Airspace Technology Demonstration 2 (ATD-2)

Integrated Surface and Airspace Simulation – Experiment Plan

Joint Workshop for NASA-DLR Research Collaboration
NASA Ames Research Center
August 22 - 24, 2017

Airspace Technology Demonstration 2 (ATD-2)

Integrated Surface and Airspace Simulation (ISAS)

March 7th- 9th

- Objectives of the HITL
- ATD-2 capabilities tested in the HITL
- Tools used in the HITL
- What to expect during testing?
- Participants
- Roles and responsibilities
- Schedule

- Evaluate operational procedures and information requirements for the following:
  - Tactical Surface Metering Tool
    - Evaluate the level of gate holds and its impact on runway queue
    - Evaluate the impact of EOBT accuracy level on the advisories
  - APREQ/CFR procedures between ATC Tower and Center
  - Data exchange elements between Ramp and ATC Tower
- Obtain feedback for Phase 1 Freeze decisions
  - Software
  - Procedures
  - Training

APREQ = Approval Request
CFR = Call for Release
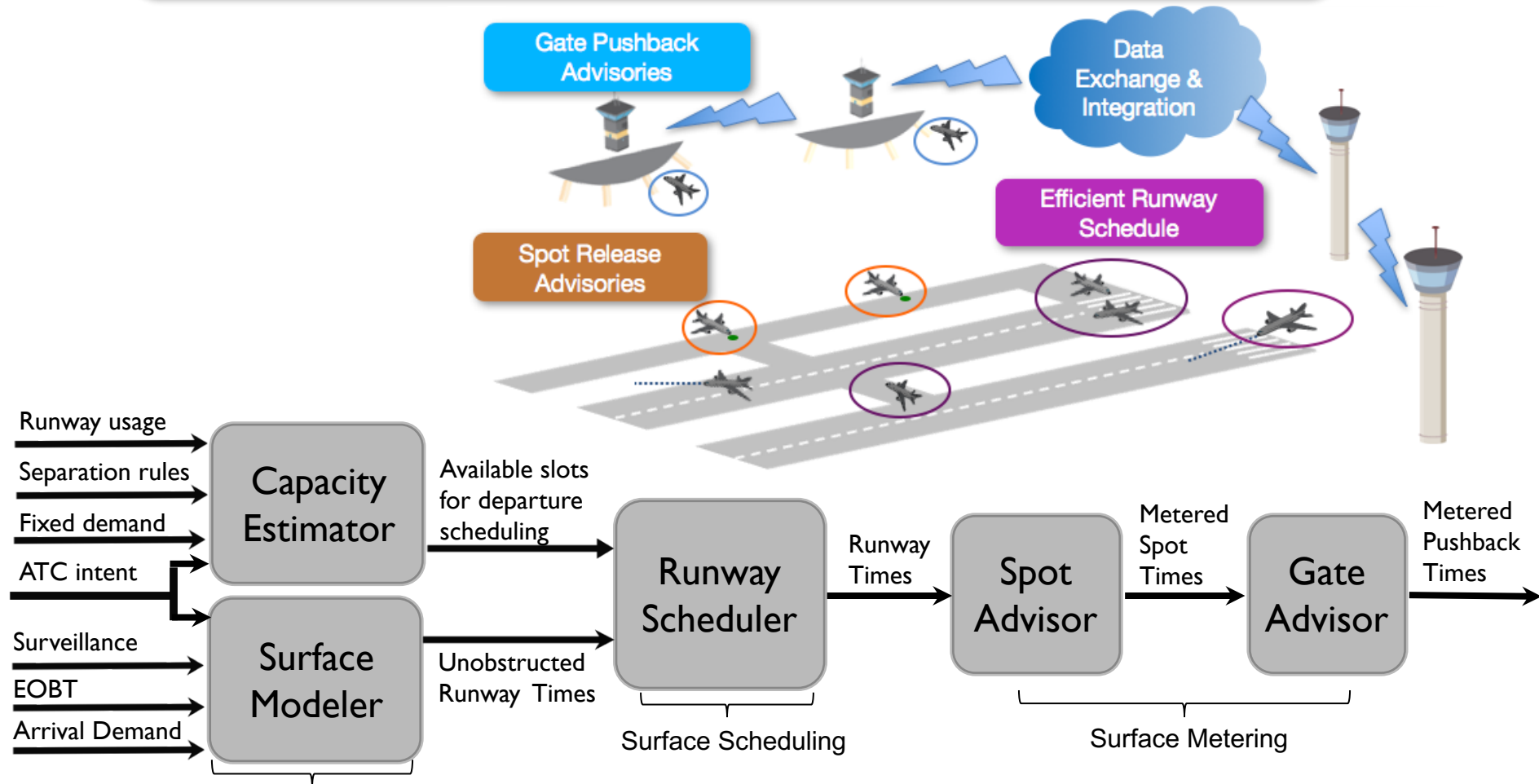EOBT = Earliest Off-block Time

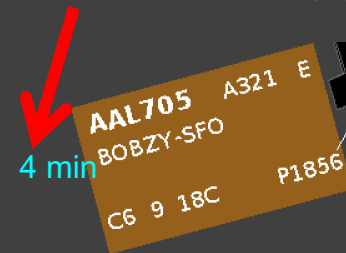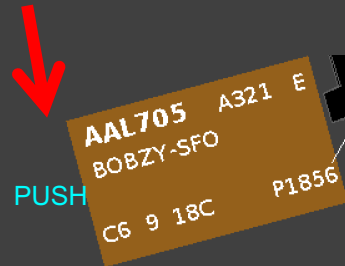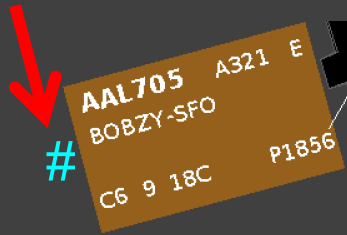# ATD-2 capabilities tested in the HITL

Surface Metering Concept

- Estimates capacity of current and future runway resources
- Builds an efficient runway schedule based on readiness, EOBT and RBS
- Calculates spot advisories that support the metered runway schedule
- Provides push back advisories from gates that support the spot advisories

Gate Pushback Advisories

Data Exchange & Integration

Efficient Runway Schedule

Spot Release Advisories

Runway usage
Separation rules
Fixed demand
ATC intent

Capacity Estimator

Available slots for departure scheduling

Surveillance
EOBT
Arrival Demand

Surface Modeler

Unobstructed Runway Times

Runway Scheduler

Runway Times

Spot Advisor

Metered Spot Times

Gate Advisor

Metered Pushback Times

Surface Scheduling

Surface Metering

Trajectory prediction and constraint modeling

RBS = Ration By Schedule

APREQ/CFR Process

- Based on legacy PDRC currently deployed at DFW ATC tower
  - Improves the insertion of the flight into the overhead stream
  - Automates the process of getting a flow time (i.e., wheels-up time) from the Center that was traditionally handled via phone calls
- Provides Surface trajectory based OFF times to TBFM scheduler
- Integrates IDAC/IDST into the STBO (Surface Trajectory Based Operations)
- Shows the slots on STBO Timeline and allows automated APREQs

PDRC = Precision Departure Release Capability
TBFM = Time Based Flow Management
IDAC = Integrated Departure and Arrival Capability
IDST = Integrated Departure Scheduling Tool
DFW = Dallas/Ft. Worth International Airport

STBO Client Timeline

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Data Exchange
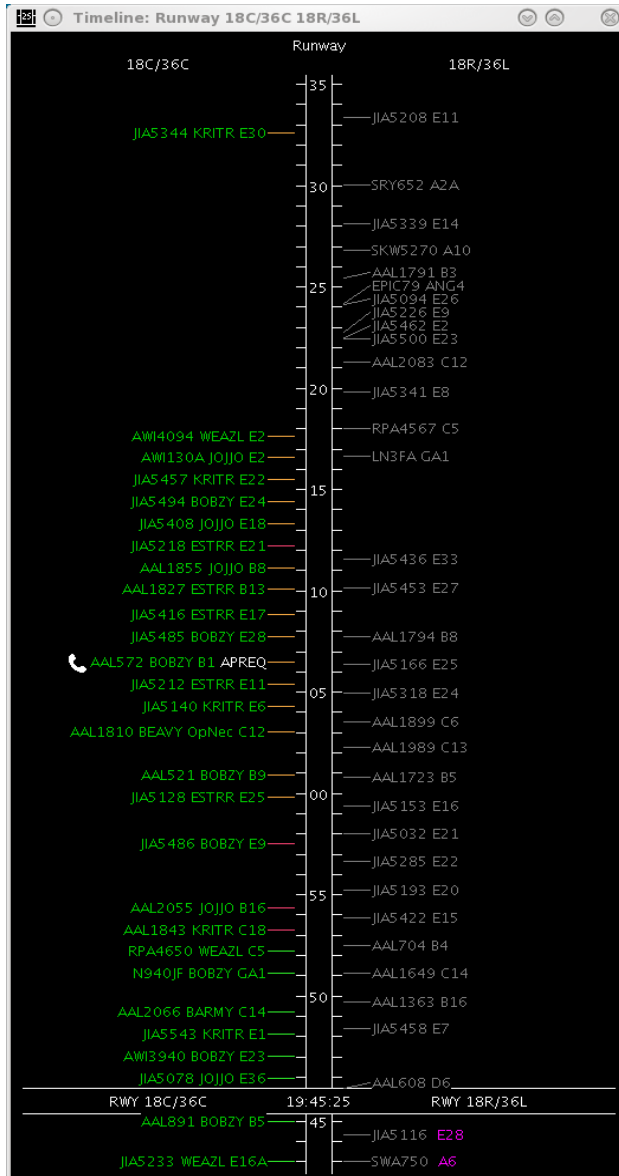
- Surface Metering - Time Based Metering
- Pushback and Surveillance information
- APREQ/ CFR
- MIT flights
- EDCT flights
- Gate Conflicts
- Runway utilization intent
- Runway assignments – operational necessity only
- Long on board (LOB) common awareness
- Runway closures

EDCT = Expected Departure Clearance Time
MIT = Miles in Trail

Tools used in the HITL

Tools & Equipment

- ATC Tower
  - Mini Tower showing CLT ATC tower out-the-window view (270 degree view) using 8 monitors
  - STBO Client: Surface Trajectory Based Operations
  - Emulation of ASDE-X display (STBO map)
  - Flight Strips
- AAL Ramp
  - 360 degree Simulator at FutureFlight Central (FFC)
  - Tactical Surface Scheduler (Ramp Tool)
  - Ramp Traffic Console (RTC) & Ramp Manager Traffic Console (RMTC)
- CLT TRACON
  - Emulation of STARS displays
  - Operational TBFM (ZTL arrival metering)
  - Remote view of STBO
- Washington Center (ZDC)
  - TBFM (ZDC Departure scheduling)
  - Remote view of STBO Client
  - Emulation of Traffic Situational Display (TSD)

AAL CLT Ramp Tower - FFC

ZDC TMCs with TSD, TBFM and STBO
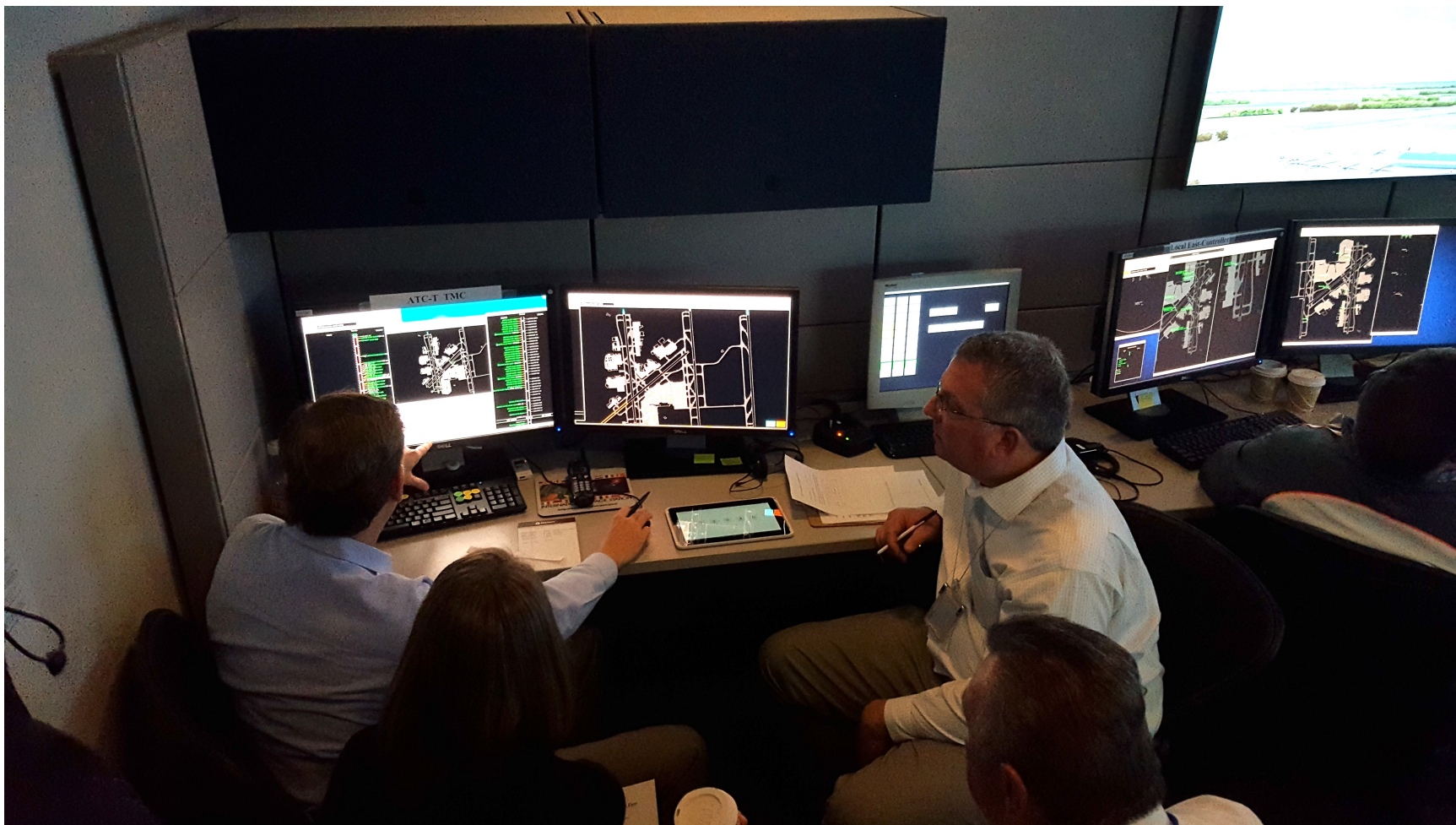
TSD = Traffic Situation Display

CLT TRACON TMC interacting with TBFM and STBO

ATG = Airspace Traffic Generator

- STBO Client : Surface Trajectory Based Operations (ATC Tower Tool)

- RTC: Ramp Traffic Console (Ramp Tool)

- RMTC: Ramp Manager Traffic Console (Ramp Tool)

- TBFM – Trajectory Based Flow Management (ZDC & TRACON Tool)

- MACS- Multi Aircraft Control System (TRACON & En route Tool)

- ATG: Airspace Traffic Generator (Tower Pseudo Pilot Tool)
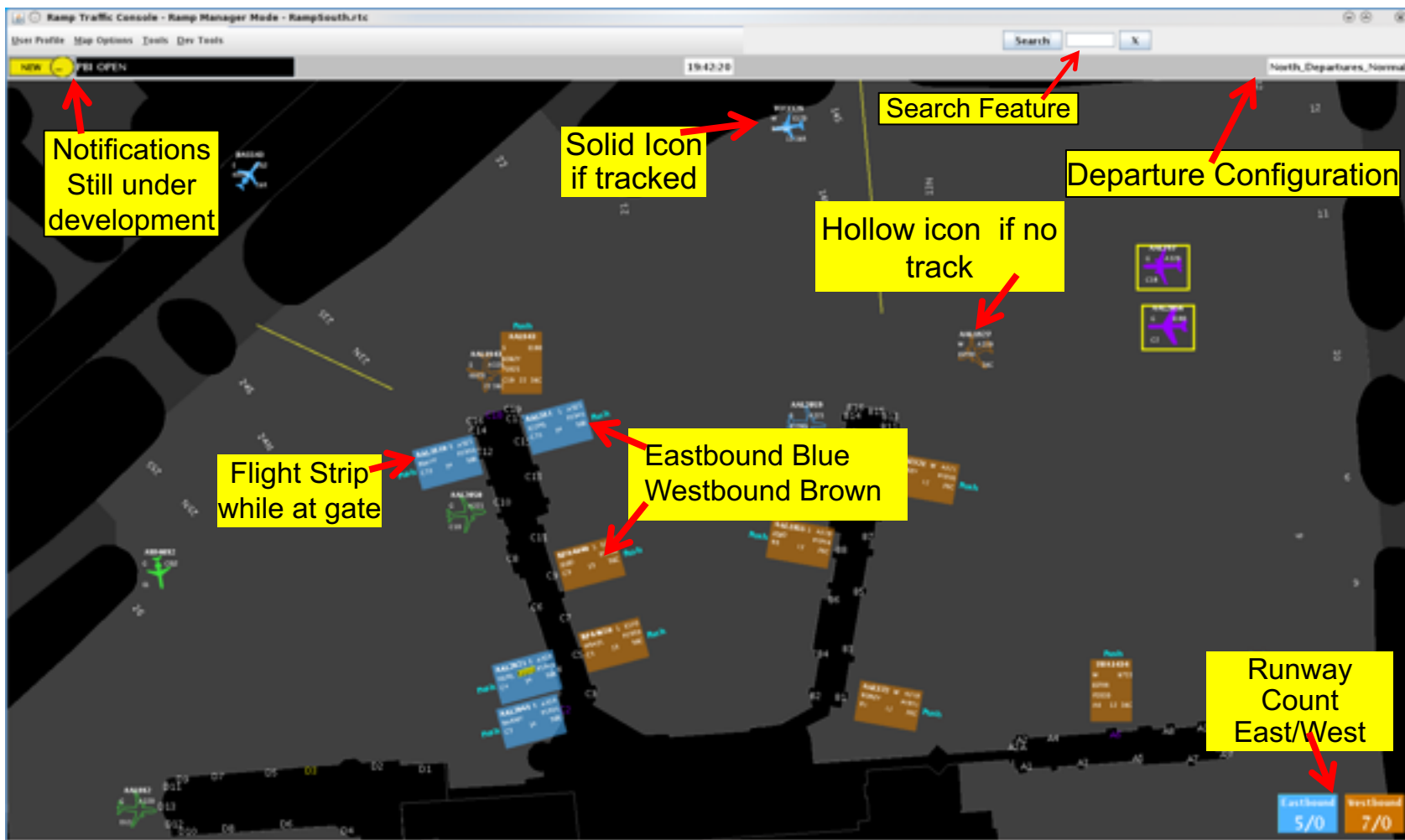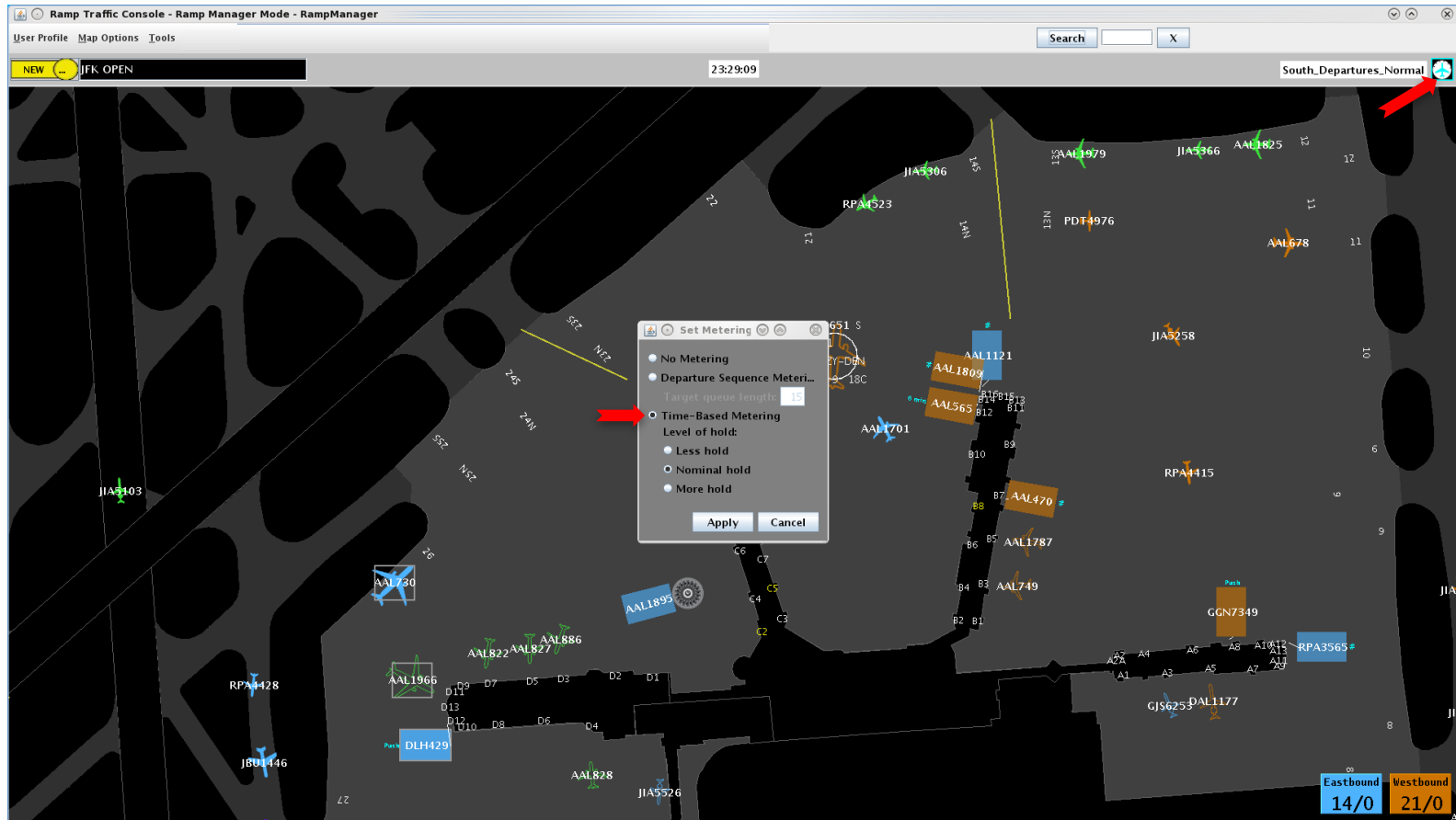
Surface Trajectory Based Operations (STBO) Client

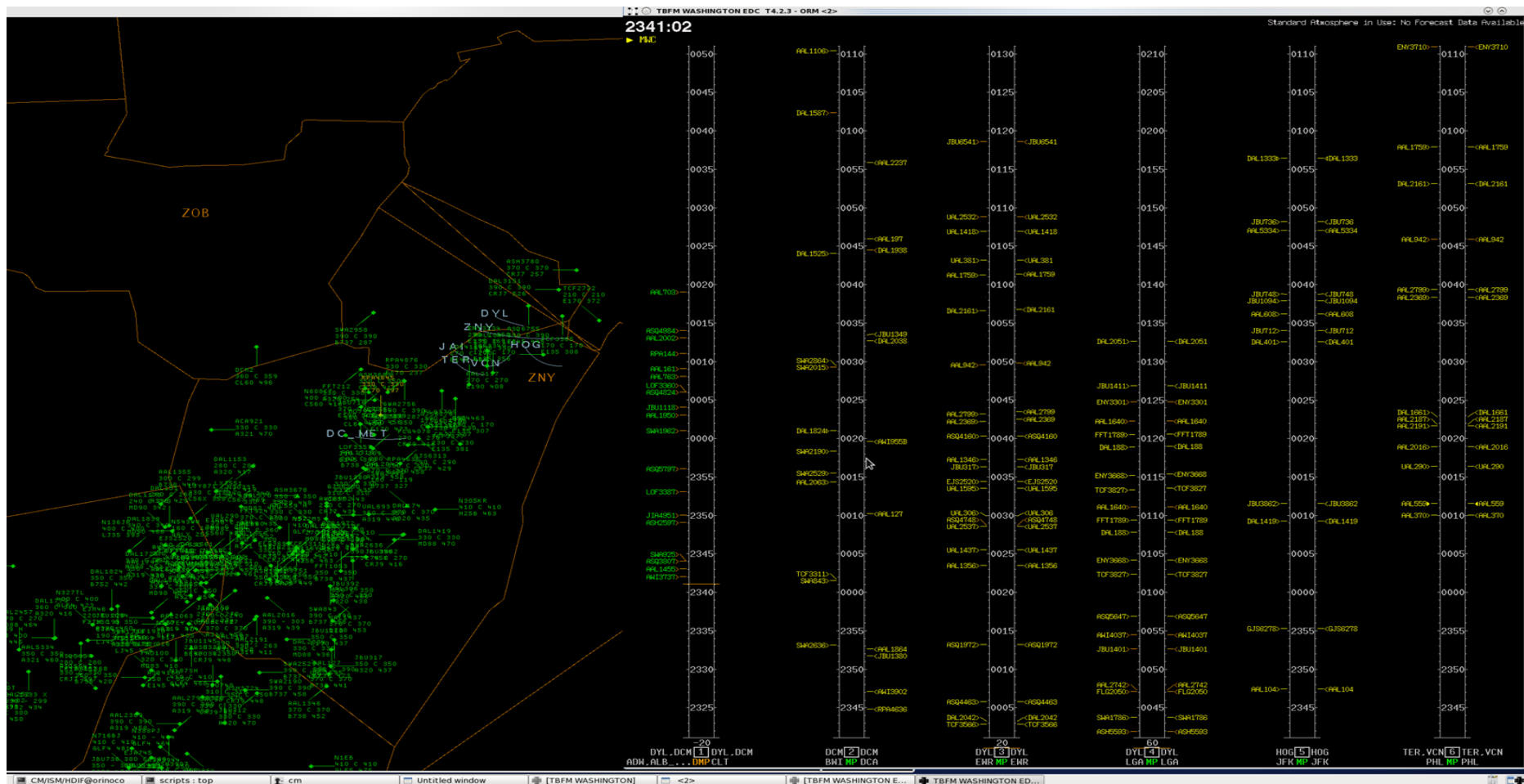# Ramp Traffic Console (RTC)

ZDC TBFM TGUI and PGUI
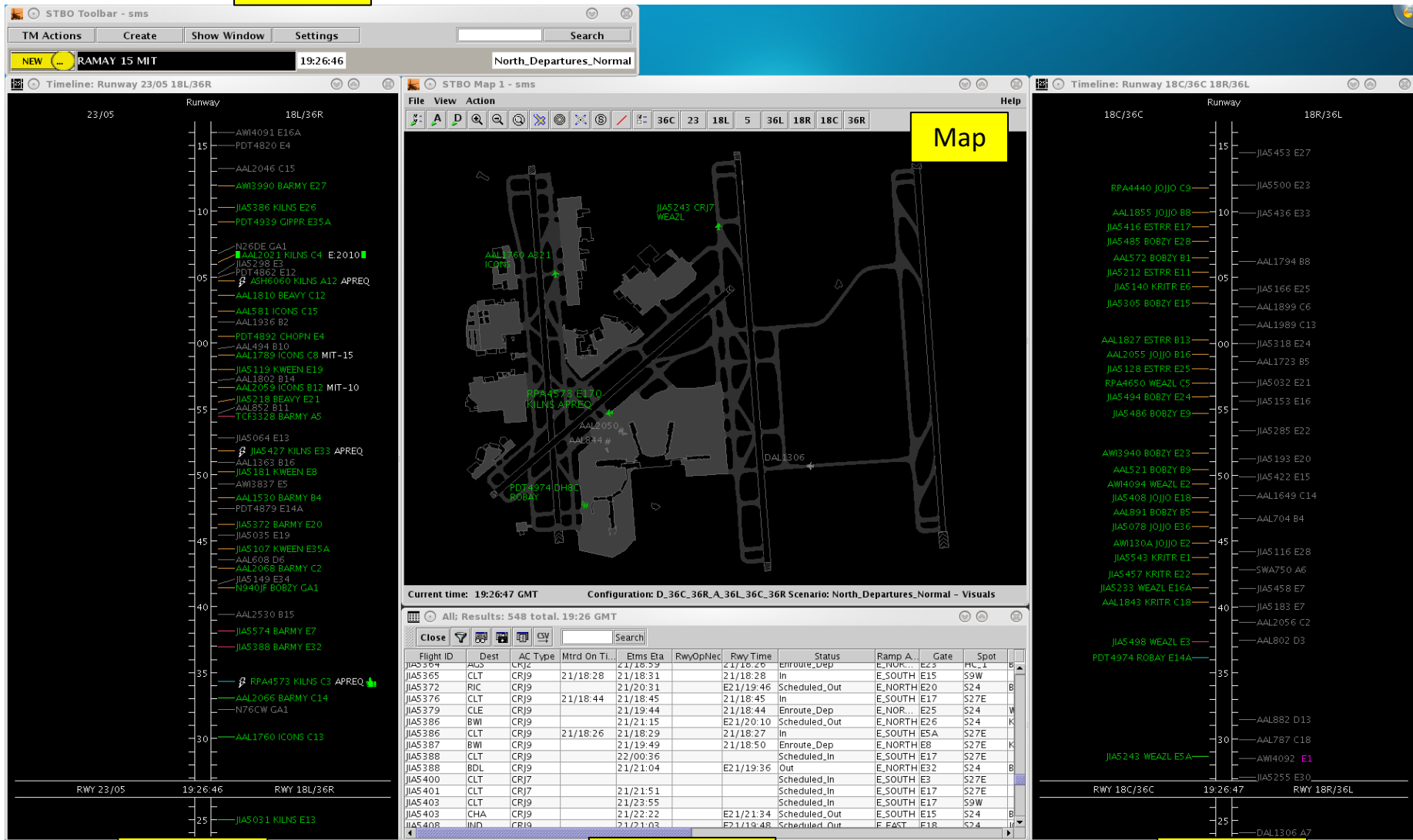
What to expect during testing?

What to expect?

- Time Based Metering
  - Amount of delay propagated to surface (AMA and Ramp area) vs. Gate
    - Different levels of gate hold (i.e., nominal/less/more hold)
  - Earliest Off-block Times (EOBTs)
    - Perfect EOBTs for all carriers
    - Phase1 EOBT: Higher accuracy for AAL and regionals, and current day accuracy for non-AAL flights
- Runway Configurations
  - North flow
  - South flow
- Various Data Exchange Exercised
  - APREQs, EDCTs, MITs
  - Runway Utilization (arrivals and departures)
  - Runway Assignments
  - Gate Conflicts

AMA = Airport Movement Area

South Dual Converging Operations
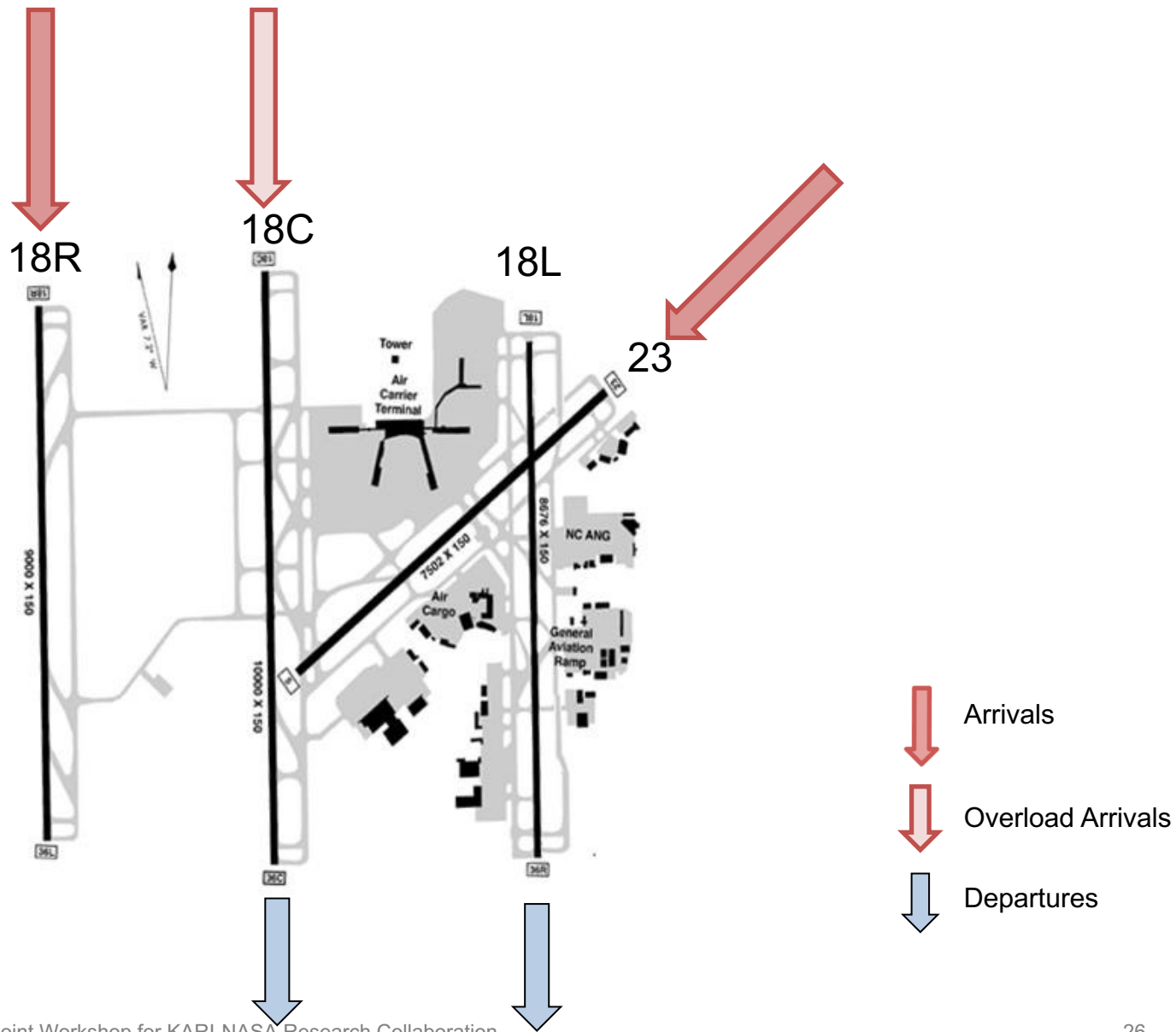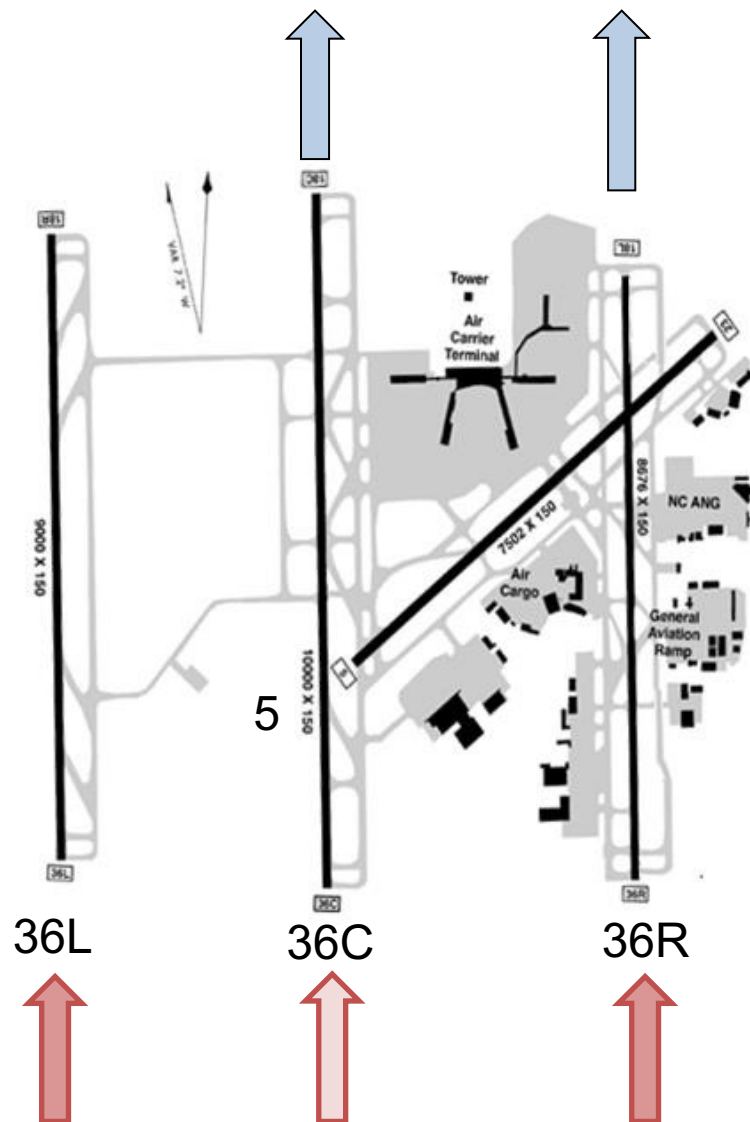
Arrivals

Overload Arrivals

Departures

36L   36C   36R

Arrivals

Overload Arrivals

Departures

Actual IN and Actual OUT Events
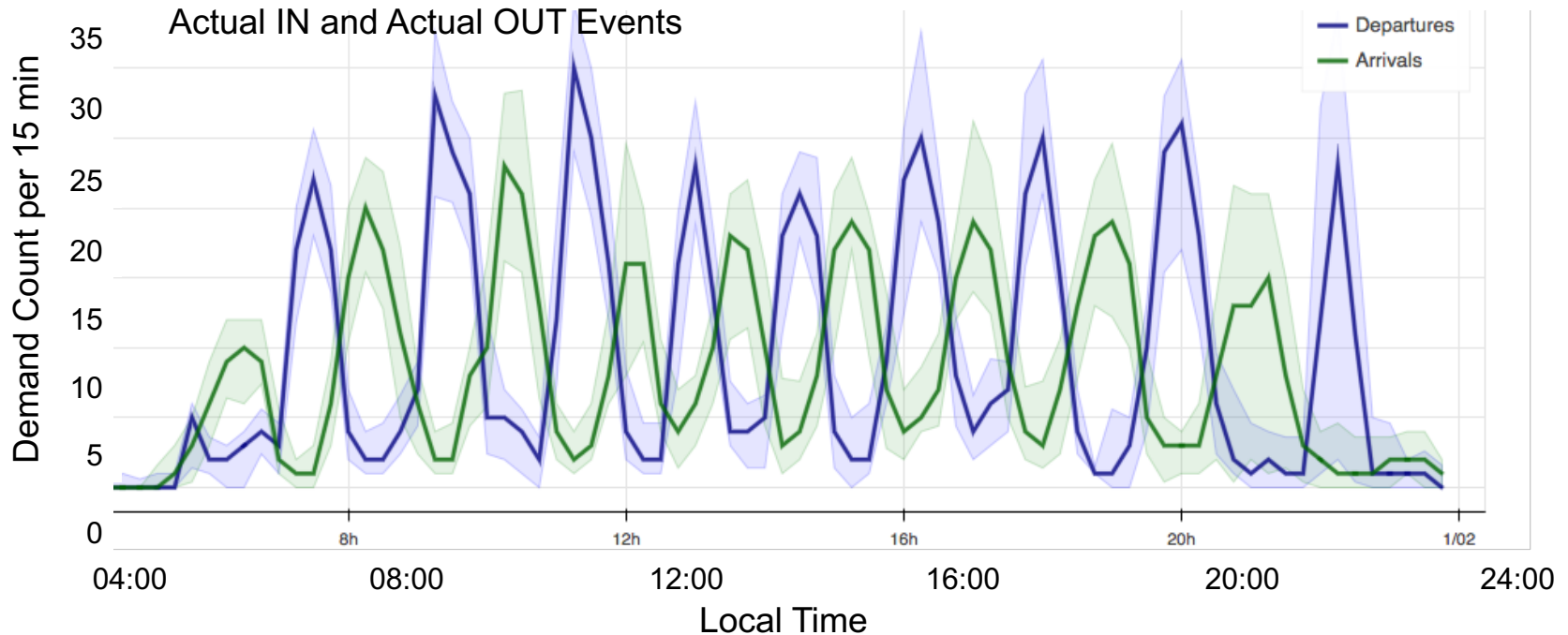
- **CLT has highly dynamic departure and arrival demand**

- **Other airports in NAS have similarly dynamic demand profiles**

- **Need for metering at such airports can be intermittent and must be informed by both departure and *arrival* demand predictions**

Scenarios – Bank Analysis
Actual On and OUT
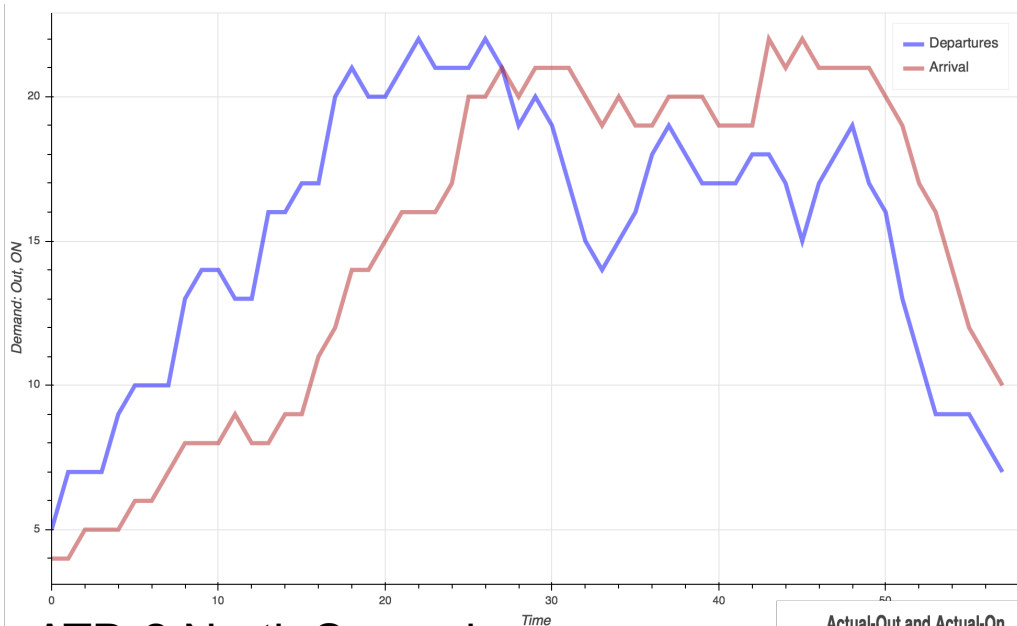
ATD-2 North Scenario

CLT Bank-6 data

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Traffic Scenarios in CLT
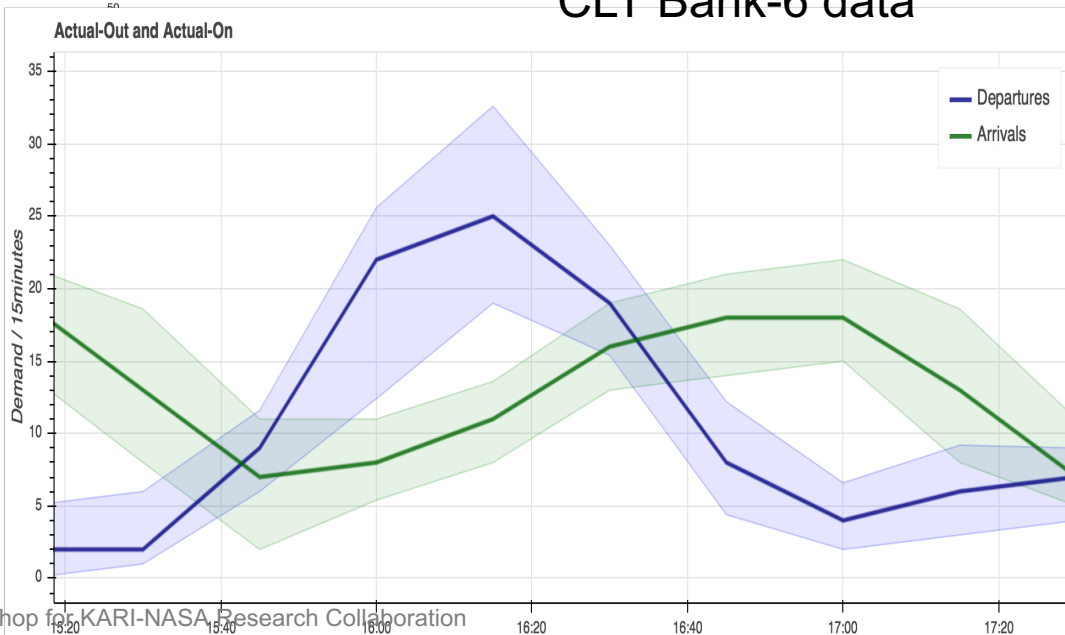
- South Dual Converging Operation (92 arr & 80 dep per hour)
- Triple North Operation (75 arr & 65 dep per hour)
- No wind, clear visibility, but IFR rules in effect (can't fly visual in this sim)
- No GA, No Cargo flights
- Duration 65 - 70 min
- Banks: matching heavy banks (2nd and 6th)
  - 47-48 arrivals on RWY 36L/18R
  - 31-30 arrivals on RWY 36R/23
  - 36-25 departures on RWY 36C/18C
  - 33-38 departures on RWY 36R/18L
- TMIs:
  - ZDC requesting CLT APREQ departures to DCA, EWR, LGA, JFK and PHL
  - ZDC requesting CLT 15 MIT on BARMY and KILNS excluding APREQs
  - EDCTs

Traffic Scenario in ZDC

- En route traffic to DC metro and NY metro.

- Departures from CLT, GSO, RDU, RIC, DCA, IAD, BWI

- TMIs
  - ZDC requesting CLT APREQ departures to DCA, EWR, LGA, JFK and PHL
  - ZDC requesting CLT 15 MIT on BARMY and KILNS excluding APREQs

- BWI, CLT, DCA, IAD, RIC, RDU will send electronic APREQ requests

Airspace

- Washington Center schedules flights bound to NY and DC to the meter points at the boundary of the Potomac and N90 TRACONs
- The schedules include flows coming from Atlanta, Jacksonville and all the CFR departures they control.

Simulation Artifacts

Handoff Boundary compared with CLT traffic
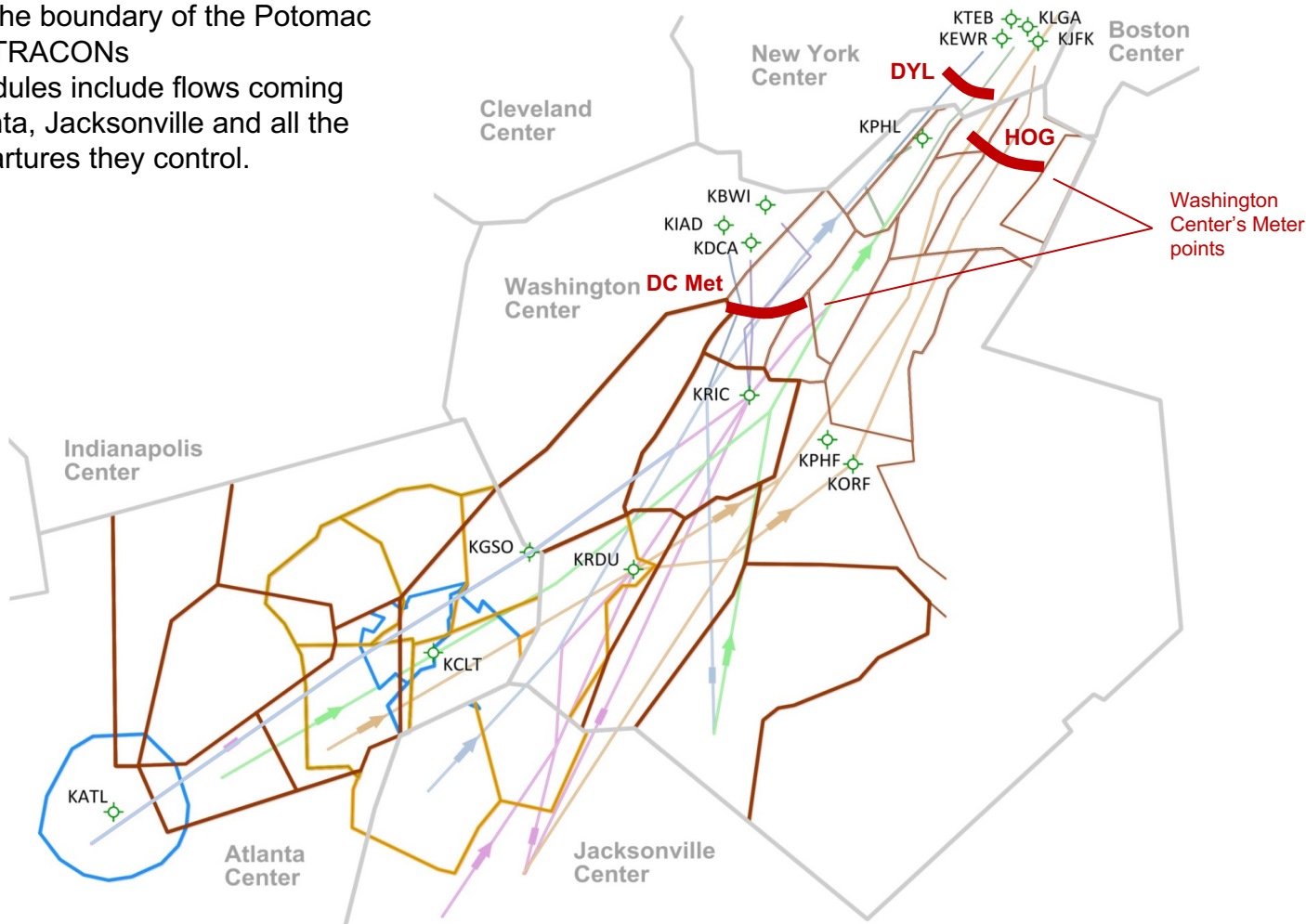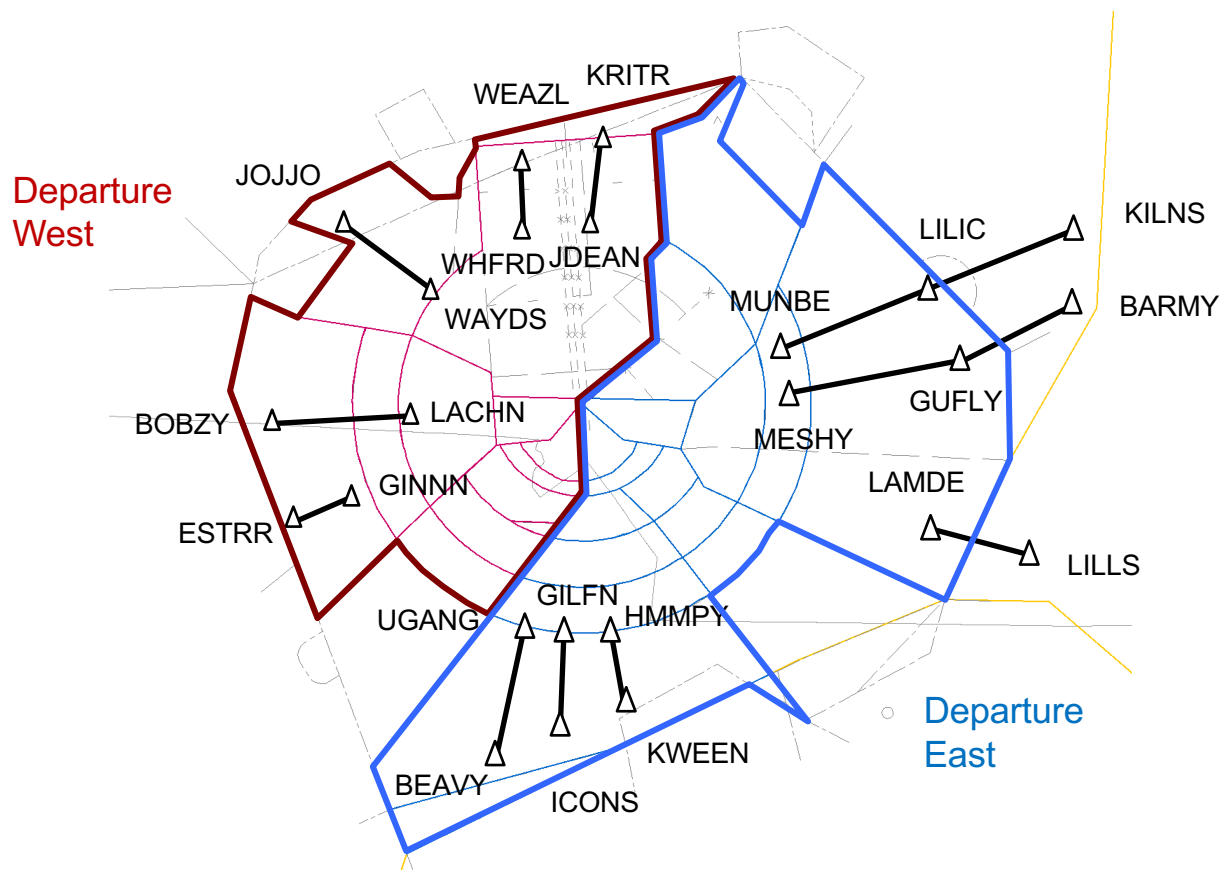
- Approaches in burgundy
- Arrivals in blue
- Departures in red
- MACS ATG handoff boundary

7nm away from the RWY threshold

2nm away from the RWY threshold
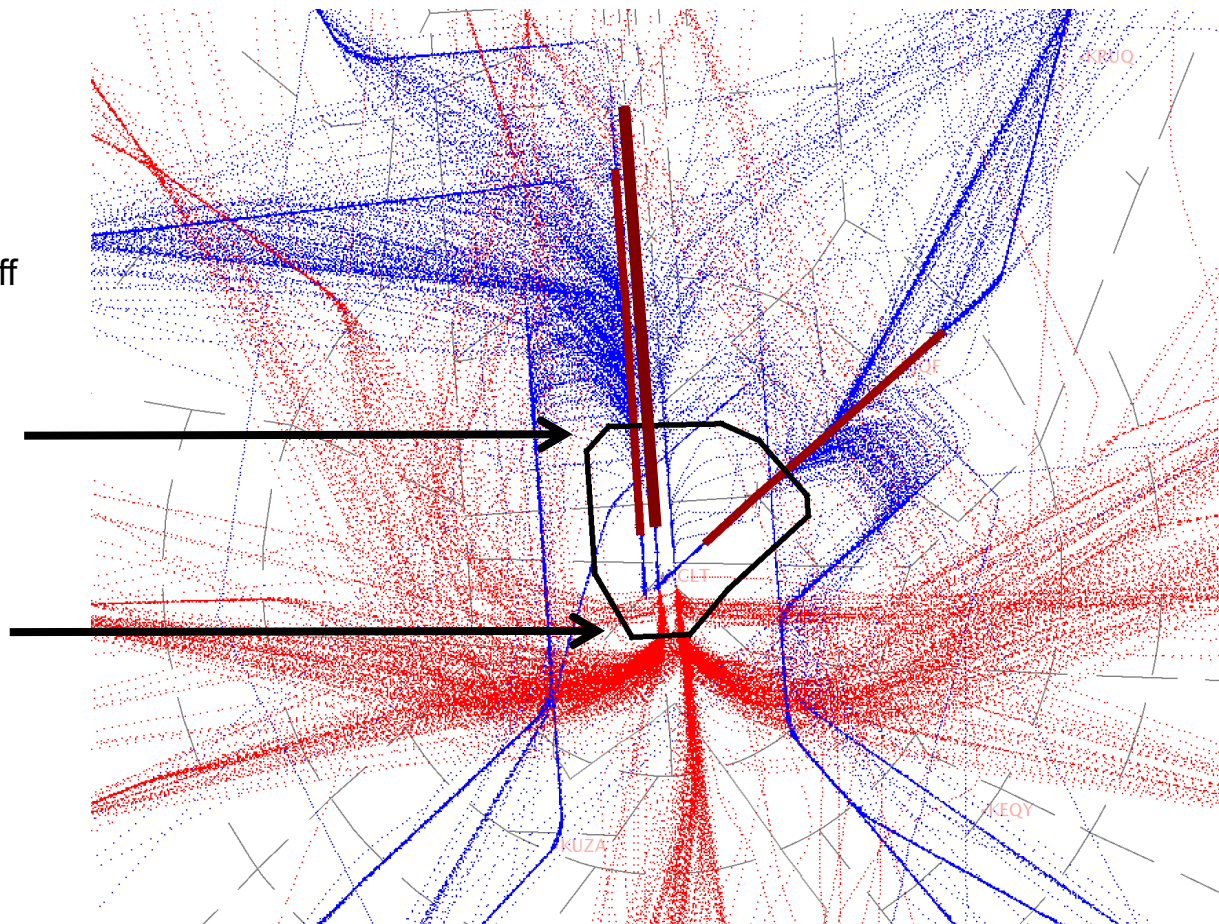
Operational constraints:
Arrivals will be established on the approach before transferring to Tower (ATG).
Departures will be on a RWY heading until they are transferred to TRACON (MACS). We are not using divergent heading).

Participants/Positions

Participants

- 2 Local and 2 Ground Controllers
- 1 Tower TMC
- 2 AAL Ramp Controllers
- 2 Retired Controllers
- 1 Ramp Manager
- 1 Clearance Delivery – confederate
- 1 TRACON TMC
- 1 ZDC TMC
- 1 ZTL TMC as observer
- 2 Ghost En route Controllers
- 1 ZDC other Towers - confederate
- 4 Arrival controllers
- 2 Departure controllers
- 18 pseudo pilots

Note: Positions in the Ramp, ATC Tower and TRACON will rotate.

- Manage traffic as usual
- Provide an accurate assessment of workload during the simulation runs
- Fill in Post Run surveys online
- Fill in Post Study surveys
- Will rotate positions in the Ramp, ATC Tower and TRACON

Roles and Responsibilities

Roles & Responsibilities

- ATC Tower TMC
  - Enter the APREQs and MITs into STBO Client
  - Evaluate nominal and reschedule process for APREQ flights
  - Evaluate the RWY Off-times predictions and APREQ compliance
  - Evaluate that the information presented on STBO Client is adequate to handle ramp operations
  - Evaluate the data exchange items for procedures and information such as runway utilization, metering modes, and others
  - Evaluate how the gate holds are impacting operations in the AMA
- ATC Tower GC/LC
  - Manage traffic as usual
  - Ensure that flights with TMIs meet their scheduled wheels-up time with the compliance windows (-2/+1 min for APREQ and +5/-5 min for EDCT)
  - Evaluate how difficult or easy it was to comply to the wheels-up times
  - Evaluate how the gate holds are impacting operations in the AMA

Roles & Responsibilities

- Ramp Controllers / Ramp Manager
  - Adhere to the metering advisories as much as possible
  - Evaluate the advisories on TMI and non-TMI flights
  - Ensure flights with APREQ have a flow time before they are sent to the spot
  - Evaluate the level of gate holds and how they impact ramp operations
  - Evaluate that information presented on RTC/RMTC is adequate
  - Evaluate the data exchange items for procedures and information such as runway utilization, metering modes, and more
  - Ramp Manager - assess and point out times when metering should be turned on or off

Roles and Responsibilities

- CLT TRACON
  - Controllers to provide vectors to arrivals and departures, as well as required minimal separation as usual
  - Pre-arranged coordination between departures and arrivals.
    - Departures controllers are responsible to separate departures from arrivals
    - Arrival controllers must point out arrivals to departures. This is indicated in the SOP
  - Two final sectors
    - Final West controls East and Center RWY
    - Final East controls the East and crossing RWY
  - Feeder sectors enter scratchpad entries for RWY assignments.
    - East arrivals are assigned to East RWY
    - West arrivals are assigned to West RWY

South	North
18L =L	36L = NL
18C = C	36C = NC
23 = X	36R = NR

- TRACON TMC
  - Use both TBFM arrival metering TGUI and STBO as information input on traffic flow
  - Determine the use of Center RWY (18C/36C)
    - TRACON TMC decides which arrivals go to the Center RWY.
  - Determine in-trail spacing for En-route feed to the TRACON airspace, as needed
  - MIT and APREQ from CLT
    - STBO displays which departures have an APREQ and which have an MIT
    - Departure controllers will also know which destination the flights are flying via the datablock

Roles and Responsibilities

- TRACON TMC
  - Evaluate STBO demand prediction for RWY utilization
  - Evaluate RWY Off-times and APREQ compliance

- Time permitting
  - Evaluate that information presented on STBO Client is adequate to handle ramp operations
  - Evaluate the data exchange items for procedures and information such as runway utilization, metering modes, and more
  - Evaluate how the gate holds are impacting operations in the AMA

- ZDC Center TMC
  - Schedule all departures to ZDC's Meter Points on the phone or electronically
  - TBFM EDC is used to schedule <u>all</u> stream classes going to NY and DC metro, including EWR and PHL (will be handled by CFR)
  - Center TMC will have STBO for situational awareness about CLT
  - Evaluate the APREQ nominal and reschedule process with IDAC
  - Evaluate usefulness of information presented on STBO Client for TMC operations

Data Collection

- Data source:
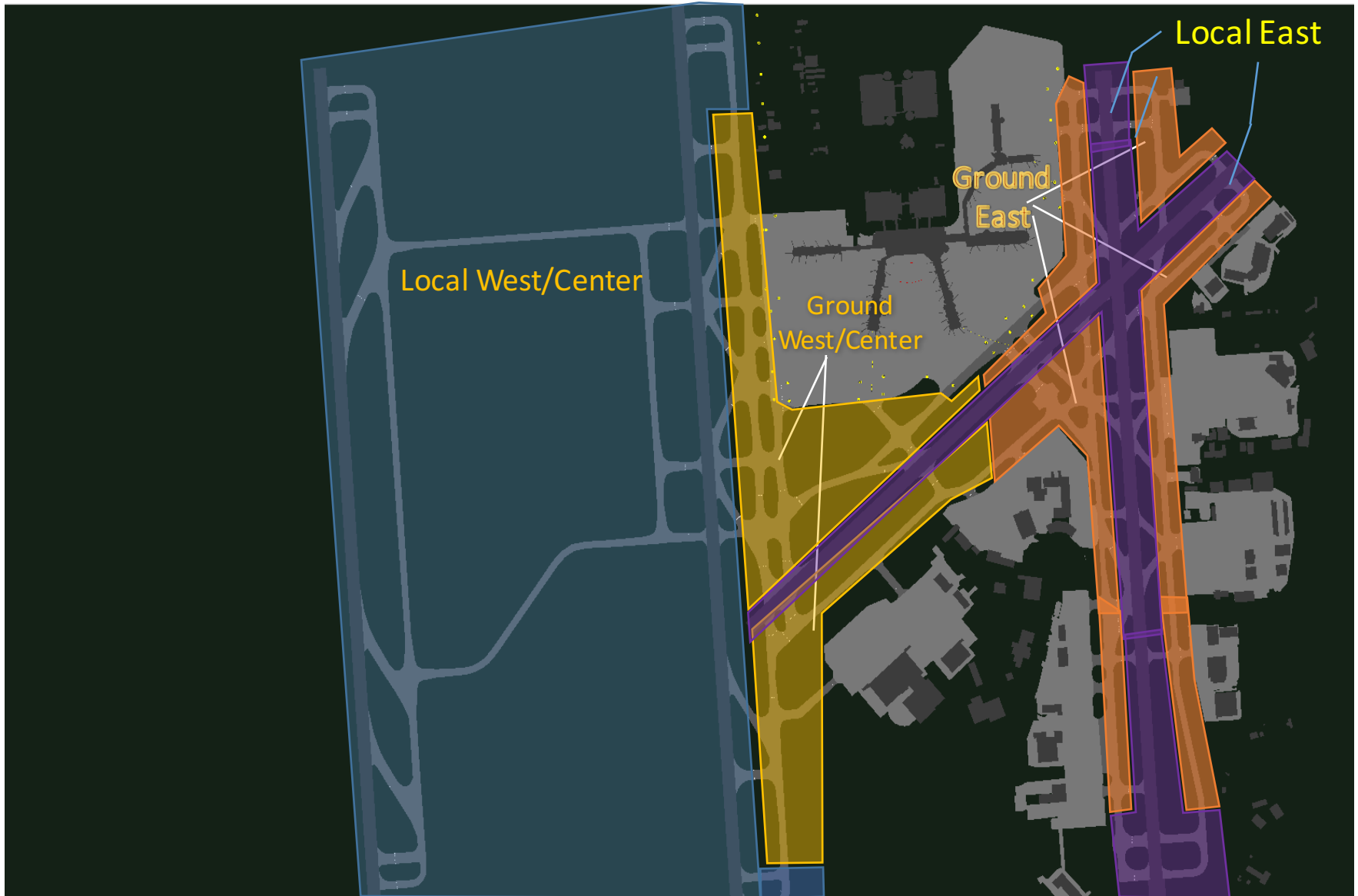
    - SDSS and ATG data logs

    - Audio and video recording of each station

    - Workload (prompts every 5 min during the scenario)

    - Post-run and Post-Simulation surveys

- Metrics (Not exhaustive list):

    - Both real time and post analysis

    - Queue size, Gate holds, Taxi Times, compliance to TMI, Throughput, Efficiency and predictability metrics

    - Subjective assessments of: Workload, Situation Awareness, usability, acceptability

Schedule

Time	Run No.	Condition/Description	Scenario
0830	Rm 100	**Welcome/Briefing**	
0920		**Break**	
0930	Rm 100 FFC AOL	**Classroom training**	
1020	Rm 100	**Data Exchange & Integration**	
1050		Break	
1100	TR1	**Training Run – No metering/ Time Based Metering**	
1200		Lunch	
1300	Run 1	**Time Based Metering**	North flow
1405		Questionnaire	
1410		Break	
1425	Run 2	**Time Based Metering**	South flow
1530		Questionnaire	
1535		Break	
1540		**Debrief**	
1630		End	

Back up slides

Functional Architecture
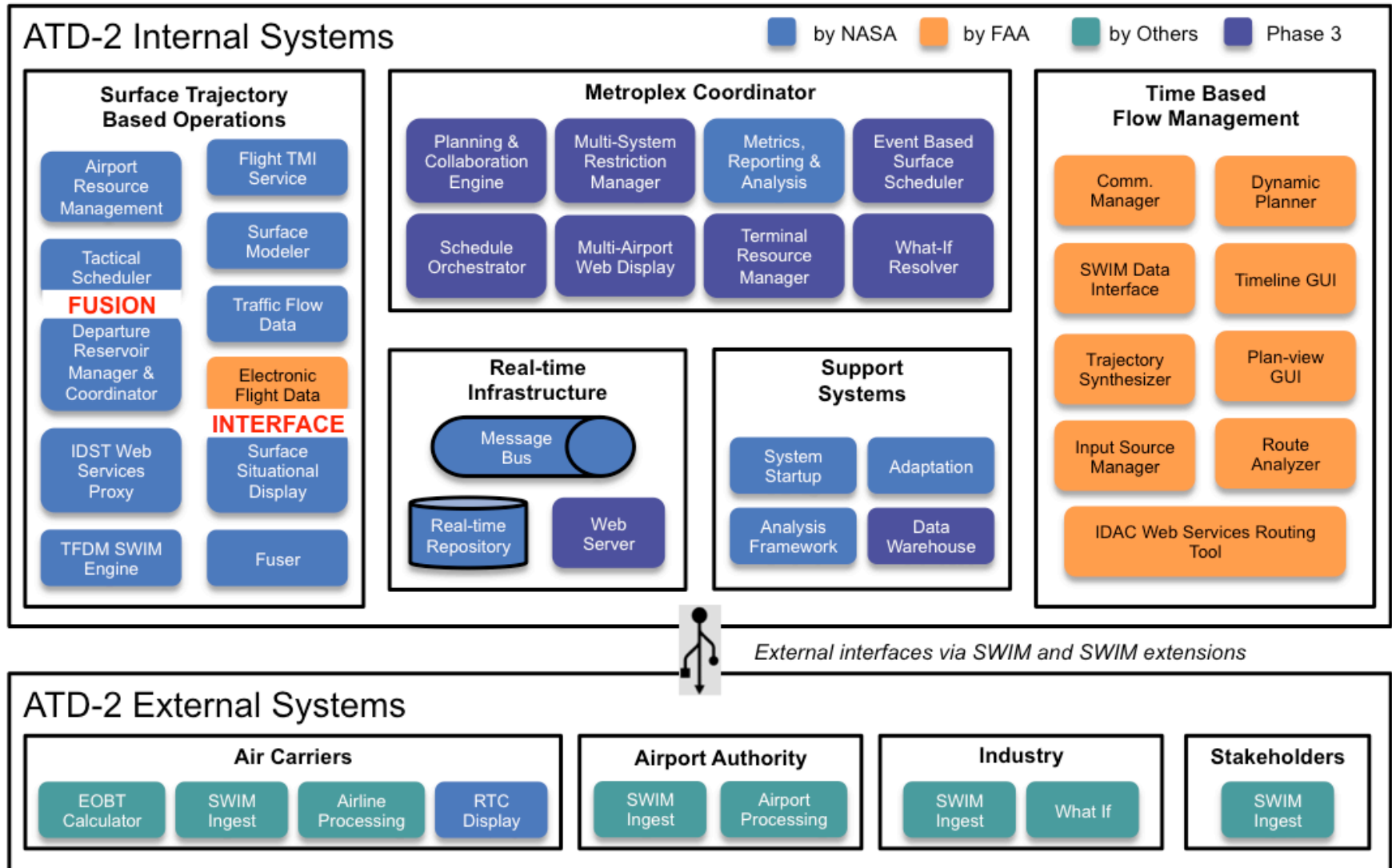
ATC- Tower Sectors

CLT Ramp Sectors

North Ramp

EAST RAMP

West Ramp

South Ramp

One Controller Two Pilots
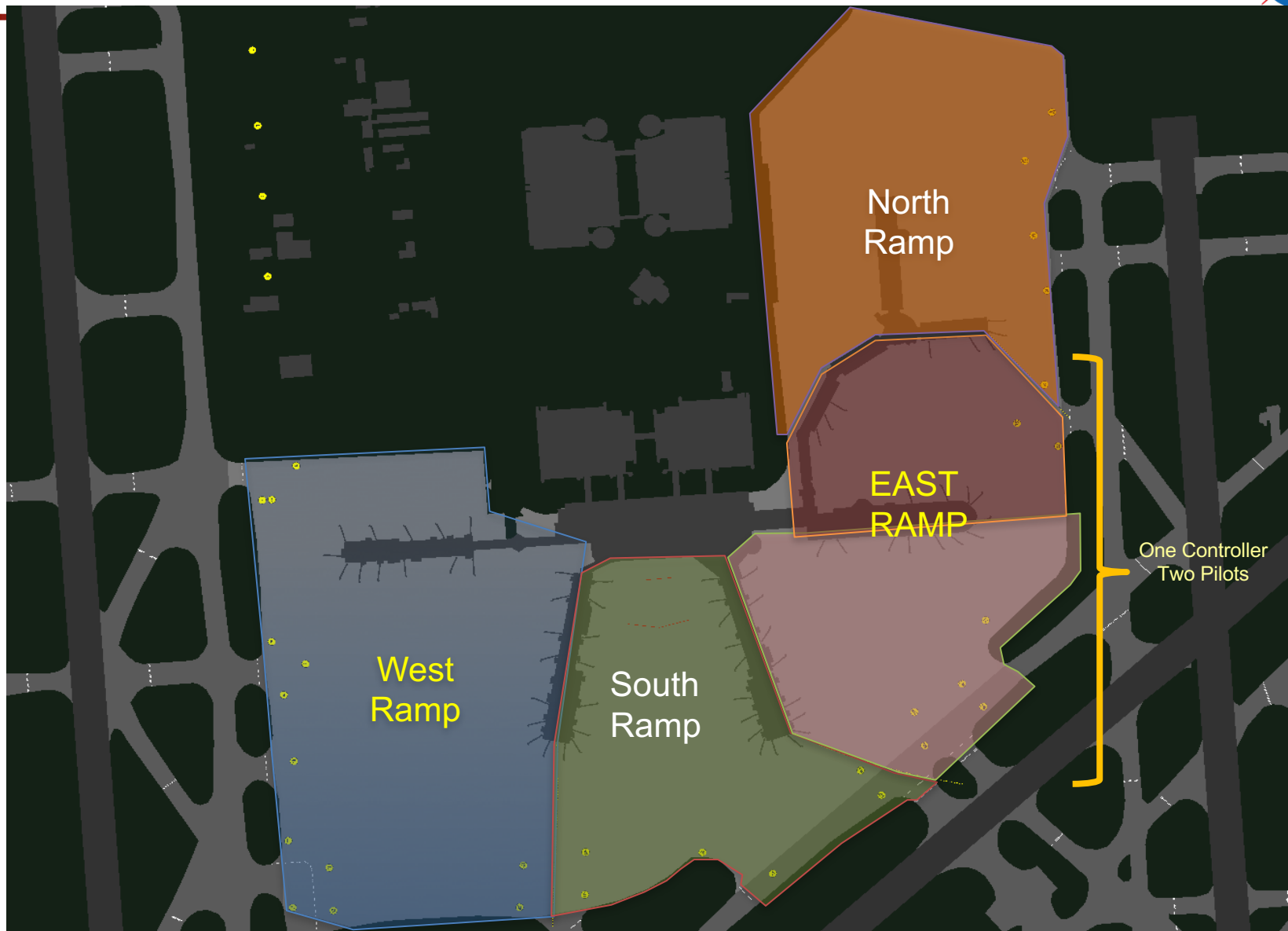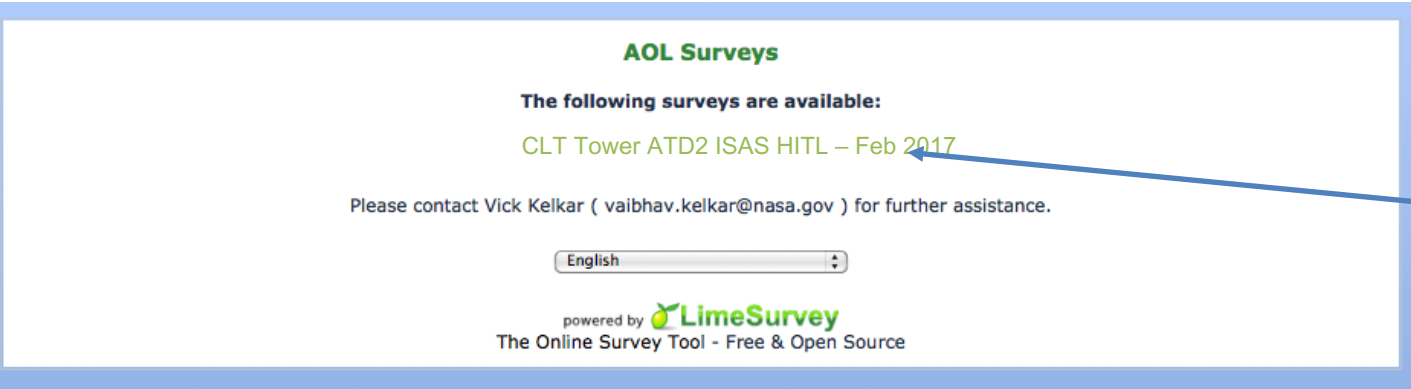
Accessing Surveys
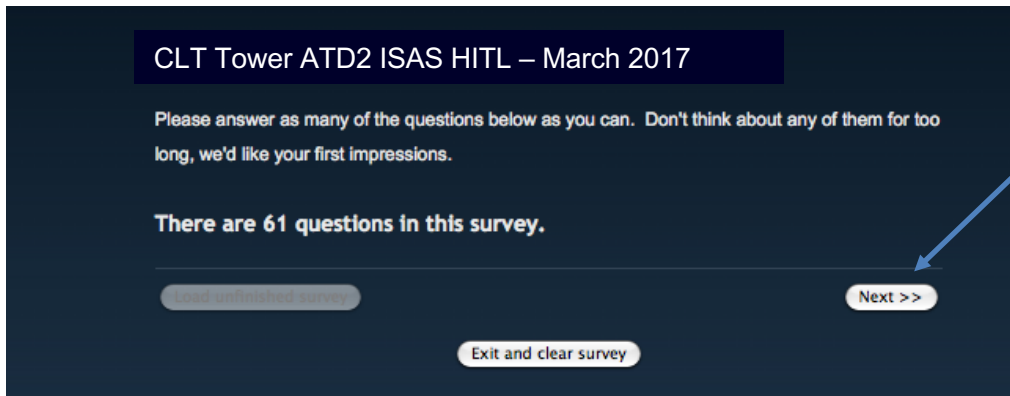
1. In the AOL: On the lower menu bar (extreme bottom left corner) on your screen, open Internet Explorer with a double click on the icon. It will open on the survey page.
In the FFC: The correct page will be brought up for you automatically at the right time.

AOL Surveys

The following surveys are available:

CLT Tower ATD2 ISAS HITL – Feb 2017

Please contact Vick Kelkar (vaibhav.kelkar@nasa.gov) for further assistance.

English

powered by **LimeSurvey**
The Online Survey Tool - Free & Open Source

2. Double click on the green survey title in the middle of the survey page

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CLT Tower ATD2 ISAS HITL – March 2017

Please answer as many of the questions below as you can. Don't think about any of them for too long, we'd like your first impressions.

There are 61 questions in this survey.

Load unfinished survey   Next >>

Exit and clear survey

3. Click "next>>" on the bottom right of the start page & the first question page will open.

Answer questions by clicking in the buttons or boxes, or place your cursor in the white boxes and use the regular keyboard to type a written answer.

You may need to scroll down to see all the questions & will need to click "next>>" to move from one page to the next & "submit" at the end to save your answers.

Very low
workload

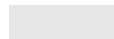Moderate
workload
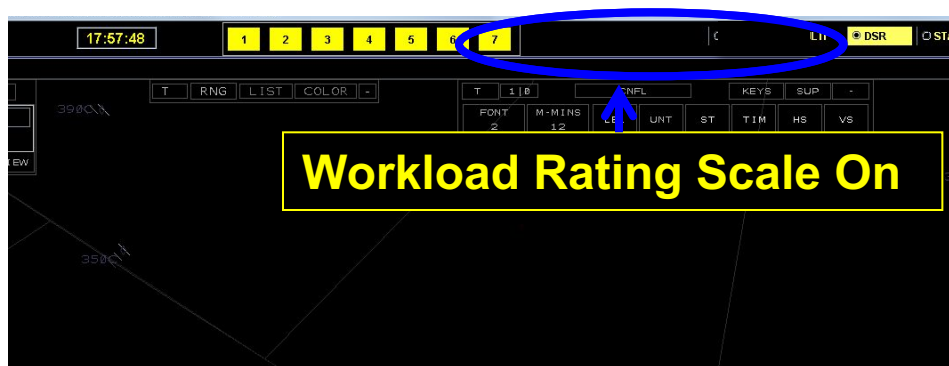
Very high
workload

Low
workload

High
workload

"ding!"

When keypad lights
up, press a key to
indicate your level
of mental workload
at that time

AOL Workload Assessment Keypad (WAK)

Workload Rating Scale Off

"ding!"

Workload Rating Scale On

<u>Workload Scale will randomly prompt you for your current workload level</u>

When keypad lights up press a key to indicate your workload at that time
Trackball PICK or hit F1-F6 key on keyboard for appropriate rating number
Rating Scale will turn dark until next prompt
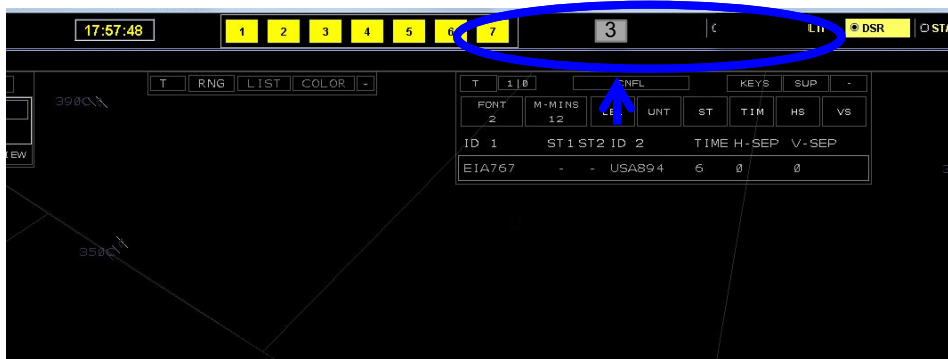
Very low
workload

Moderate
workload

Very high
workload

3

Accepted

After a key is pressed, feedback is given until the end of the 20 sec time
At the end of 20sec whether or not a key is pressed, the screen reverts back to its quiet
state

Workload: All the physical and mental effort you must exert to do your job, including maintaining the "picture," planning, coordinating, decision making, communicating, and whatever else is required to maintain safe and expeditious traffic flow.

Very Low	Low	Moderate	High	Very High
1	**2**	**3**	**4**	**5**

Time on Hands
- 1 - very low workload - very little traffic - hardly anything to do – time to talk
- 2 – low workload – light traffic - time to give best routes – time to talk

In the Groove
- 3 – moderate workload – in the groove – firm grasp of the flick – proactively looking for conflicts – still provide services
- 4 – high workload – mostly in the groove – still have the flick – proactive most of the time but focusing more on the separation management over providing services or other tasks with less priority

Overloaded
- 5 – high workload – having trouble keeping the flick – working reactively instead of proactively – mode - falling behind in routine tasks – cannot take on any additional tasks

Remember that your rating is intended to reflect your workload at the moment you are prompted, not your general appraisal of workload for the whole scenario

- *Workload is a very important measure for data analysis please try to respond to every prompt*

Arrival Airspace (South Flow)

ZID

PARQR 2

CHSLY 2

FILPZ 2

ZDC

ZTL

MLLET 1

JONZE 1

BANKR 1

STOCR 1

ZJX