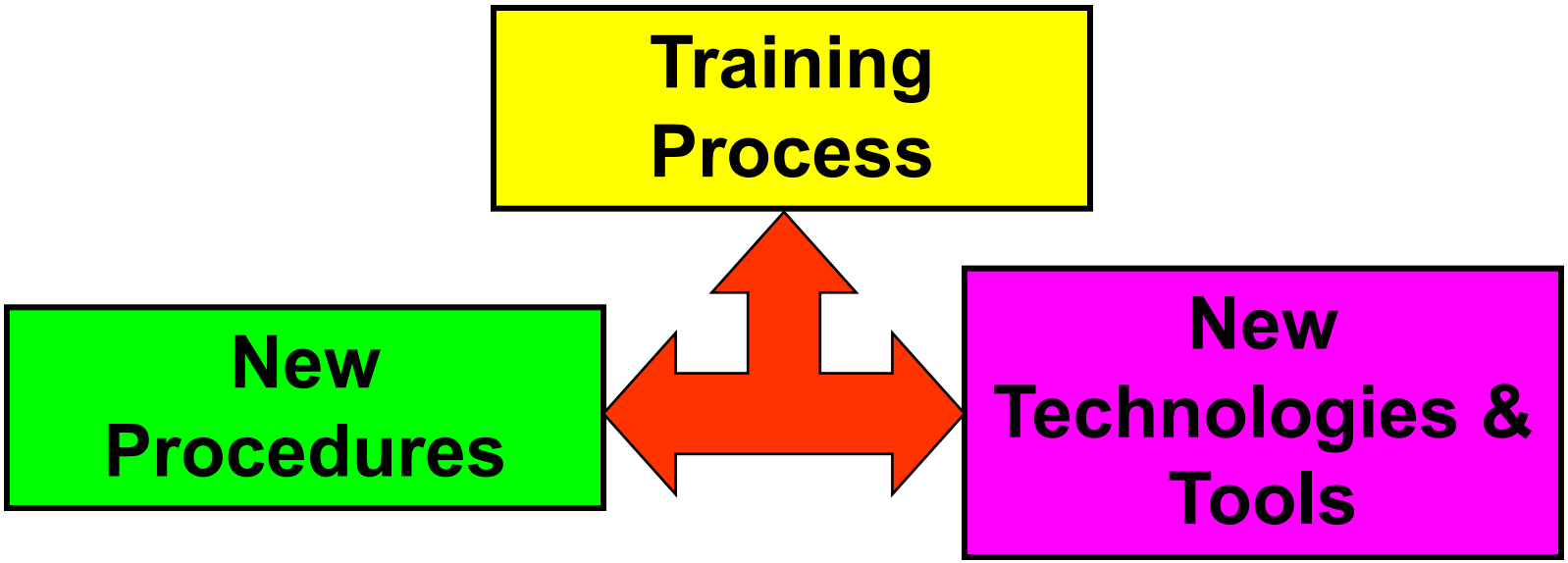


Standardized Airspace
"Sector X'

- **Template for standardized sectors across multiple areas/facilities**
- **Standardized, simple geometry**
- **Easily learned naming convention**
  - ❑ Navigational / reference points
  - ❑ Communication frequencies
- **Standardized interface procedures**
  - ❑ Handoffs
  - ❑ Pointouts & surrounding sector structure
- **Consistent procedures for sector operations:**
  - ❑ Holding patterns
  - ❑ DST usage
  - ❑ Encounter geometries
    - o Standard flow pattern
  - ❑ Aircraft performance characteristics



Training Processes to Enable Rapid Introduction of New Technology and Procedures



CTI - Academy Alignment

- **Observation: Collegiate Training Initiative (CTI) programs are seen as one way of expanding the FAA training capability. In order to exploit that possible expansion, the CTI programs need to be better aligned with Academy and FAA requirements.**

- **Recommendation:**
  - ✓ **Immediately, give the CTI schools clear guidance to allow their graduates advance in Academy training. Immediately establish minimum requirements for CTI graduates to enter Academy training as well as requirements for advanced Academy placement**
  - ✓ **Streamline the transition between CTI and Academy and support currency training during transition**
  - ✓ **Develop a program of feedback to the CTI schools using Academy statistics to improve CTI curricula including use of training technologies.**

CTI Schools

CTI Program	City	State
College of Aeronautics	Flushing	NY
Community College of Beaver County	Beaver Falls	PA
Daniel Webster College	Nashua	NH
Dowling College	Brookhaven	NY
Embry-Riddle Aeronautical University	Daytona Beach	FL
Hampton University Hampton, Virginia	Hampton	VA
Inter-American University of Puerto Rico	Bayamon	PR
Miami-Dade Community College	Homestead	FL
Middle Tennessee State University	Murfreesboro	TN
Minneapolis Community & Technical College	Eden Prairie	MN
Mount San Antonio College	Walnut	CA
Purdue University	West Lafayette	IN
University of Alaska Anchorage	Anchorage	AK
University of North Dakota	Grand Forks	ND

From: ATCS Workforce Plan Briefing

Use of Team Training

- **Observation: Use of team training is not addressed in *A Plan for the Future: The FAA's 10-Year Strategy for the Air Traffic Control Workforce*. Part of this strategy should be ensuring safety management and a reporting culture by indoctrinating controllers early on the value of teamwork.**

- **Recommendation:**
  - ✓ In the next six months, implement an approach for leveraging the use of team training, whether in the form of team based collaborative learning, Air Traffic Teamwork Enhancement (ATTE), crew resource management (CRM), or some other approach. Principles should be introduced at the Academy, and practiced in OJT.

Conclusion

- The upcoming transition in controller workforce provides both the stimulus and opportunity to define the next generation air traffic controller workforce.
- Urgent demands will push for short term solutions.
- We need to assure that the processes result in a next generation air traffic controller workforce that can enable to Next Generation Air Transportation System.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