COMprehensive Environment for TMC Training by Simulation

White Paper

MOSAIC ATM

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Background

In January 2016, Mosaic ATM submitted a proposal to NASA to develop a training simulation environment for Traffic Management Coordinators (TMCs) called the Comprehensive Environment for Traffic Management Training by Simulation, or COMETTS. During the Phase I Small Business Innovation Research (SBIR) contract, which was awarded to Mosaic ATM in April of that year, COMETTS was developed to operate in the Cloud and provide displays to traffic management trainees via standard computer web browser applications. The Phase I contract focused on completing the following research activities:

1. A comprehensive TMC training shortfalls analysis
2. An analysis of simulation requirements
3. A detailed literature review of the comparative effectiveness of experiential learning versus lecture/classroom-based (non-experiential) learning
4. Develop multiple operational Use Case scenarios
5. Identify COMETTS capabilities and develop a thin-client prototype that would leverage NASA's Air Traffic Management eXploration (ATM-X) Test Bed cloud computing environment.

Mosaic successfully completed Phase I and was awarded a Phase II contract in May 2017, which included the following COMETTS research activities:

1. Continue to develop the TMC training simulator prototype
2. Develop Use Cases and training scenarios
3. Conduct a Shadow Evaluation using operational personnel at a key site field facility

All Phase II requirements were successfully completed in the spring of 2019, except for testing at the chosen key site facility: Fort Worth ARTCC (ZFW). Due to several changes in FAA policies regarding research activities at field facility TMUs, the COMETTS Team had to enlist the help of several recently retired ZFW TMCs, and the Shadow Evaluations were successfully conducted in our Leesburg office.

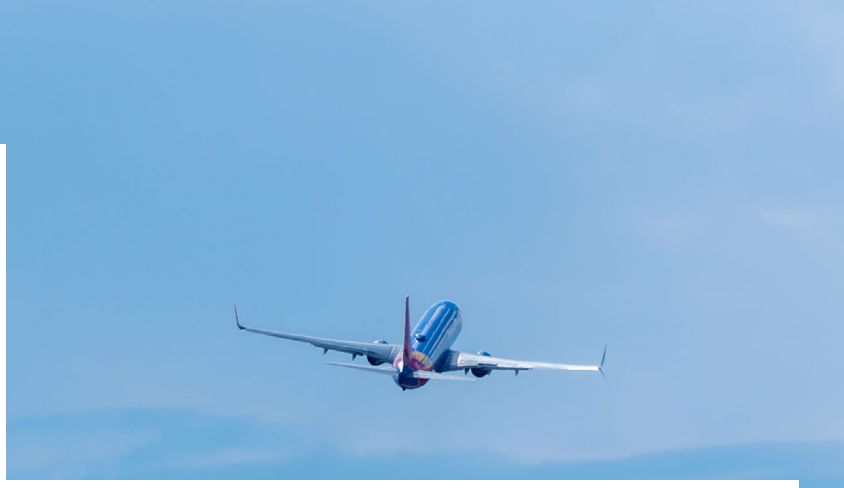
TMC Training Shortfalls

My first assignment after joining the Mosaic team in January 2016, was to write a TMC Training Shortfalls white paper for this project. That list of shortfalls has now grown to over 20 items, but a few of the most important TMC training deficiencies that the COMETTS simulator is designed to resolve include:

1. TMC training is conducted on Computer Based Instruction (CBI) PCs. Air traffic controllers receive extensive radar (R-side) and radar associate (D-side) training in a simulated ATC environment called the Technical Training Lab (TTL), however, no such capability exists for training TMCs. TMC training is conducted on PCs in the CBI lab, not on TMU workstations. These nationally adapted "one-size-fits-all" training courses use non-local examples that contain fixes, airports, routes, sectors, and traffic flows that may be unfamiliar to the TMC.
2. New TFM program features, parameters and options cannot be explored in the CBI. Without the availability of a realistic TFM traffic simulator, the TMC may not acquire a full understanding of the TMI parameter selections and expected outcomes. Their first opportunity to exercise any of these software enhancements occurs while working live traffic on position in TMU. Unfortunately, since live operations cannot tolerate deviations from accepted practices, there is a disincentive to experiment and test new concepts and procedures, plus there is often very little time afforded to perform an evaluation of possible outcomes.
3. TMC on-the-job (OJT) training is often accomplished during the "Off Season". New-hire TMCs are reassigned to TMU throughout various times of the year, usually after the summer vacation and severe weather season is over. As a result, TMC OJT training and certifications are conducted during the off-season, with little opportunity to receive effective training on these season-specific TMU procedures, particularly severe weather operations.
4. There is no national TFM platform available to conduct large scale training exercises between field facility TMUs, the ATCSCC, and/or NAS operators. When new NextGen TFM systems are deployed

in the NAS, there is little ability to conduct comprehensive large-scale training involving multiple TMU positions and/or stakeholders (i.e., airline dispatchers, National Business Aircraft Association (NBAA), and military users), due to the lack of a training platform robust enough to support such an undertaking.

5. The PERTI connection. Several years ago, the FAA introduced a new continuous improvement strategy called the Plan, Execute, Review, Train and Improve (PERTI) initiative. PERTI's vision statement is "Making the best aviation system in the world even better by providing integrated air traffic management (ATM) solutions to complex challenges". PERTI would benefit by leveraging COMETTS' ability to create realistic simulations and to provide quality playback for review and training scenarios.



COMETTS Capabilities

To combat these shortfalls, COMETTS is designed to address training on all of the TFM systems that currently exist in the NAS, including TFMS, TBFM, NTML, En Route Automation Modernization (ERAM), Voice Switching and Control System (VSCS), plus the Corridor Integrated Weather System (CIWS), Integrated Terminal Weather System (ITWS), Weather and Radar Processor (WARP), and other weather displays. In addition, the COMETTS workstations are designed to be able to accept future technologies as the training needs for those new systems evolve.

COMETTS workstation capabilities include:

- Thin-Client Display/Workstation – COMETTS displays can operate on existing administrative computer hardware or on purpose-built computer workstations that are configurable, lightweight computers that require only a browser and connection to the internet (or other appropriate network) to be able to join a COMETTS training simulation.
- Cloud Deployment Architecture – COMETTS will leverage cloud computing technology to provide controller training simulations at all ATC facilities from a centralized location.
- TFM Systems and Displays – COMETTS provides full integration with the TFMS FSM system, an emulation of the TFMS TSD and of TBFM.
- Modular Design – COMETTS is designed to be integrated with additional systems, such as NTML, ERAM, VSCS, plus all other required information and weather resources needed to run realistic simulations.
- Multiple Input Capabilities – COMETTS provides the ability to input various parameters and interact with the simulation through various player controls, including fast-forward, pause, stop, and jump-back.
- Local Adaptation – COMETTS simulation training will integrate locally maintained databases and scenarios, tailored to local operations.

The COMETTS system has been designed to be easily expanded to support additional training requirements. The system already includes significant capabilities to emulate and provide training support for the following NAS systems and associated operational requirements:

- Flight Schedule Monitor (FSM)
- Traffic Flow Management System (TFMS) and the Traffic Situation Display (TSD)
- Time Based Flow Management (TBFM)N
- National Traffic Management Log (NTML)
- Various Weather Information Display Systems

Further, COMETTS uses an Incoming Message Board to represent the operational activities, decision, and behaviors of flight operators, airports, and other Air Traffic Control (ATC) facilities or positions that are not staffed by a trainee in the COMETTS simulation. This approach allows the COMETTS simulation to realistically represent the critical interactions and feedback to operational decisions that the trainee makes during a training exercise.

The COMETTS UI Dashboard, including the Playback Control, Intelligent Tutoring Metrics display, and Incoming Message Board is depicted in Figure 1 below.

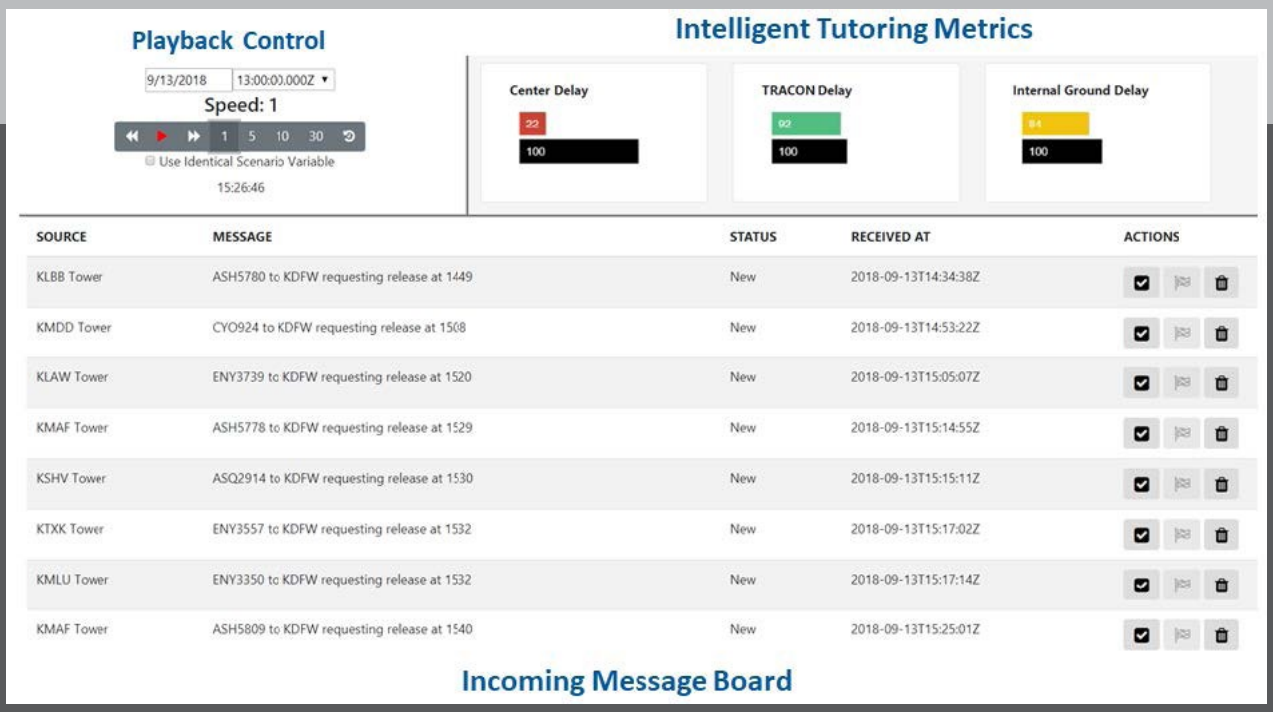


Figure 1. COMETTS UI Dashboard

COMETTS Training Approach

During COMETTS simulation exercises, TMC trainees are provided with as many of the systems, displays, and other information sources that are available in the real operation as possible. These systems, displays, and other information sources are referred to as the Training System Environment (TSE). The TSE provides consistent information that is synchronized with respect to time and to the events that occur in the traffic scenario. The COMETTS simulation environment has the ability to control the time of the simulation via the 'fast-forward' and 'jump-back' features that allow for more efficient use of training time, as well as the ability to repeat sections of a scenario. If trainees do not like the results of a certain set of parameters they have entered, they can jump-back, enter a different set of parameters, then fast-forward to observe the new results.

The COMETTS approach of using a simulation engine allows the storage of a wide variety of seasonal scenarios throughout the NAS, that can be locally adapted according to each facility's adaptation, constraints, procedures, and restrictions that are appropriate for each local scenario. Thus, a winter snowstorm scenario, with runway closures and de-icing, can be trained in July, and complex thunderstorm scenarios can be trained in January.

COMETTS training scenarios, which can be recorded, will be available with varying degrees of complexity, according to the trainee's progression in the training plan. Scenarios will include practice problems (no instructor), OJT (with an instructor), progress checks/evaluations, and certification (if necessary in the off-season). The instructor will also have the ability to manipulate the scenario by entering additional message sets that can instantly change the complexity or introduce different training elements into the training session. COMETTS will also have the ability provide a training session "score", based on various grading criteria, such as delay minutes, number of reroutes, airborne holding, etc.

Another unique COMETTS feature is the ability to send web browser training invites to other positions or facilities, expanding the training experience to multiple participants. These sessions could range from running small, local training scenarios between TMCs at a center and a TRACON, to running large-scale Command Center tabletop exercises involving multiple facilities and NAS operators.

Finally, the COMETTS training system is designed to be able to accept future technologies as the training needs for those new NextGen systems evolve.

COMETTS Moving Forward

Since 2019, Mosaic has been promoting the use of COMETTS training simulators in numerous NASA/FAA projects, and has provided several demonstrations to the Air Traffic Control System Command Center (ATCSCC) Training Department. Mosaic has recently been in contact with the Civil Aerospace Medical Institute (CAMI) Human Factors Division at the FAA Training Academy in Oklahoma City. Currently, we awaiting a Request for Proposal (RFP) in support of CAMI's Air Traffic Control Tasks – Traffic Management Simulation Statement of Work (SOW) and are hopeful that through this contract that COMETTS simulators will become the new standard for TMC training in the NAS.

Mosaic COMETTS Contributors: Chris Brinton, Curt Kaler, Steve Atkins, Shane Axtell, Mike Garland, Dave Brinton, Jeremy Lindsey, Matt Brinton, Michelle Eshow, Jeff Zhao, John Sahl, Steve Vail. Those are the names that appear in all of the reports, but I know there were additional contributors to this project – thanks to all.