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# ATD-2

## TFDM Terminal Publication Service (TTP)

### September 4-5, 2019

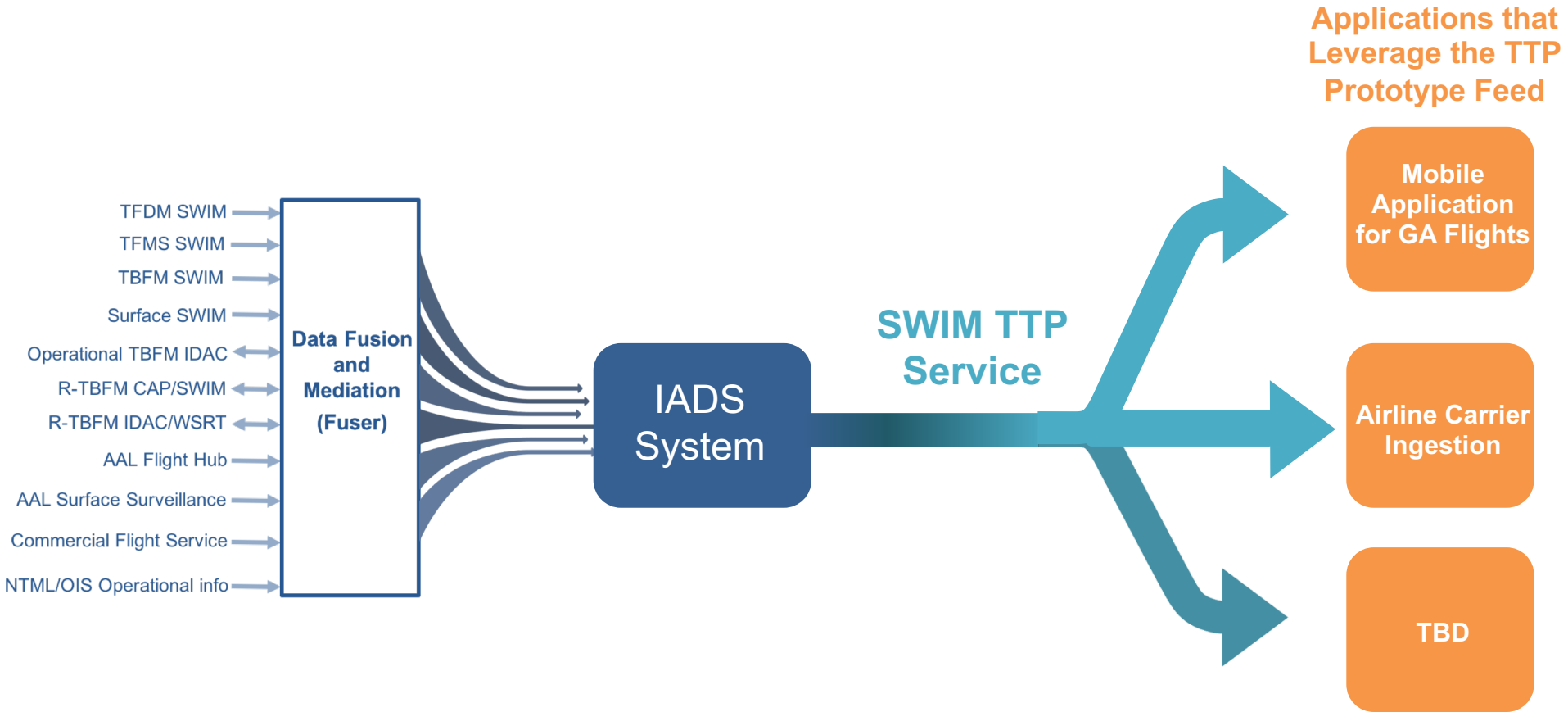


- TFDM data feed publishing Flight and Flow data to consumers
- Will provide data exchange between TFDM and NAS Systems and the National Airspace System (NAS) users (airlines, air carriers, air freight, military or general aviation/business aviation operators).
- Accessible via the National Airspace (NAS) Enterprise Messaging Service (NEMS).
- Uses the publish-subscribe (pub-sub) Message Exchange Pattern (MEP).
- XML data format, using FIXM standard for Flight Data
- Airport Information, Surface Metering Program, Traffic Management Restrictions use a schema defined by the TFDM team



- Registered as “NASA TTP” in NSRR
- Currently available via SWIM R&D Gateway
- Based on TFDM specifications
  - Currently no deviations from TFDM specifications
  - Does not include all information published by TFDM
- Publishing data for:
  - Charlotte Douglas International Airport
  - Dallas/Fort Worth International Airport
  - Dallas Love Field Airport
- Planning support of NASA TTP for CLT until TFDM proper installed (May 2021)\*
- Goal - work invested in integrating with ATD-2 via TTP could be utilized when TFDM is deployed

\*Source: [https://www.faa.gov/air\\_traffic/technology/tfdm/implementation/](https://www.faa.gov/air_traffic/technology/tfdm/implementation/)

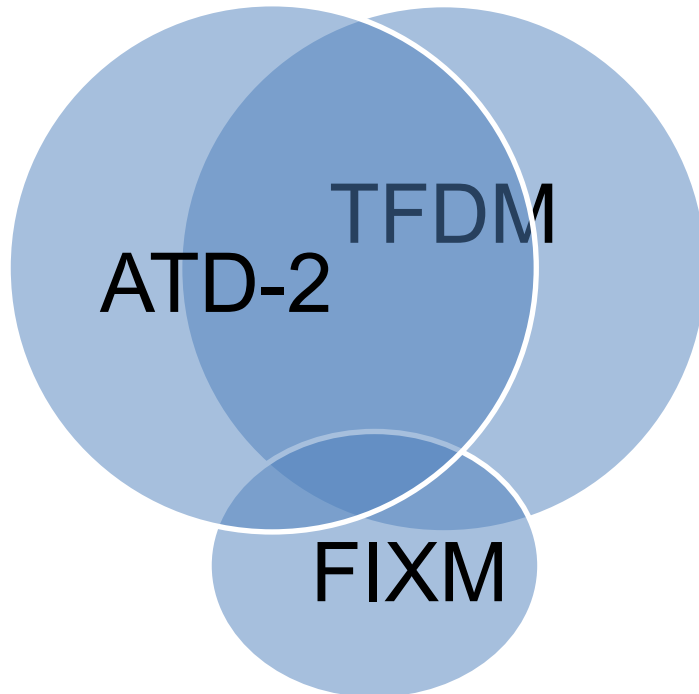


- Share valuable data with other stake holders
- Automate data sharing avoiding manual inputs
- Data doesn't exist in other feeds
- Doesn't naturally fit into any existing feeds





- **Practice**
  - NASA TTP was built against the TFDM TTP design standard
  - Using the NASA TTP provides users with a period of time to become familiar with the TTP schema and information provided
- **Integration**
  - Data generated by NASA TTP is accurate and will be similar to the data produced by TFDM
  - Users are able to begin integration of TFDM TTP data into their internal systems / operations prior to TFDM going operational
- **Feedback**
  - Using existing forums (CDM WG, SWIFT, etc.) users are able to ask questions and provide feedback to TFDM prior to its deployment



- **Program intersection limitation**
  - NASA ATD-2 has data that is not in the TFDM requirements
  - NASA ATD-2 does not have all the data to fill the TFDM requirements.
  - TFDM is expected to produce all flight data in FIXM format
  - FIXM does not currently support everything TFDM will need to publish
- **Not a one stop shop**
  - TTP generally not intended to include data that is found in other feeds

Service	Includes
Flight Data	Individual flight updates containing flight identifiers, targeted times, actual times, runway, parking gate, spot, departure fix (predicted, assigned, actual as appropriate), flight states, and more.
Airport Information	Airport configurations, airport and runway rates, ramp closures, runway closures, taxiway closures.
Traffic Management Restrictions	Call for Release programs departure MIT/MINIT restrictions, departure stop/ground stop programs. Along with list of impacted flights for each.
Flight Delay	Airport and runway delay by arrival, departure, and total.
Operational Metrics	Metrics on airport throughput and individual flight metrics.
Surface Metering Program	SMP start / end times, metering constraint type / details, updates to existing programs, TMAT compliance window, departure queue length, and more.



Name	Event Driven	Full Update	Implemented in NASA TTP
Flight Data	Yes	Every 15 minutes	Yes (subset)
Airport Information	Yes	Every 15 minutes	Yes (subset)
Traffic Management Restrictions	Yes	Every 15 minutes	Yes (subset)
Flight Delay	Yes	Every 15 minutes	Yes (subset)
Operational Metrics	No	Every 15 minutes	Yes (subset)
SMP	Yes	Every 15 minutes	Yes (subset)

- We will continue to track and align with TFDM as much as possible
- Implementation details of specific messages can be found on [NASA TTP NSRR](#)



- Use to filter data
- Use to route data
- Some messages do not have a body
  - Heartbeat
  - SystemStart
  - PeriodicStart
  - PeriodicEnd
- Indicate sync vs. real time message

# TTP Headers



Header	Flight Data	Airport Information	Traffic Management Restrictions	Flight Delay	Operational Metrics
DATA_GROUP	Yes	Yes	Yes	Yes	Yes
MESSAGE_TYPE	Yes	Yes	Yes	Yes	Yes
AERODROME	Yes	Yes	Yes	Yes	Yes
AIRLINE	Yes	No	No	Yes	No
SYNC	Yes	Yes	Yes	Yes	No
TIME_STAMP	Yes	Yes	Yes	Yes	Yes
PRIVACY_LEVEL	Yes	No	No	Yes	Yes
TFDM_RELEASE	Yes	Yes	Yes	Yes	Yes
SCHEMA_VERSION	Yes	Yes	Yes	Yes	Yes
TIME_STAMP	Yes	Yes	Yes	Yes	Yes
UUID	Yes	Yes	Yes	Yes	Yes



- **Flight Data Fields**

- APREQ Release Time

- Approval Request Release Time / Call for Release Time received from TBFM

- Departure Runway Predicted

- The departure runway predicted by the STBO model

- Estimated Departure Ramp Transit Time

- The time the departure would be predicted to enter the AMA if it were unimpeded and unconstrained by restrictions

- Estimated Departure Queue Waiting Time

- Estimation of taxiway delay predicted by the STBO model. Calculated by subtracting the takeoff time predicted by the tactical scheduler from the takeoff time that is predicted by the model if the flight were unimpeded and unconstrained by restrictions

- Actual Departure Runway

- The departure runway the flight departed from

- Arrival Runway Predicted

- The arrival runway predicted by the STBO model



- The TTP messages are evaluated based on its Sensitive Flight Data (SFD) and CDM data. The message's JMS Property, called `PRIVACY_LEVEL`, is then updated accordingly. This JMS Property ultimately allows for routing of messages to the appropriate consumers.
- Basic assumption – The consumers of TTP messages will fall into three categories:
  1. NAS systems
  2. CDM participants
  3. Other systems that are not NAS systems or CDM participants
- Basic assumption regarding which systems are allowed to see which types of data:
  1. NAS systems can receive information about SFD flights and CDM sensitive data
  2. CDM participant systems can receive CDM sensitive data but no information about SFD flights
  3. "Other" systems cannot receive CDM sensitive data or information about SFD flights



- **Traffic Management Information**

- Traffic Management Restriction

- Miles in Trail
  - Start / End times
  - Spacing (NM)
  - Applicable airport / fix
- Minutes in Trail
  - Start / End times
  - Spacing (minutes)
  - Applicable airport / fix
- Approval Request (APREQ) List
  - Start / End times
  - Applicable airport / fix
- Airport Departure Stop
  - Start / End Time
  - Impacted Airport
  - Reason for stop

- **Airport Information**

- Airport Configuration

- Arrival Runway
  - Departure Runway
- Runway Configuration
  - Departure Rate
  - Arrival Rate
  - Runway Closure

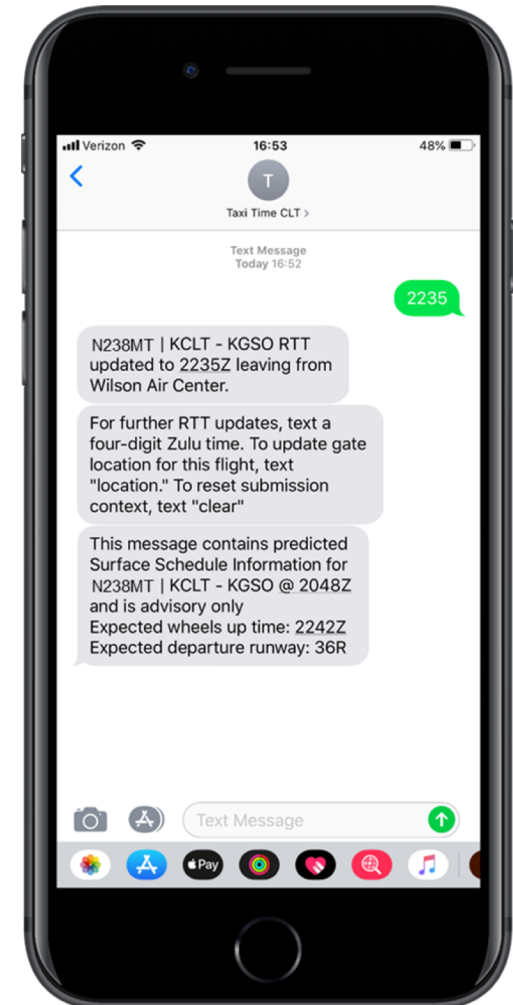
- **TMI Flight Lists**

- Each TMI is published with a unique ID
  - CFR
  - Departure MIT/MINIT restrictions
  - Departure Stop
- Flight messages published for flights impacted by a TMI(s) have the impacting TMI ID(s) included in their Flight Messages
- Provides information needed to determine which flights are impacted by a specific TMI

- **Runway Capacity / Throughput**

- Capacity
  - Airport Arrival / Departure Rate (set by ATC)
  - Airport / Runway / Taxiway Closures (set by ATC)
- Throughput
  - Airport Departure / Arrival Count
  - Runway Departure / Arrival Count
- Provides real time insight into airport status and demand

## MITRE Prototype using TTP data @ CLT



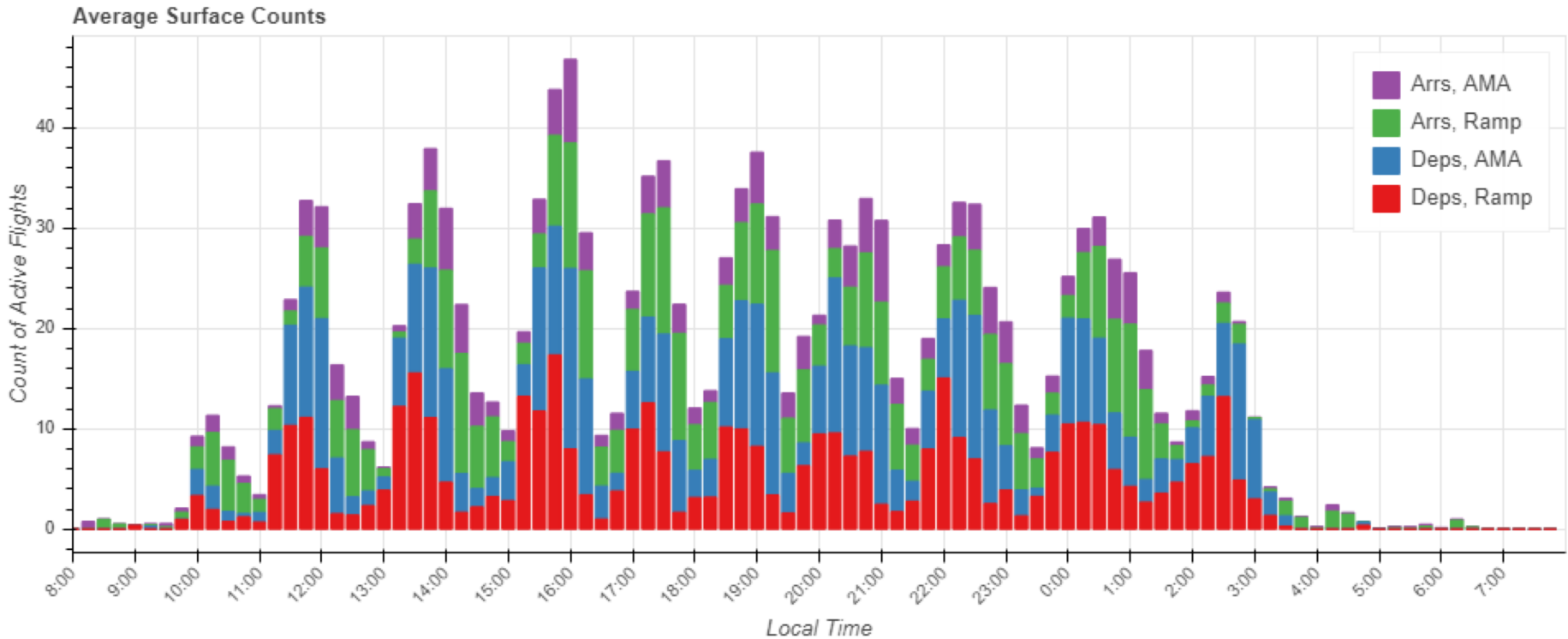


- Airport Configuration Summary
- Average Surface Counts
- Flights with Apreqs
- Average Taxi Out Times
- Average Taxi In Times
- Occupied Gates
- Runway Accuracy Analysis
- Spot Accuracy Analysis



Start	End	Airport Configuration
2019-08-25 04:00	2019-08-25 06:00	North
2019-08-25 06:00	2019-08-25 18:00	South
2019-08-25 18:00	2019-08-26 04:00	North

- Airport Information can be used to produce configuration summary
  - current\_airport\_configuration\_name
  - current\_airport\_configuration\_start\_time
  - current\_airport\_configuration\_end\_time



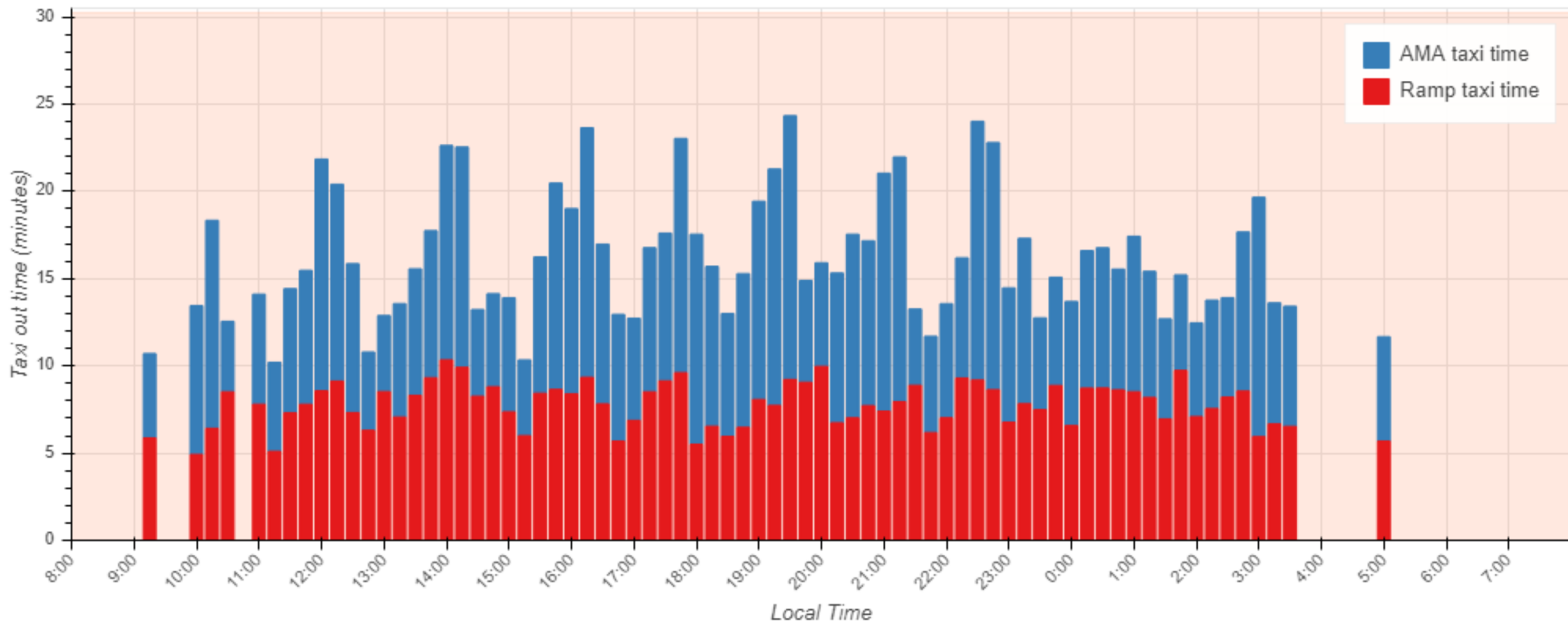
- Average surface counts broken down by location, category
- Using fields from FlightData:
  - actual\_off\_block\_time
  - actual\_movement\_area\_entry\_time
  - actual\_take\_off\_time
  - actual\_landing\_time
  - actual\_movement\_area\_exit\_time
  - actual\_in\_block\_time

Destination	Flights	APREQ
KATL	18	18
KBWI	1	1
KDCA	5	5
KDFW	1	1
KEWR	12	12
KIAH	5	4
Total:	42	41

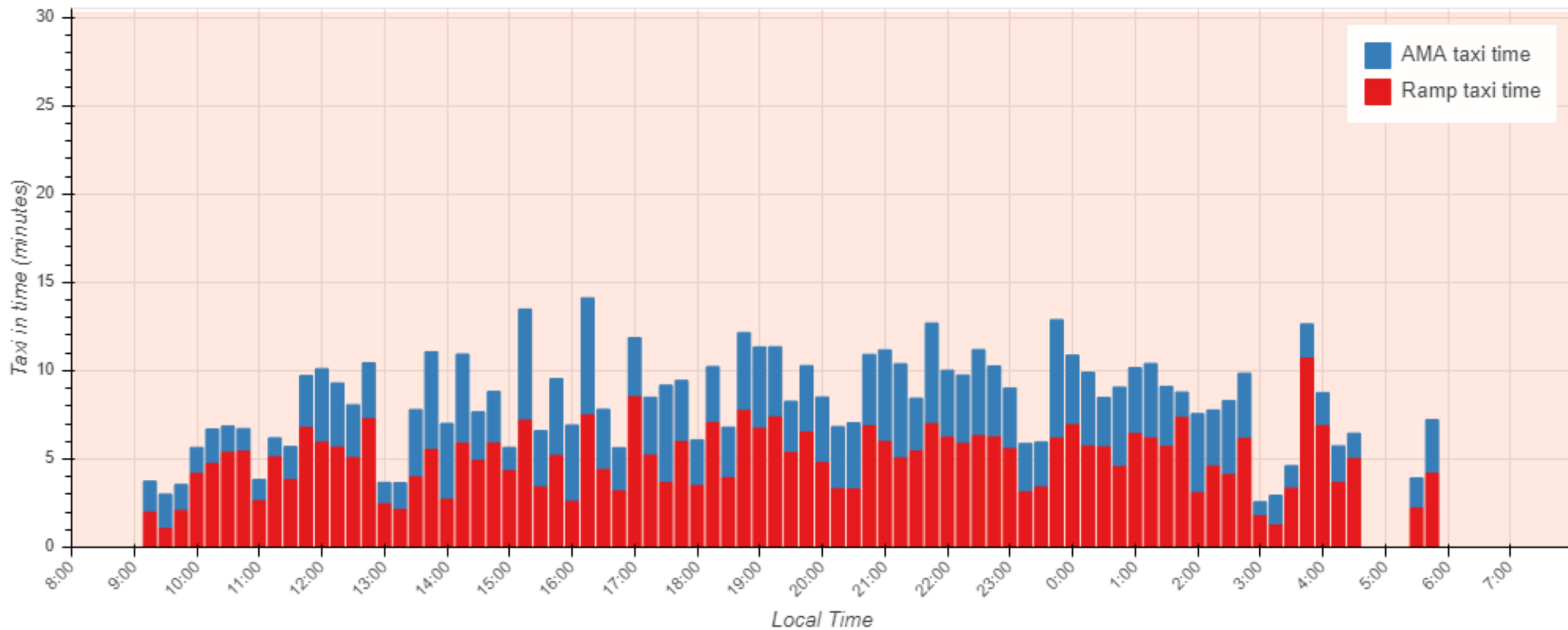
- Controlled Flights by Destination
- Using fields from FlightData:
  - destination\_point
  - approval\_request\_release\_time
  - actual\_off\_time

Carrier	Flights	APREQ
AAL	30	29
ASH	2	2
DAL	6	6
SKW	1	1
UAL	3	3

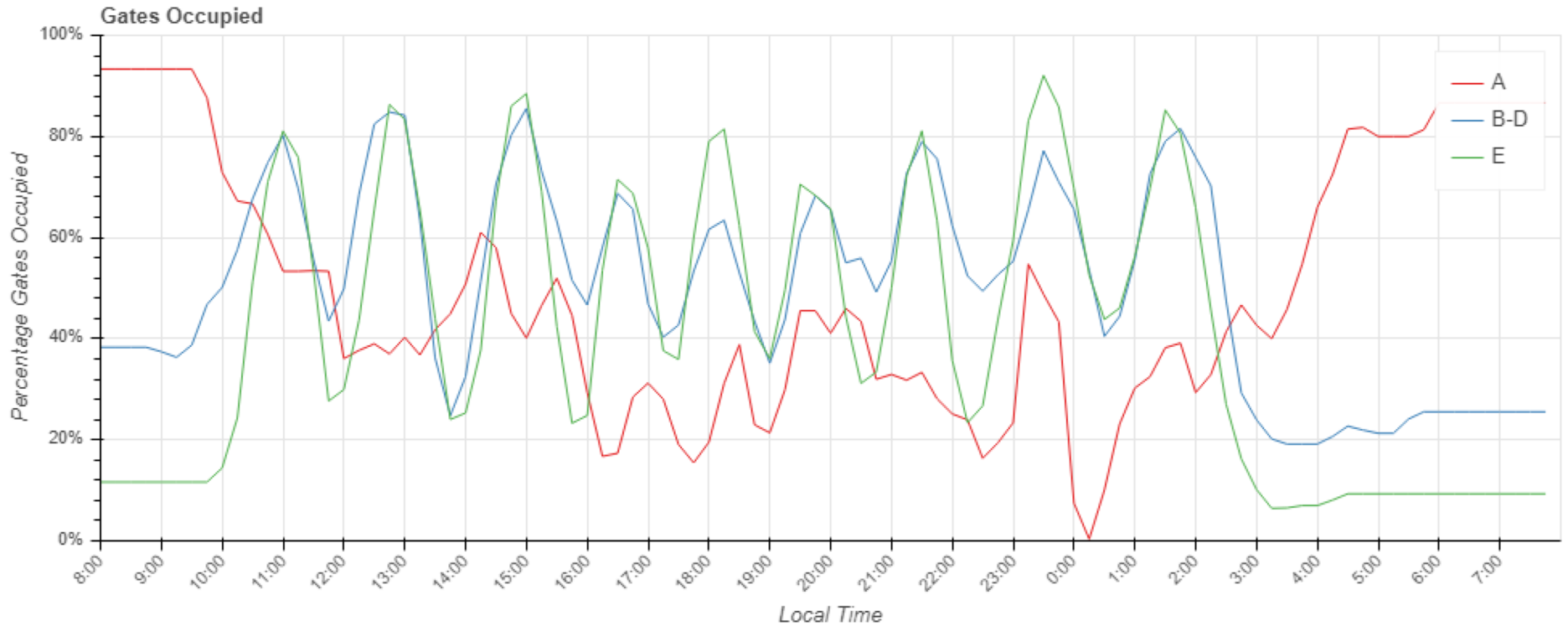
- Controlled Flights by Carrier
- Using fields from FlightData:
  - carrier
  - approval\_request\_release\_time
  - actual\_off\_time



- Average Taxi Out Times by Ramp, AMA
- Using fields from FlightData:
  - actual\_departure\_ramp\_transit\_duration
  - actual\_take\_off\_time
  - actual\_movement\_area\_entry\_time



- Average Taxi In Times by Ramp, AMA
- Using fields from FlightData:
  - actual\_arrival\_ramp\_transit\_duration
  - actual\_landing\_time
  - actual\_movement\_area\_exit\_time



- Occupied Gates by Terminal
- Using fields from FlightData:
  - actual\_off\_block\_time
  - actual\_in\_block\_time
  - arrival\_stand\_designator
  - departure\_stand\_designator
- \*A list of parking gates at the airport was also used (not provided through TTP)



*Total scheduled departures: 847*  
*Missing Off Time: 11*  
*Number of departed aircraft: 838*  
*Missing runway prediction at Out: 1*  
*Missing runway prediction at Spot: 0*  
*Accuracy at Out: 807/836 (96.5%)*  
*Accuracy at Spot: 823/836 (98.4%)*

*Top 10 errors in departure runways:*

<i>Prediction at Spot</i>	<i>Actual</i>	<i>Count</i>
36R	36C	9
36C	36R	1

- Runway Prediction Accuracy Analysis
- Using fields from FlightData:
  - actual\_movement\_area\_entry\_time
  - actual\_take\_off\_time
  - departure\_runway\_actual
  - departure\_runway\_predicted
  - estimated\_time\_of\_departure

*Total scheduled departures: 847*  
*Missing Off Time: 11*  
*Incorrect predicted gate at Out: 92*  
*Number of departed aircraft: 836*  
*Accuracy at Out: 591/755 (78.3%)*

Actual Spot	Count
24	504
12S	57
GA_2	49
13	44
11W	42
22W	40
27E	29
26S	14
9W	10
29	8
29S	7
10W	6
28E	5
25	3
S_R1_1	3
6W	2
HC_2	2
SC_6	2
S_R2_1	2
AC_1	1
ANG_1	1
ANG_2	1
SC_1	1
SC_2	1
SC_7	1
S_R1_2	1

- Spot Usage and Prediction Accuracy Analysis
- Using fields from FlightData:
  - actual\_take\_off\_time
  - estimated\_time\_of\_departure
  - actual\_departure\_spot
  - actual\_off\_block\_time
  - actual\_movement\_area\_entry\_time
  - predicted\_departure\_spot





- Work with SWIM to establish a connection to SWIM R&D if you don't already have a connection
  - If you already have a connection getting access to TTP will be pretty straight forward.
- Subscribe to SWIM R&D TTP feed via a new queue that will be established for each stake holder
- Work with ATD-2 team on how to utilize the information
  - See TTP Resources slide for links to documentation



- **Links to FAA TFDM resources**
  - **Concept Overview:**
    - [https://www.faa.gov/air\\_traffic/technology/tfdm/](https://www.faa.gov/air_traffic/technology/tfdm/)
  - **SWIM On-Ramping:**
    - [https://www.faa.gov/air\\_traffic/technology/swim/products/get\\_connected/](https://www.faa.gov/air_traffic/technology/swim/products/get_connected/)
  - **Implementation Roadmap:**
    - [https://www.faa.gov/air\\_traffic/technology/tfdm/implementation/](https://www.faa.gov/air_traffic/technology/tfdm/implementation/)
- **Links to ATD-2 TFDM / NASA TTP Resources**
  - **NSRR:**
    - <https://nsrr.faa.gov/services/nasa-ttp/profile>
  - **NASA Website:**
    - <https://www.aviationsystemsdivision.arc.nasa.gov/research/atd2/index.shtml>



- **Java Messaging Service Description Documents (JMSDD)**
  - Required for all FAA SWIM Services
  - Provides technical details for TTP including:
    - Service Profile
    - Service Interface
    - Service Implementation
  - One document for each service
- **TTP Message Description Documents**
  - Describes the messages published by each services including message headers, description of each data element, and relevant details
  - Indicates for each element whether it is in FIXM, FIXM Extension, or non-FIXM format
  - Provides breakdown of adherence to TFDM specification for each element
  - Includes a sample message
  - One for document each service
- **Sample Data**
  - Zip file containing samples of messages from each service
- **Schemas**
  - FIXM 4.0 schema and extensions used for services publishing flight information (Flight Data and Flight Delay)
  - NASA TTP schema used for services publishing non-flight information (Airport Info., Operational Metrics, Surface Metering Program, and Traffic Management)

