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Terminal Data Exchange Concept of Use for SWIM Segment 1

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Abstract

This Terminal Data Exchange Concept for System Wide Information Management (SWIM) Segment 1 describes the expected exchange of data involving the Air Traffic Control Tower (ATCT) and Terminal Radar Approach Control Facility (TRACON), collectively known as the Terminal domain, in the 2009-2013 timeframe. These concepts represent the first major set of Terminal capabilities that will be available via the SWIM program and provide important foundations for several Next Generation Air Transportation System (NextGen) elements. This concept document is also designed to support the future detailed interface requirements associated with the data exchange between the Terminal domain and other domains, specifically Traffic Flow Management (TFM) and En Route.

In addition, this document directly supports the Flight and Flow Data Community of Interest (FF COI) under the SWIM program. The Air Traffic Organization (ATO) systems engineering teams for Terminal (ATO-T), TFM (ATO-R) and En Route (ATO-E) are collaborating with other systems engineering teams to identify the data elements that are needed and used by each domain for the first set of operational capabilities to be implemented in the SWIM Segment 1 timeframe.

The analysis includes an operational description for both the current and future data exchanges. The future data exchange is based on previously developed operational concepts and on the ongoing definition efforts under the aegis of the FF COI. The focus is on the following categories of data: flight data, flight status/event data, traffic management initiative execution data, surface position data, and airport status data. Open questions associated with this data exchange are identified and potential areas for expansion are also addressed.

KEYWORDS: Terminal, TFM, Tower, ATCT, FDIO, TDLS, Traffic Flow Management, SWIM, FF COI, EFS, Flight Object, ERAM

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1 Introduction

1.1 Purpose

This document describes an operational concept of use for terminal data exchange in the 2009-2013 timeframe. It identifies and describes the key cross-domain data exchanges that are required to support operational enhancements planned for this timeframe, and provides a foundation for more detailed interface requirements development. This data exchange concept also supports the initial implementation of several Next Generation Air Transportation System (NextGen) cross-domain operational capabilities. In addition, this document is designed to provide inputs to the System Wide Information Management (SWIM) Flight and Flow Community of Interest (FF COI) for operational concepts and qualitative operational benefits, which can then be used by the SWIM Program Office for SWIM Segment 1 investment analysis activities. It is also designed to support System Engineering integration activities and Service Level Agreements (SLA) among Terminal, Traffic Flow Management (TFM) and En Route domains involving the implementation of near-term and mid-term cross domain capabilities and concepts.

1.2 Background

This document is a follow-on to previous documents The MITRE Corporation's Center for Advanced Aviation System Development (MITRE/CAASD) did to support Cross Domain Systems Engineering activities and analyses. This analysis has been an ongoing effort among the En Route, TFM and Terminal Systems Engineering teams within Air Traffic Organization-En Route and Oceanic Services (ATO-E), Air Traffic Organization - Systems Operations (ATO-R) and Air Traffic Organization-Terminal Services (ATO-T), respectively. MITRE/CAASD has supported this work with multiple analyses and products, with a particular focus on Flight Data [2, 4, 7]. In Fiscal Year 2004 (FY04) and FY05, the primary focus was on TFM-En Route capabilities as both domains have modernization programs underway and are continuing to define the requirements. Agreements on TFM-En Route data exchanges were reached in a Service Level Agreement between ATO-E and ATO-R in the spring of 2005. Additional analysis has been ongoing to define a lower level of detail for the TFM-En Route interface and cross-domain capabilities and to update the Service Level Agreement as applicable.

In FY06, the Terminal and TFM Systems Engineering teams began work on a similar data exchange analysis activity between tower automation and TFM [2]. This activity was specifically targeted at tower automation but also supported the requirements definition for future TFM enhancements after the initial TFM System (TFMS) modernization program. Additional analysis was planned to address Air Traffic Control Tower (ATCT)-En Route data exchanges and also expand into the Terminal Radar Approach Control Facility (TRACON) arena.

In the spring of 2006, a cross-domain Systems Engineering team was established under the leadership of ATO-E to address the cross domain requirements to support the Next Generation (NextGen) vision for an Agile National Airspace System (NAS). This team initially consisted of members from En Route, TFM, and Terminal Systems Engineering organizations, but quickly evolved to become the FF COI team that included SWIM, Data Comm, Oceanic and Traffic Management Advisor (TMA) members. Over the next several months, the team focused on support for the SWIM Segment 1 investment analysis activities. This team became actively involved with defining operational capabilities and domain implementation strategies for SWIM Segment 1 [1]. The FF COI team has spawned sub-teams among the domains to collaborate and coordinate the concepts, benefits, and potential costs associated with the SWIM Segment 1 cross-domain capabilities.

The terminal operational capabilities and cross-domain infrastructure planned for SWIM Segment 1 provide a foundation for future NextGen capabilities in several areas: Trajectory Based Operations, Collaborative ATM, High Density Arrival/Departure Terminals and Airports, and Flexible Terminals and Airports. The SWIM program is providing guidance, governance and a framework of core services as follows: "The operational concept for SWIM is to provide an open, flexible, modular, manageable, and secure information management and sharing architecture for NAS operational data. This includes but is not limited to aeronautical information, flight data, traffic flow management, surveillance, and weather information. To achieve this concept, the strategy for SWIM is to migrate NAS applications toward a loosely coupled, open distributed processing environment focused on information sharing (where loosely coupled systems tend to be highly scalable, robust and agile). These open architecture principles provide value by reducing costs, reducing risks, enabling new services, and extending and therefore adding value to existing services." [10] The initial phase of SWIM, Segment 1, is planned for 2009-2013 and will include capabilities implemented by three communities of interest: Flight and Flow Management, Aeronautical Information Management, and Weather. Within the Flight and Flow COI, there are multiple service-oriented capabilities involving Terminal data exchange that are planned for incremental implementation within the SWIM framework.

1.3 Concept Scope

The scope of this data exchange operational concept involves selected categories of data that are exchanged among ATCTs, En Route and TFM. The concept of use includes both Air Traffic Control (ATC) and Traffic Flow Management (TFM) personnel and automation, both within the same facility (e.g., Air Route Traffic Control Center [ARTCC]) and between facilities (e.g., tower controller and ARTCC TFM). The data categories are summarized in Table 1-1 below:

Table 1-1. Data Categories

#	Data Category	Data Category Description
1.	Flight Data	Flight plan, flight strip and flight object data, including trajectory. Includes auxiliary flight data, such as runway assignment, that is not in flight plan but is in larger set of flight data, i.e. flight object.
2.	Terminal Flight Status/Event Data	*Note that although this is treated as a separate category, it can all be considered part of the larger flight data category.*
	2.a - Tower Flight Status/Event Data	Flight status (e.g., aircraft at spot or in lineup) or event (e.g., starts taxi or runway roll) data that is captured on controller action or derived by automation.
	2.b - Clearance Delivery Status Data	Pre-departure clearance delivery status from tower automation when clearance is delivered to pilot (by automation or controller).
3.	Surface Position Data	Surface position reports (surface surveillance correlated with flight data from Airport Surface Detection Equipment – Model 3X/Model X [ASDE-3X/ASDE-X]).
4.	Airport Status Data	
	4.a - Runway Visual Range (RVR) Data	Runway visibility data (along runway visibility, light setting) for each runway (at several points) collected and correlated from various airport sensors.
	4.b - Airport Configuration Data	Current and/or planned runway configuration. Includes runways in use and approaches in use.
5.	TFM Initiative Data	Controlled departure or arrival times, routes, and restrictions from TFM. Includes associated initiative data, such as restricted portion of reroute.
6.	Predicted Flight Data	Predicted surface, departure and arrival data, including predicted flight path, lineup positions, and predicted event times. In Segment 1, expected to be primarily for departures.

The target timeframe of this operational concept for terminal data exchange is SWIM Segment 1, which is 2009-2013 as currently understood by the FF COI. Some of the data categories above do not apply to this timeframe, but the analysis is included as candidates for future segments. There are multiple modernization and enhancement activities planned within the domains in the SWIM Segment 1 timeframe. SWIM Segment 1 loosely maps to the following initiatives:

- Air Traffic Organization – Planning Service (ATO-P) Automation Roadmap (Terminal Systems)
- Traffic Flow Management System (TFMS) Work Packages 1 and 2
- En Route Automation Modernization (ERAM) Releases 1 through 3
- Data Comm – Tower Data Link System/Pre-Departure Clearance (TDLS/PDC) potential early enhancements under Terminal Roadmap and early Data Comm Segment 1

SWIM Segment 2 is still being defined and a set of future capabilities are included in the document as potential candidates. This data exchange analysis is based on the current SWIM program plan; changes are expected as the concepts mature and SWIM program implementation activities progress.

This initial concept is also designed to set the foundation for further exploration and decomposition for the Performance-based Air Traffic Management (P-ATM) and Next Generation Air Transportation System (NextGen) concepts that are expected to follow the 2013 timeframe. This document does not explicitly address these future concepts but the data exchange concepts are consistent with them.

Although the intent of this document is to avoid implementation-specific information and concentrate on the operational concepts and benefits, the automation systems involved include the following:

- Current Systems – Flight Data Input Output (FDIO), Electronic Flight Strip Transfer System (EFSTS), Tower Data Link System (TDLS)/Pre-Departure Clearance (PDC), Airport Surface Detection Equipment – Model X (ASDE-X), Automated Radar Terminal System (ARTS), Standard Terminal Automation Replacement System (STARS), Host Computer System (HCS), Enhanced Traffic Management System (ETMS)
- Planned Systems – En Route Automation Modernization (ERAM), Traffic Flow Management System (TFMS), Advanced Electronic Flight Strip System (AEFS)
- Potential Future Systems – Departure Flow Management (DFM), Electronic Flight Strip System (EFS), Tower Flight Data Management (TFDM), Terminal Data Distribution System (TDDS)

1.4 Approach

The focus of this initial concept is on enhanced capabilities between the ATCT and the TFM and En Route domains. Matrices were developed to document the terminal data exchange capabilities identified in SWIM Segment 1, using the Federal Aviation Administration (FAA) Enterprise Architecture framework, which is based on the Department of Defense Architecture Framework (DODAF) model for operational and system exchanges. These matrices were organized to highlight the operational data exchange between domains rather than emerging system data exchanges with SWIM. This approach was designed to provide insight into the operational need and use of the data by the user (e.g., traffic manager in an ARTCC TMU) rather than the means of implementation (e.g., ERAM and SWIM). In addition, the domain-specific analysis approach supports the Service Oriented Architecture focus of the SWIM program by helping in the identification of service providers and service consumers. As the terminal, SWIM, and emerging Flight Object concepts mature, the matrices are expected to be updated to reflect additional data and allocations to specific systems and applications. The matrices were also designed to support the more system-specific interface definition that will be developed by the domains to reflect the planned services and architectures.

Operational threads were developed or updated from previous versions for selected target capabilities. These were designed to help clarify the operational exchanges for less well understood capabilities or for capabilities expected to be implemented by new SWIM-supported terminal infrastructure.

1.5 Organization of This Paper

Section 2 provides a summary of the current operational concept of use for selected Terminal capabilities applicable to the SWIM Segment 1 timeframe. Section 3 provides a summary of several potential future capabilities. Section 4 provides potential follow-on activities for this analysis activity. Section 5 summarizes the current and future data exchange between ATO-T, ATO-R and ATO-E. Detailed information is provided in appendices as follows:

- Appendix A: Operational Information and System Data Exchange Matrices (ATCT and TRACON)
- Appendix B: Operational Threads for Terminal Data Exchange SWIM FF COI Analysis
- Appendix C: Operational and System Context Diagrams for Terminal FF COI Data Exchange

2 Terminal Operational Data Exchange Concept - SWIM Segment 1

2.1 SWIM Data Exchange Overview

In response to shortfalls identified in the current data exchange approach across domains, the FAA has developed a system wide approach for improving and enhancing the capabilities for domains to share and manage information. Details of this approach are included in the SWIM Concept of Use document [5]. The key points related to this Terminal Data Exchange Concept include those capabilities provided by the domains and enabled by a SWIM infrastructure:

- Improvements in information sharing reduce costs and duplicative processing
- More timely access to data improves common situational awareness across the NAS, including users
- The wide availability of relevant data provides improved capability to measure NAS performance

In addition to the SWIM infrastructure, another concept under development that relates directly to Terminal data exchange capabilities is the "Flight Object." The flight object will include relevant flight plan, flight status, trajectory, and other data elements for specific flights and will be available for use by multiple domains. This flight object is currently being based on the En Route flight and track data that is used today as a common source of flight data [8]. However, it should be noted that no design decisions have been finalized. The terminal domain could provide some of the data elements in this "Flight Object," such as taxi status or departure runway assignment.

2.2 Flight Data

The primary focus of the Terminal data exchange in SWIM Segment 1 involves flight data in the ATCT. As an overall category of data, Flight Data comprises flight plan data, flight strip data, flight data added by controllers or automation via various mechanisms, flight status or event data, clearance delivery status and various other data elements for a specific flight. In addition to the more well-known flight plan data, this larger set can include the assigned runway, taxi start event time, initial heading, and special indicators that are marked on flight strips by tower controllers. Most of these additional data elements are included in the emerging concept for a Flight Object described previously. In order to provide more visibility for the operational threads being worked by the Flight and Flow COI, flight data has been broken out into three subsets within this document: flight data, flight status/event data and departure clearance delivery data.

2.2.1 Tower Flight Data

Current Operations:

Most of the flight data in the terminal is provided by the Host en route automation system. With the exception of the NY Metro sites that have Departure Spacing Program (DSP), flight data available to the terminal is limited by what the en route automation system prints via FDIO on paper flight strips that are printed in the tower. The data sent routinely to the ATCT is controlled by the Host and changes to get additional data or to change format of the flight strip data require coding changes in the en route automation system. Examples of limitations are:

- departure strips in the ATCT may not contain the full route of flight
- data that is unique to the International Civil Aviation Organization (ICAO) flight plan, such as data on aircraft equipage, is not routinely available.

Additional data is available via the FDIO "full route" readout, however that adds to the controller workload since it requires an additional input message and additional strip(s).

See Appendix B, Threads 1.1 and 1.3 for details.

Future Operations:

The tower automation systems, specifically EFS/TFDM and TDLS, will be able to access the full flight data in ERAM. The full route and ICAO flight plan unique data could be routinely sent to EFS/TFDM and be available to the tower controller for display.

See Appendix B, Threads 1.2, 1.4 and 1.5 for details.

Operational Benefits:

The capability to routinely receive the full flight plan data from ERAM will support more efficient delivery of revised clearances since the full route will be available and a full route readout message will not be needed.

2.2.2 Tower Flight Status/Event Data

Current Operations:

Currently, tower controllers and tower automation provide flight status and event data within the tower domain and to personnel at other facilities. This is particularly applicable during departure operations, when the aircraft's readiness to depart, gate location and taxi status are used operationally to manage surface operations such as taxi queues. In addition, flight status and event data is used for multiple departure flow management activities, such as Approval Request (APREQ) releases into overhead flows. The majority of this flight status and event data is communicated manually among controllers, either orally or on flight strip markings within the tower environment. Tower controllers, supervisors and traffic managers share flight status externally via phone calls, such as when an ARTCC Traffic Management Coordinator (TMC) calls to coordinate a reroute for a flight that is assumed to be close to departure.

In those facilities with EFSTS, DSP or Airport Resource Management Tool (ARMT), this flight status and event data is also captured and distributed when the tower controller uses the tools to update flight status. In sites with EFSTS, tower controllers swipe the flight strips when the flight status changes due to a taxi start or runway roll, and this data is then available to the TRACON. At sites with DSP, ATCT controllers update the line-up and other departure information as the flight progresses through the departure process. This status data is then available internally within the ATCT and externally in the TRACON, ARTCC and Air Traffic Control System Command Center (ATCSCC). In those facilities with ARMT, there is a local data exchange between EFSTS and ARMT that provides updated flight event/status data from the ground or local controller to traffic managers. This data is then shared with traffic managers in the overlying TRACON and ARTCC via an ARMT-ARMT data exchange.

See Appendix B, Threads 2.1 and 2.4 for details.

Future Operations:

In the future, tower controllers and tower automation will provide flight status and event data within the tower domain and to personnel at other facilities with more integrated automation support. In the SWIM Segment 1 timeframe, flight event data at EFSTS and possibly DSP sites will be captured and distributed when the tower controller uses these tools to update flight status. This information will be available within the tower, between the tower and TRACON, to TFM automation, and to SWIM. As an example, when the ground controller delivers the taxi clearance and instructions, the flight status is updated. This information can now be used to update the flight object data that is used by traffic managers to evaluate predicted surface and departure demand and determine flight-specific flight status.

In addition to controller-generated flight status and event data, flight status and event data may be derived from surface position reports provided by ASDE-X tower automation. This new data exchange will support event detection, facilitate determination of surface metrics such as taxi delays, and provide the basis for event/time predictions by TFM or other automation that now have access to the data.

In future increments, it is expected that additional flight status and event data, such as pushback data, will become available from other FAA or user automation. In addition to direct FAA use, access to flight status and event data via SWIM may be of interest to outside government agencies, such as the Department of Homeland Security (DHS).

See Appendix B, Threads 2.2, 2.3 and 2.5 for details.

Operational Benefits:

Tower controllers will be able to use this flight status and event data internally for increased situational awareness and enhanced coordination. Terminal controllers will benefit from integrated flight status and event data within the tower and TRACON environments. Electronic flight status can be readily shared among positions, and earlier notification between facilities is facilitated for departure operations, potentially reducing controller workload.

In addition, external users, such as TMCs in the ARTCC or TRACON, will gain enhanced situational awareness as well as specific flight event information needed for coordination. Operational access to this status/event data will enable traffic managers to reduce the manual coordination with the tower when executing pre-departure reroutes and other traffic management initiatives. TFM automation will use flight status and event data to provide more accurate end-to-end trajectory predictions, predicted surface and departure demand and determine flight-specific flight status. TMCs will use the improved predictions and actual flight status to plan and implement traffic management initiatives with more accuracy than done currently. As an example, traffic managers will be able to make more informed decisions about the feasibility of reroutes based on the current status of the flight, such as whether it has pushed back from the gate, without requiring phone calls to the ATCT to determine that flight status. [2]

In addition, the availability of flight status and event data is expected to provide improved analysis of delays and surface departure operations, improving the overall capability to monitor performance of the NAS.

2.2.3 Departure Clearance Delivery Data

Current Operations:

The status of delivery of a departure clearance to an aircraft is known in the ATCT but is not generally available outside the ATCT, except for sites that have DSP, where it is available to the TRACON and ARTCC. If the clearance is delivered by voice to the aircraft, then after pilot readback, the status is annotated on the flight strip or is entered into DSP via a scan of the bar code on the departure flight strip. If the clearance is delivered via PDC and the Airline Operations Center (AOC) computer acknowledges it was received, it is assumed that the clearance was delivered and the strip can be annotated or scanned into DSP, in similar fashion to the voice clearance. If the pilot does not receive the departure clearance, they will call the ATCT and request a clearance.

See Appendix B, Threads 1.1 and 1.3 for details.

Future Operations:

Departure delivery clearance status will be maintained electronically in the tower and disseminated outside the tower. Status will be entered (e.g., captured electronically) by the tower controller for clearances delivered via voice. For clearances delivered by Data Communications directly to the aircraft, the delivery status will be determined based on the acknowledgement returned from the aircraft. When the information in a previously delivered clearance is updated, for example, a route or altitude change, then the clearance delivery status will be reset and available for dissemination. For clearances delivered only to the AOC via a commercial service provider, i.e. legacy PDC, the delivery status will not be disseminated electronically outside of the tower due to its level of uncertainty.

See Appendix B, Threads 1.2, 1.4 and 1.5 for details.

Operational Benefits:

The operational concept of use for the clearance delivery status is still under development. Initial feedback has identified an operational benefit associated with the Center Traffic Management Unit (TMU) not needing to call the ATCT before amending a flight plan for a pre-departure flight close to the proposed time of departure. By knowing that the aircraft has not yet received its clearance, the TMC may be able to execute a reroute more efficiently. There is a need for further refinement and operational validation of this capability.

2.3 Airport Status Data

2.3.1 Runway Visual Range (RVR) Data

Current Operations:

The RVR data for a fully instrumented runway includes the following: RVR values measuring airport visibility, ambient light, and runway light intensity at runway touchdown point and runway midpoint. The RVR Data is reported every two seconds.

The controllers at the towers, TRACONs, and some ARTCCs can view the RVR data (along with other weather) on various tower Information Display System (IDS) or other tower information displays. Controllers use RVR data, which is fed directly to FAA tower facilities, for control decisions only when it is supported by visual confirmation. Although users have access to RVR information on the TFM ATCSCC Website for about 50 airports, this is informational only; pilots are therefore directed to contact the local tower for visibility numbers rather than rely on the Website information.

In addition to having the IDS display in some TMUs, traffic managers receive RVR data via the TFM display and can request additional RVR data for specific airports from tower personnel. Traffic managers can use this data for general airport constraint information during demand/capacity analysis, i.e. if arrivals are expected to be constrained due to low visibility.

Future Operations:

RVR data can be provided via SWIM to domains other than TFM, specifically En Route. This facilitates making airport visibility data available from all RVR equipped sites and allows en route controllers to see RVR data for arrival airports. Traffic managers and Collaborative Decision Making (CDM) users will continue to have access to RVR data for evaluating airport constraints during planning activities.

Operational Benefits:

The increased availability of RVR data is expected to reduce the manual coordination by controllers by providing wider access to current runway conditions. En route controllers at the ARTCCs can use the RVR data as guidance information in accessing runway conditions for landing operations or determining the need for airborne holding for specific flights.

2.4 TFM Initiative Data

Current Operations:

Today, tower controllers are notified of controlled departure times as Estimated Departure Clearance Times (EDCTs). EDCTs are generated by TFM, incorporated in the flight plan, and printed on paper flight strips in the tower. In response to congestion or weather related constraints, Traffic Managers use TFM automation to assign specific departure times/windows to flights. This data is provided to the tower controller, generally the Flight Data/Clearance Delivery position, on flight strips via existing En Route automation capabilities. Other controlled departure times are communicated manually, such as when an ARTCC TMC provides a controlled departure time for:

- Flights from specified airports feeding into an en route stream (APREQ/Call for Release procedures)
- Flights departing for a metered arrival airport in the same ARTCC (TMA internal departures)
- Flights from specified airports feeding a common departure fix (DSP).

This two-way coordination between the tower controller and TMC includes the status of the flight and the constrained time, and is usually done via one or more phone calls.

In addition to revised departure times, tower controllers also receive revised routes due to TFM initiatives as revised flight strips, via existing En Route automation. These reroutes are entered by Traffic Managers directly into the En Route automation, and then routed to the appropriate controllers via normal flight data processing.

Other TFM initiative data, such as Miles-in-Trail (MIT) restrictions or general advisories, are made available either manually (e.g., phone) or via existing General Information capability in En Route automation, which is printed on flight strip printers in the tower. Tower personnel also enter TFM initiative data into tower information tools, such as entering the current airport acceptance rate into IDS (generic Information Display System) in the tower.

See Appendix B, Threads 3.1 and 3.2 for details.

Future Operations:

In SWIM Segment 1, access to flight status and event data from tower automation will allow current or future TFM tools, such as TFMS, Flight Schedule Monitor (FSM), TMA or the DFM, to better predict when flights are ready to depart, thereby allowing the generation of a more efficient departure schedule (or for TMA, an arrival schedule that includes internal departures). The TFM tools then make the associated departure times, which include EDCTs, APREQ times, and other controlled departure times, available to tower automation for execution by tower controllers. Note that at this time, EDCTs are expected to be available via the existing flight data from En Route, but there are no specific plans for TFM automation to share other controlled departure times from DFM or TMA with SWIM in this SWIM Segment 1 timeframe. However, the controlled departure times need to be available to tower personnel operationally. This represents an area of opportunity for future integration.

At towers with legacy flight strips, EDCTs will continue to be provided as controlled departure times on strips and other times will still be communicated manually. At towers with electronic flight data capability, e.g., EFS, controllers will be able to identify flights needing controlled departure times and have access to the controlled departure times that are generated by traffic managers using TFM automation, either locally or at another facility, if they are provided to SWIM. Tower controllers will use this information to depart the flight at the desired time, or initiate manual coordination to revise it.

TFM initiatives that involve reroutes will continue to be available as flight data updates. Other flight-specific traffic management data, such as MIT or dynamic altitude restrictions, are expected to be manually exchanged between traffic managers and tower controllers in this timeframe. Tower controllers will continue to have access to general TFM initiative information provided by TFM automation to ATC automation, similar to the current General Information message.

See Appendix B, Thread 3.3 for details.

Operational Benefits:

Improvements in the electronic dissemination of controlled departure times are expected to reduce both tower and traffic manager workload by reducing the need for manual communication of APREQ times or other TFM initiative information. The improved sharing of general TFM initiative data with terminal personnel provides for increased situational awareness of the overall flow initiatives in place that may impact local operations.

3 Future Terminal Data Exchange Concept – Post SWIM Segment 1

The capabilities in this section represent future data exchanges that Terminal may provide to SWIM subscribers beyond the SWIM Segment 1 timeframe. They are included in order to provide insight into how various types of terminal data, either in the tower or TRACON, may have potential operational benefits that could be realized once the operational concepts are more fully developed, the initial SWIM infrastructure provides a more efficient mechanism to share the data, and the associated automation capabilities are implemented.

3.1 Airport Configuration Data

Current Operations:

Airport configuration is the set of active runways and the assignment of each runway for landing, departure or both together with the approaches in use. Airport configuration changes are made in response to shifts in wind direction and expected traffic demand such as the arrival/departure mix. Other factors may also influence configuration such as Navigational Aid (NAVAID) availability, snow removal and construction. Changes to configuration are generally a collaborative process between ATCT and TRACON since both are affected and the change needs to be coordinated for a smooth transition.

The current airport configuration is entered separately into multiple systems in the ATCT (IDS, Digital Automated Terminal Information Service [D-ATIS], Airport Movement Area Safety System [AMASS], ARMT) and is disseminated to the TRACON electronically via IDS or via voice. It is conveyed via voice to the TMU in the ARTCC for entry into TMA and other TFM tools. Only the current configuration is entered into systems in the ATCT. Planned changes to the airport configuration are not entered into ATCT systems for dissemination electronically.

See Appendix B, Thread 4.1 for details.

Future Operations:

In the future, dissemination of current airport configuration will be done electronically to systems outside the ATCT. Dissemination electronically will also be done among systems in the ATCT. For example, the entry of configuration at the ATCT will be automatically distributed to other ATCT systems and to TMA in the center. In addition, it will be possible to enter and automatically disseminate planned configurations with a time of implementation.

See Appendix B, Thread 4.2 for details.

Operational Benefits:

Electronic distribution of current airport configuration will reduce workload of ATCT personnel for entry of data into multiple systems. Electronic distribution will also reduce the potential for data entry errors. Electronic distribution outside the ATCT will reduce the need for voice coordination and the potential for introducing errors in communications. It will also support new capabilities, for example, a capability in ERAM to automatically change activation status of preferred routes based on a configuration change.

Electronic dissemination of planned configuration will reduce workload for voice coordination and re-entry of data and will reduce potential for communications errors.

3.2 TRACON Flight Data

Current Operations:

Most of the flight data in the TRACON is provided by the Host en route automation system. With the exception of sites that have DSP, flight data available to the terminal is limited by what the en route automation system prints via FDIO on paper flight strips or sends to ARTS/STARS via the existing inter-facility interface. The data sent routinely to the TRACON is controlled by the Host and changes to get additional data or to change format of the flight strip data require coding changes in the en route automation system. Examples of limitations are:

- route information is not printed on arrival strips in the TRACON
- data that is unique to the ICAO flight plan, such as data on aircraft equipage, is not routinely available.

Additional data is available in the TRACON via the FDIO "full route" readout; however, that adds to the controller workload since it requires an additional input message and additional strip(s). In the TRACON, FDIO data entry devices are not accessible to the controller so the readout entry must be made by a flight data specialist and the readout strip passed to the controller.

Entry of flight data at TRACON controller positions is limited to Visual Flight Rules (VFR) flight plans and abbreviated flight plans for local terminal flights. Flight plans for Instrument Flight Rules (IFR) flights that will exit the terminal airspace must be entered via the flight data specialist.

Distribution of flight data to ARTS/STARS control positions for display in the Arrival/Departure Tabular List is based on entry-exit fix-pairs determined by the Host. This may not always work correctly for flights, such as flights on direct routes or for flights with complex terminal routing involving multiple ARTCCs or TRACONs (e.g., PHL). This increases workload on TRACON and ARTCC controllers, who must coordinate manually and may need to correct routing. Further, this adds to the Host adaptation maintenance workload and makes the terminal more dependent on ARTCC resources. [6]

Future Operations:

The TRACON systems will be able to subscribe to any flight data in the ERAM flight object. The full route and ICAO flight plan unique data could be routinely sent to ARTS/STARS and be available to the TRACON controller for display. Trajectory information of interest to the TRACON could be sent to ARTS/STARS and used for distributing flight data and for graphical display of the route to TRACON controllers.

ARTS/STARS will be able to send flight data for incorporation into the ERAM flight object. The capability to enter IFR fight plans and amendments at TRACON controller positions could be provided.

Operational Benefits:

The capability to subscribe to the ERAM flight object will support increased use of Area Navigation also Random NAVigation/Required Navigation Performance (RNAV/RNP) routes in the terminal. The controller will have the route of flight for arrivals as well as departures routinely available, indicating which flights are on an RNAV/RNP route. The controller could also display the graphic route of flight on the ARTS/STARS situation display and ARTS/STARS could do conformance monitoring and indicate non-conformance to the controller. Also, the controller would have ICAO equipage routinely available indicating a flight's capability to fly RNAV/RNP routes. If a flight needed to be re-routed by the TRACON radar controller, the reroute could be done from the radar controller's position rather than from a flight data position, reducing coordination and extra work for the controller.

Use of FDIO in the TRACONs could be reduced or eliminated by providing the controller with a flight data entry capability.

3.3 Terminal Position Data

This data exchange is included in this document in order to provide visibility into an existing data exchange between terminal and TFM that may be facilitated by changes in the

SWIM Segment 1 timeframe. The SWIM FF COI has expanded its scope to include current ARTS/STARS flight data; this section is included as a possible SWIM Segment 2 data exchange.

Current Operations:

Aircraft position data are sent from the TRACON systems (ARTS/STARS) to TFM automation (ETMS) at those sites where there is an ETMS server collocated at the terminal facility. Terminal sites that do not have a local ETMS can send the position data (e.g., ARTS tracks) via the Host computer system, which transfers it to ETMS. ETMS uses the terminal position data to refine its trajectory and to display the flight position to the traffic manager.

Future Operations:

Aircraft position data from TRACON systems (ARTS/STARS) could be made available to TFM and other users via SWIM. This would allow other users to have access to terminal position data and facilitate the existing distribution of terminal data by providing direct access.

Operational Benefits:

Access to aircraft position data at more sites and by more users provides improved situational awareness, which is expected to improve overall system performance.

3.4 Terminal Arrival Flight/Track Data

Current Operations:

The terminal domain provides additional arrival flight data to TFM and users at selected airports via Surface Movement Advisor (SMA). SMA receives real-time flight and position data from the terminal automation (ARTS/STARS). It provides the Ramp tower and AOC personnel this real-time data for flights arriving at an airport at 20-second intervals. SMA data is used by Ramp personnel primarily for planning ground operations. SMA provides a list of arrivals with touchdown time prediction and position, distance, altitude, and speed. SMA also provides a graphic situation display of arrival flights showing position relative to the airport. SMA systems are operational at more than 20 sites.

In addition to users, SMA sends gate assignment, flight position of the aircraft relative to the arrival airport, and estimated touchdown time data to the TFM system. This data is not used currently by TFM but is routed through the TFM data distribution system (e.g., Volpe National Transportation Systems Center) to participating AOCs.

Future Operations:

SMA data consists of two parts: the flight and positional data that is sent from the terminal automation (e.g., ARTS) to SMA, and the data generated by SMA, which is a list of arrivals and predicted times. The data could be sent to SWIM via the proposed tower distribution system. Currently there are no known plans to incorporate SMA data exchanges with Terminal, or TFM in SWIM in the Segment 1 timeframe. This is included here for completeness and as a potential area for more research.

Operational Benefits:

Increased access to arrival prediction data via SWIM could increase situational awareness for traffic managers. This can lead to improved opportunities for arrival planning. This is an area that needs more research to determine the operational benefits. In addition, the operational benefits to the airport, airline and ramp service providers might be more widely available if this becomes part of the SWIM services, which could improve overall system performance.

3.5 Enhanced Arrival/Departure Management and TMI Initiatives

Current Operations:

Traffic managers at the TMU unit at the ARTCC currently use the TMA as a strategic planning tool that affects traffic flow (arrivals) and planning of aircraft operating in en route airspace. In addition to managing arrivals, TMA also provides a departure scheduling capability for internal departures, i.e. flights that are departing from airports in the same facility as the arrival airport that is being metered. This departure scheduling function generates a controlled departure time, similar to an APREQ time, based on the desired arrival time. ARTCC TMCs manually coordinate with tower controllers to determine when the flight is ready to depart and to communicate the controlled times.

Today, some facilities have an additional TFM tool, ARMT, which is used by traffic managers for arrival/departure management. There is currently an interface to ARMT from EFSTS in the tower that provides updated flight status/event data for departures when a tower controller swipes the flight strip to indicate the flight has started to taxi or takeoff. This can be used by TMCs to fine-tune departure traffic flow management by identifying those flights that are ready for controlled release times (e.g., APREQ). ARMT also provides predicted arrival times based on flight plan and ARTS track data.

Future Operations:

In SWIM Segment 1, it is expected that TFM automation will provide limited controlled departure times, such as EDCTs, via En Route automation to tower automation, which displays it to the tower controller for implementation. In later SWIM segments, a larger number of TFM tools are expected to provide controlled departure times, such as TMA and the future DFM.

Enhancements to arrival/departure management by TFM automation are expected, such as providing predicted arrival or departure flight data to tower or TRACON controllers via SWIM. For those facilities with electronic flight data automation, the tower controller may be able to request a revised EDCT, APREQ time or other controlled departure time, or notify TFM that the controlled departure time will be missed, using electronic coordination capabilities. In addition, enhancements in terminal automation may facilitate the future display of TMA or other TFM metering information to TRACON controllers for arrival or departure management. This could include scheduled arrival times or scheduled departure times, as well as queue and/or delay information. The concept for providing this information to TRACON controllers needs to be developed.

In addition, tower controllers may have access to predicted surface queues, predicted departure times, and predicted taxi delays and other predicted departure management data that TFM will generate. The concept of use is still being developed but it does include predicted arrival/departure demand data, which includes surface demand data, to be generated by TFM automation and provided to tower controllers for increased situational awareness and tactical coordination.

Operational Benefits:

The automation of the data exchange between tower and TRACON controllers and TMCs to provide flight status or controlled times (e.g., APREQ or metering times) is expected to significantly reduce the need for manual coordination and workload for both TMCs and terminal controllers. The situational awareness provided by the expanded data exchange enhances arrival/departure management in the terminal area, which reduces delays and improves system-wide performance.

4 Areas of Further Work

4.1 Operational Concepts

The focus of this document is on engineering analyses to support cross-domain concept and requirements definition for a select group of cross-domain capabilities. Some of these capabilities have been validated operationally under their respective domains. However, some data that is now expected to available via SWIM-enabled improvements and infrastructure needs more operational concept refinement and validation during the actual requirements definition activities.

In particular, a more detailed operational concept for the use of enhanced flight data in the TRACON is needed. This includes the use of En Route-provided flight data, tower-added flight data, and internal TRACON-added flight data by TRACON controllers. In addition, future work could address the potential needs and concepts for enhanced tower entry of flight data amendments, such as the incorporation of ATC Preferred Routes.

4.2 Level of Detail

This concept of use document was developed at a level of detail designed to be sufficient for the SWIM investment analysis activities, e.g., high-level requirements, functional allocations and costing. The details in the appendices, specifically the matrices, provides supporting material for estimating the automation enhancements and interface costs for implementing Terminal data exchange via the SWIM framework. In order to support the more detailed requirements for actual system implementation for terminal automation and cross-domain capabilities, more detailed system data exchange information is required. This next level of detail would provide the inputs for system interface requirements documents, and include more performance requirements than the current analysis.

In addition, the operational concepts of use may need to be developed in more detail in order to ensure sufficient detail for operational validation.

4.3 Expansion of Data Elements and Candidate Systems

There are several cross-domain data exchange areas that are not included in this analysis but may present opportunities for further integration and benefits as the SWIM and Terminal infrastructures are developed. Some of these are described in the above section and include the following:

- ARTS/STARS scratch pad information, such as arrival runway
- IDS airport information
- Airport and TRACON acceptance rates
- Notice(s) to Airmen (NOTAMs)

5 Summary

5.1 Terminal Operational Concept, Capabilities and Benefits

The following table is a summary of the data categories, the expected data exchange and the potential benefits, described in the operational concept section of this document, that are expected in SWIM Segment 1.

Table 5-1. Terminal SWIM Segment 1 Data Exchange Summary

#	Data Category	Data Category Description	Data Exchange Description	Potential Operational Benefits
1.	Flight Data	Flight plan and flight object data, including trajectory	2-way between Tower and ERAM Includes full flight plan from En Route. Includes flight strip data derived by ERAM	Enables sharing of full flight data, which enables automation of revised clearances which reduces tower workload and delays due to voice clearances. This in turn improves implementation of TFM reroute initiatives for pre-departures.
2.	Flight Status/Event Data			
	2.a - Tower Flight Status/Event Data	Flight status (e.g., aircraft at spot or in lineup) or event (e.g., starts taxi or runway roll) data that is captured on controller action or derived by automation.	From tower automation (EFSTS) to TFM and ERAM Flight Object.	Provides surface data for more accurate modeling of predicted departure times, which improves system performance. Captures surface events for delay calculations. Provides flight status for increased situational awareness.
	2.b - Clearance Delivery Status Data	Pre-departure clearance delivery status from tower automation when clearance is delivered to pilot (by automation or controller).	From tower automation (TDLS/PDC or EFS) to ERAM Flight Object	Provides increased situational awareness.

#	Data Category	Data Category Description	Data Exchange Description	Potential Operational Benefits
3.	Surface Position Data	Surface position reports (surface surveillance correlated with flight data)	From tower automation (ASDE - 3X/ASDE-X) to TFM	Provides surface data for more accurate modeling of predicted departure times, which improves system performance. Note that this capability requires additional functionality, currently being prototyped in TFM, to convert the raw data provided by tower automation into flight status/event data. (See above).
4.	Airport Status Data			
	4.a - RVR (Runway Visual Range) Data	Runway visibility data for each runway	Terminal to ERAM and TFM	Provides situational awareness for arrival/departure management, including potential for airborne holding.

5.2 Future Terminal Data Exchange: SWIM Segment 2

The following table is a summary of several future data exchange capabilities that are expected to evolve from those provided in SWIM Segment 1. After the initial set of capabilities and service definitions, it is expected that the En Route, TFM and Terminal domains will expand the scope of data that is available to SWIM and other users. The ERAM Flight Object is also expected to evolve and provide more opportunities for terminal automation to access and use flight data that will now be available.

Table 5-2. Future Terminal Data Exchange Summary

#	Data Category	Data Category Description	Data Exchange Description	Potential Operational Benefits
1.	Flight Data	Flight plan and flight object data, including trajectory	2-way between Terminal (ATCT and TRACON) and ERAM Flight Object. Includes full flight plan from En Route. Terminal provides auxiliary flight data such as departure runway and departure	Enables sharing of full flight data and flight object data, which supports future capabilities, including trajectory modeling in En Route and TFM.

#	Data Category	Data Category Description	Data Exchange Description	Potential Operational Benefits
			gate. Includes flight strip data derived by ERAM.	
2.	Airport Configuration Data	Current and/or planned runway configuration	Distribution of current and future airport (runway) configurations between Terminal, En Route and TFM (multiple systems).	Supports enhanced arrival/departure management. Supports more accurate modeling of predicted departure and arrival times, which improves system performance.
3.	Terminal Position Data	TRACON position data derived from correlation of surveillance and flight data.	ARTS/STARS to SWIM, as possible "Terminal Track Service."	Provides situational awareness to wider distribution of users, which improves overall system performance.
4.	Arrival Flight Data	Flight and track data, including predicted arrival times.	Terminal (ARTS/STARS/ SMA) to Users (ramps), SWIM and Flight Object. Terminal provides auxiliary flight data such as arrival runway and arrival gate.	Enables sharing of flight data and flight object data, which supports future capabilities. Supports more accurate modeling of predicted departure and arrival times, which improves system performance.
5.	Enhanced Arrival /Departure Management	Controlled departure or arrival times from TMA; flight status/event data from Terminal.	2-way data exchange, most likely through ERAM Flight Object. TMA to Terminal for controlled times and Terminal to TMA for flight status/event data. Could also include data exchange between Terminal and ARMT and predicted surface data from TFM.	Improved tower implementation of TFM initiatives for departures and arrivals. Provides situational awareness for enhanced arrival/departure management.

#	Data Category	Data Category Description	Data Exchange Description	Potential Operational Benefits
6.	TFM Initiative Data	Controlled departure or arrival times, routes, and restrictions from TFM.	TFM to Terminal, most likely through ERAM Flight Object, including controlled times from DSP/DFM or TFMS (EDCTs).	Improved tower implementation of TFM initiatives for departures and arrivals. Provides situational awareness for enhanced arrival/departure management.
7.	Predicted Flight Data	Predicted surface, departure and arrival data, including predicted flight path, lineup positions, and predicted event times.	TFM to Terminal. This could be provided by DSP, ARMT or future DFM.	Provides situational awareness for enhanced arrival/departure management. In Segment 1, expected to be primarily for departures.

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7 Glossary

AEFS	Advanced Electronic Flight Strip System
AFP	Airspace Flow Program
AMASS	Airport Movement Area Safety System
AOC	Airline Operations Center
APREQ	Approval Request
ARMT	Airport Resource Management Tool
ARTCC	Air Route Traffic Control Center (FAA)
ARTS	Automated Radar Terminal System
ASDE-3X	Airport Surface Detection Equipment – Model 3X
ASDE-X	Airport Surface Detection Equipment – Model X
ATC	Air Traffic Control
ATCT	Air Traffic Control Tower
ATM	Air Traffic Management
ATO-E	Air Traffic Organization-En Route and Oceanic Services
ATO-R	Air Traffic Organization-Systems Operations Service
ATO-P	Air Traffic Organization - Operations Planning
ATO-T	Air Traffic Organization-Terminal Services
ATCSCC	Air Traffic Control System Command Center
CAASD	(MITRE's) Center for Advanced Aviation System Development
CDM	Collaborative Decision Making
COI	Community of Interest
D-ATIS	Digital Automated Terminal Information Service
DFM	Departure Flow Management
DHS	Department of Homeland Security
DODAF	Department of Defense Architecture Framework

DSP	Departure Spacing Program
EDCT	Expect Departure Clearance Time
EFS	Electronic Flight Strip System
EFSTS	Electronic Flight Strip Transfer System
ERAM	En Route Automation Modernization
ETMS	Enhanced Traffic Management System
FAA	Federal Aviation Administration
FDIO	Flight Data Input/Output
FF	Flight and Flow
FSM	Flight Schedule Monitor
FY	Fiscal Year
HCS	Host Computer System
ICAO	International Civil Aviation Organization
IDS	Information Display System
IFR	Instrument Flight Rules
MIT	Minutes/Miles in Trail
MITRE	The MITRE Corporation
NAS	National Airspace System
NextGen	Next Generation Air Transportation System
NOTAMS	Notice(s) to Airmen
P-ATM	Performance-based Air Traffic Management
PDC	Pre-Departure Clearance
RNAV	Area Navigation also Random NAVigation
RNP	Required Navigation Performance
RVR	Runway Visual Range

SMA	Surface Movement Advisor
STARS	Standard Terminal Automation Replacement System
SWIM	System Wide Information Management
TDLS	Tower Data Link System
TFDM	Tower Flight Data Management
TFM	Traffic Flow Management
TFMS	Traffic Flow Management System
TMA	Traffic Management Advisor
TMC	Traffic Management Coordinator
TMU	Traffic Management Unit
TRACON	Terminal Radar Approach Control Facility
VFR	Visual Flight Rules

Appendix A Operational and System Data Exchange Matrices (ATCT and TRACON)

A separate attachment contains the following data exchange matrices:

1. Current Operational Data Exchange
2. Current System Data Exchange
3. Future Operational Data Exchange
4. Future System Data Exchange

These data exchange matrices are organized by ATCT and TRACON exchanges to TFM and En Route and vice versa, in order to provide insight into the domain-specific data needs that may impact both the operational and program approaches. The operational matrix focuses on the logical data exchange among users, which includes electronic, telephone and manual methods. The system data exchanges provide insight into the current implementation and preliminary expectations for the future allocations. The system data exchanges are identified as provided by baseline, Segment 1 or Post-Segment 1 automation capabilities. These future system data exchanges are expected to be updated as the domains decompose the planned services and allocate their capabilities.

Appendix A - Operational and System Data Exchange Matrices (ATCT and TRACON)

OV-3 **Operational Data Exchange**

Ops ID - identifies row in operational info exchange matrix
Includes manual interfaces, i.e. no automation in SV-6 sheet to support operational data exchange in OV-3

ATC and TFM domains are distinct within each facility node

Scope col.

Bline - Operational Capability is provided by baseline component in Segment 1 timeframe
Seg 1 - Operational Capability will be supported by enhancements in SWIM Segment 1 timeframe.
Post-Seg 1 - Operational Capability expected in post 2013, i.e. future SWIM segment

SV-6 **System Data Exchange**

All allocations to systems within domains are assumptions. Specific allocations are TBD.

Scope col.

Bline - System Capabilityis provided by baseline component in Segment 1 timeframe
Seg 1 - System Capability will be provided by SWIM component in SWIM Segment 1 timeframe.
Post-Seg 1 - System Capability expected in post 2013, i.e. future SWIM segment

FDIO refers to Tower FDIO unless otherwise noted.

Sys ID - identifies row in system data exchange matrix

TFM/DFM refers to Departure Flow Management capability within TFM automation. May be a separate system or maybe part of TFMS.

Note that not all system exchanges are shown on Future System Data Exchange for brevity. If tower remains on legacy FDIO, see Current sheet for system data exchanges.

Performance requirements are TBD. In general, maximum of 1 minute is used for flight data exchanges.

IDs	Information Description					Source		Destination		Performance		Scope	Remarks
Op ID (current)	Current Operational Data Description	Media	Data Category	Purpose	Trigger	Producer (Node)	Producing Activity	Consumer (Node)	Consuming Activity	Frequency	Timeliness	SWIM Seg	
	The following current operational data exchanges are not likely to be supported by future capabilities within SWIM Seg 1.												
	These are included for completeness and as potential candidates for SWIM Seg 2.												
0	Local departure procedure	CD, hardcopy	Airport/ Airspace Status	Provide locally adapted departure route	Operational change, chart-date	ATCT ATC	Maintain local adaptation	All TFM nodes	Maintain adaptation	56 days	Monthly maintenance	Bline	Adaptation also available to En Route and users, e.g., CDR routes.
0	Airport Acceptance Rate	electronic, phone	Airport/ Airspace Status	Distribute initial or revised AAR	Operational decision	ATCT ATC	Determine airport AAR	All TFM nodes, all ATC nodes	Maintain airport status	Once, then as needed	Strategic and Tactical	Bline	Decision is made collaboratively, but ATC in tower have the lead. Note that this info is then made available by TFM (ATCSCC Webpage OIS) to large community. May be out of scope, but might be considered a prerequisite for TMI data from TFM to Term?
0	Airport Configuration - Current or Planned	phone	Airport/ Airspace Status	Distribute initial or future airport/runway configuration. For use by TFM in capacity planning and needed for arrival metering	Operational decision	ATCT ATC, TRACON TFM	Determine airport configuration	All TFM nodes, All ATC nodes	Maintain airport status	Once, then as needed	Strategic and Tactical	Bline	Decision is made collaboratively, but ATC in tower have the lead. Out of scope, but might be considered a prerequisite for TMI data from TFM to Term? Current Configuration Data is entered today via IDS; planned configuration data is not currently entered in the ATCT.
0	Airport Surface Status	Phone, electronic	Airport/ Airspace Status	Distribute initial or future surface conditions, such as de-icing or visibility data	Operational decision	ATCT ATC	Determine airport operational surface status	All TFM nodes, All ATC	Maintain airport status	Once, then as needed	Strategic and Tactical	Bline	ATC in tower have the lead. RVR data available to TFM electronically but any other airport status is seen as post Seg 1. Note that this info is then made available by TFM (ATCSCC Webpage OIS) to large community.
0	Flight Data for local (within TRACON) flight	manual	Arrival/Dept Flight Data	Provide flight data on local flight such as helicopter flight or training flight.	Aircraft contacts tower	ATCT ATC	Provide local departure data	TRACON ATC	Update flight data	On request	Tactical	Bline	Not expected in SWIM Seg 1

IDs		Information Description				Source	Destination	Performance		Scope	
Sys ID# (current)	Op ID (current)	Current System Data Description	Data Category	Purpose	Trigger	Producer (Node)	Consumer (Node)	Frequency	Timeliness	SWIM Seg	Remarks
		Tower to TFM									
3	8, 17	Flight Strip Data (initial strip, revisions and information updates)	Flight Data	Provide flight strip data, including EDCT, to ARMT for display to tower/TRACON TMC	Data sent by Host to FDIO Printer in tower.	EFSTS	ARMT	Once, then as needed.	Initial strip, 5-30 min before Proposed Time of Departure. Updates as needed.	Bline	Multi-system data exchange that includes a Terminal to TFM segment. (HCS-FDIO, FDIO-EFSTS, EFSTS-ARMT. This exchange includes both the initial data and any revisions.
5	18	Start taxi	Terminal Flight Status/Event	Provide status of departure	Scanning of Bar Code on strip by controller	EFSTS	ARMT	once	On event	Bline	Updates flight status at ARMT in tower and TRACON TMU.
6	6	Takeoff message	Terminal Flight Status/Event	Provide status of departure	Scanning of Bar Code on strip by controller	EFSTS	ARMT	once	On event	Bline	Takeoff message may not be needed since ARMT also gets ARTS track messages.
14	8	FP amendment	TMI Execution	Enter amendment to reroute pre-departure flight	Amendment entry by tower controller	Tower FDIO	Host (Intermediate system)	On event	On event	Bline	This system exchange is the first step in the multi-system tower-TFM data exchange that supports the Ops exchange when a tower controller enters an amendment. It uses an intermediate ATC system to ATC system exchange between different system nodes.
12	8	Updated flight plan data	Flight Data	Distribute updated flight data	Host receives amendment message from tower controller via ATCT FDIO, AND Current time is within Host time window for transmission of data	Host (Intermediate system)	ARTS (Intermediate System)	On event	Within 1 minute	Bline	This is a multi-system data exchange that supports the Ops exchange when a tower controller enters an amendment and the updated data is provided to TFM systems.

IDs		Information Description				Source	Destination	Performance		Scope	
Sys ID# (current)	**Op ID** (current)	**Current System Data Description**	**Data Category**	**Purpose**	**Trigger**	**Producer (Node)**	**Consumer (Node)**	**Frequency**	**Timeliness**	**SWIM Seg**	**Remarks**
13	8	Updated flight plan data	Flight Data	Distribute updated flight data	Updated flight data received from Host	ARTS (Intermediate System)	ARMT	On event		Bline	This is a multi-system data exchange that supports the Ops exchange when a tower controller enters an amendment and the updated data is provided to TFM systems. *Note that ARMT also receives track data from ARTS, which is out of scope.*
15	8	Updated flight plan data	Flight Data	Distribute updated flight data	Host receives amendment message from tower controller via ATCT FDIO	Host (Intermediate system)	ETMS	On event	Within 1 minute after Host processes the amendment	Bline	This is a multi-system data exchange that supports the Ops exchange when a tower controller enters an amendment and the updated data is provided to TFM systems.
20	8	Updated flight plan data	Flight Data	Distribute updated flight data	Updated flight data received from Host	Host (Intermediate system)	HADDS (Intermediate system)	On event	Within 1 minute	Bline	This is a multi-system data exchange that supports the Ops exchange when a tower controller enters an amendment and the updated data is provided to other systems. HADDS represent an Intermediate Point of Presence (IPOP) that distributes data between En Route and various TFM automation.
7	8	Updated flight plan data	Flight Data	Distribute updated flight data.	Updated flight data received from Host	HADDS (Intermediate system)	DSP	On event	Within 1 minute	Bline	This is a multi-system data exchange that supports the Ops exchange when a tower controller enters an amendment and the updated data is provided to TFM systems. HADDS represent an Intermediate Point of Presence (IPOP) that distributes data between En Route and TFM automation.

IDs		Information Description				Source	Destination	Performance		Scope	
Sys ID# (current)	Op ID (current)	Current System Data Description	Data Category	Purpose	Trigger	Producer (Node)	Consumer (Node)	Frequency	Timeliness	SWIM Seg	Remarks
		TFM to Tower									
1	13	Controlled Dept Time/EDCT	TMI Execution	Send EDCT to ATCT ATC	Ground delay or AFP program has been executed, and time within 60 min before departure	ETMS	Host (Intermediate system)	Once, then as needed.	60 - 0 min < Ptime	Bline	The operational exchange is from TFM (ATCSCC) to ATC (Tower), but system exchange goes via En Route automation. The EDCT is applied within TFM automation whenever the GDP is executed, but is sent to HCS 60 min prior to departure time. Revised EDCTs are sent using same framework, as needed.
2	13	Controlled Dept Time/EDCT	TMI Execution	Provide EDCT to ATCT ATC for implementation of controlled departure time	HCS receives CT msg from ETMS and it is time to print tower strip	Host (Intermediate system)	ATCT FDIO	Once, then as needed.	30-45 min < Ptime	Bline	The operational exchange is from TFM (ATCSCC) to ATC (Tower), but system exchange goes via En Route automation. See related system data exchange #1.
18	19	Fuel Advisory Delay Data	TMI Execution	Provide a default EDCT for flights that get an average delay based on TMC entry	Previous FA message and entry of flight plan eligible for FA processing	ETMS	ATCT FDIO	As needed	Within 60 second of flight plan entry or when strips are due to print	Bline	Actual interface is through ETMS-HCS-FDIO interface over NADIN. Note: Not used much or at all operationallly, but still a TFM to ATC ops exchange that is supported by ETMS and HCS automation and interfaces.
8	16	FP amendment	TMI Execution	Enter amendment to reroute pre-departure flight	User at ZNY departure complex enters amendment	DSP	Host (Intermediate system)	As needed	On event	Bline	This is the DSP "KVDT emulation" capability. System data exchange is TFM (DSP) to ATC (ATCT FDIO), via En Route (Host)
9	10	TFM Advisory	TMI Execution	General Information notification, such as GDP or reroutes, from TFM to ATC	TFM operational decision	ETMS	Host (Intermediate system)	As needed	Strategic (1-2 hrs before TMI takes effect)	Bline	Currently, GI messages that provide situational awareness of TFM TMIs, usually entered by ARTCC TMU. Uses En Route automation General Info Message capability to provide to tower automation to support operational exchange

IDs		Information Description				Source	Destination	Performance		Scope	
Sys ID# (current)	Op ID (current)	Current System Data Description	Data Category	Purpose	Trigger	Producer (Node)	Consumer (Node)	Frequency	Timeliness	SWIM Seg	Remarks
10	10	TFM Advisory	TMI Execution	General Information notification, such as GDP or reroutes, from TFM to ATC	TFM operational decision	Host (Intermediate system)	ATCT FDIO	As needed	Strategic (1-2 hrs before TMI takes effect)	Bline	Currently, GI messages that provide situational awareness of TFM TMIs, usually entered by ARTCC TMU. Uses En Route automation General Info Message capability to provide to tower automation to support operational exchange
16	16	Revised Flight strip data	Flight Data	Send revised flight strip data to tower in response to a reroute amendment	HCS receives amendment message from DSP and it is time to print or reprint tower strip	Host (Intermediate system)	FDIO	On event	60 - 0 min < Ptime	Bline	This system exchange supports many operational threads whenever TFM updates flight data, then the intermediate En Route system (Host) provides the updated data to ATC automation (FDIO) in the tower, which then distributes it within tower automation (e.g., TDLS/PDC, EFSTS, ARMT).
		Tower to En Route									
21	23, 24, 25	Flight Plan, Amendment, Departure, Remove Strip, Request Route Conversion, Strip Request	Flight Data	To enter new flight plan or update flight data or cause en route automation to reconvert route (and re-process preferential routes)	Tower controller data entry	FDIO	Host	As needed	N/A	Bline	Assumes that tower has FDIO. Baseline flight data processing by En Route automation from tower data entry.
22	26	Flight Plan Readout Request	Flight Data	Request additional flight data.	Tower controller data entry	FDIO	Host	As needed	N/A	Bline	Assumes that tower has FDIO.

IDs		**Information Description**				**Source**	**Destination**	**Performance**		**Scope**	
Sys ID# (current)	**Op ID** (current)	**Current System Data Description**	**Data Category**	**Purpose**	**Trigger**	**Producer (Node)**	**Consumer (Node)**	**Frequency**	**Timeliness**	**SWIM Seg**	**Remarks**
		En Route to Tower									
23	27	Flight Strip Data	Flight Data	Provide flight data to tower controller	Intial strip printed based on automation system time parameter before Proposed time of departure. Updates are output as data changes.	Host	FDIO	As needed	Within 60 sec of strip print time or of entry of update or request.	Bline	Assumes that tower has FDIO.
24	27	Flight StripData	Flight Data	Provide flight data to EFSTS	FDIO receives strip data from Host	FDIO	EFSTS	On initial strip printing or on update	Simultaneous with receipt by FDIO.	Bline	This is a multi-system data exchange, using FDIO in the tower to distribute flight data from Host to tower automation.
28	28	Flight Plan Information Update	Flight Strip	Provide flight data updates	Update of previously sent data.	Host	FDIO	As needed	Within 60 sec of update or request.	Bline	Assumes that tower has FDIO. These are flight information updates, as separate from reprinted strips.
29	27	Response to Flight Plan Readout	Flight Strip	Provide additional flight data such as full route to tower controller	Controller enters request	Host	FDIO	As needed	Within 60 sec of update or request.	Bline	Assumes that tower has FDIO.
		Tower to TRACON									
11	29	"Rolling report"	Terminal Flight Status/ Event	Provide take off information for the departed flight	Takeoff	EFSTS	TRACON EFSTS	Once	Tactical	Bline	This is also provided today via EFSTS swipe.
17	31	Tower-Added Flight Data	Arrival/Dept Flight Data	Provide additional data such as departure runway, initial heading, initial altitude.	Flight strip processing	EFSTS	TRACON EFSTS	Once	Tactical	Bline	This is auxiliary data that is added to flight strip by the tower, such as departure procedure or runway. May be transferred electronically via EFSTS

IDs		**Information Description**				**Source**	**Destination**	**Performance**		**Scope**	
Sys ID# (current)	**Op ID** (current)	**Current System Data Description**	**Data Category**	**Purpose**	**Trigger**	**Producer (Node)**	**Consumer (Node)**	**Frequency**	**Timeliness**	**SWIM Seg**	**Remarks**
		TRACON to TFM									
19	39	RVR (Runway Visual Range)	Airport Status	For use by TFM and users n capacity planning.	Data from various airport sensors	RVR	TFM (ETMS)	Every 2 sec	Tactical	Bline	Currently available for about 50 airports. Data is collected at server in TRACON and sent to ETMS. *Note that ETMS makes available to users.*
		TRACON to En Route									
26	34	Flight Plan, Amendment, Departure, Remove Strip, Request Route Conversion, Flight Plan Readout Request, Strip Request	Flight Data	To enter new flight plan or update flight data or cause en route automation to reconvert route (and re-process preferential routes) or to request additional flight data.	TRACON controller data entry	FDIO	Host	As needed	N/A	Bline	
27	34	VFR Flight Plan	Flight Data	To enter new flight plan for a VFR flight.	TRACON controller data entry	ARTS or STARS	Host	As needed	N/A	Bline	
4	35	Flight Plan Readout	electronic	TRACON ATC		ARTCC Host	As needed/on request	As needed	N/A	Bline	

IDs		Information Description				Source	Destination	Performance		Scope	
Sys ID# (current)	Op ID (current)	Current System Data Description	Data Category	Purpose	Trigger	Producer (Node)	Consumer (Node)	Frequency	Timeliness	SWIM Seg	Remarks
		En Route to TRACON									
25	33, 36, 37	Flight Strip, Flight Plan Information Update, Response to Flight Plan Readout	Flight Data	Provide flight data to TRACON controller	Intial strip printed based on automation system time parameter before Proposed time of departure. Updates are output as data changes. Readout is on controller request.	Host	TRACON FDIO	As needed	Within 60 sec of strip print time or of entry of update or request.	Bline	
24	38	NAS/ARTS Flight Plan or Amendment	Flight Data	Provide flight data to TRACON controller	Flight Plan sent a parameter time before departure time. Amendments when previously sent data is amended.	Host	ARTS/STARS	As needed	Within 60 sec of timer-based time or of entry of update or request.	Bline	

IDs	Information Description					Source		Destination		Performance		Scope	Remarks
Op ID (future)	Current Operational Data Description	Media	Data Category	Purpose	Trigger	Producer (Node)	Producing Activity	Consumer (Node)	Consuming Activity	Frequency	Timeliness	Timeframe	
0	Estimated Gate Push-Back Time	voice, phone, *electronic*	Terminal Flight Status/Event	Provide estimated OUT time	User-provided estimate or ATCT controller determination	ATCT ATC	Coordinate expected departure time	All TFM Nodes, All ATC	Predict departure flight demand	On request	Strategic and Tactical	Post-Seg 1	Tower controller may get updated expected departure time, i.e. revised P-time, manually from user via pilot or ramp. *May enter into tower automation for transfer to TFM and other domains.*
0	Predicted Arrival Time	electronic	Flight Data	Predict runway arrival time	ARTS Track data	TRACON ATC	Distribute predicted arrival times	All TFM Nodes, CDM users, ATCT ATC	Arrival Management	Track update cycle	Tactical	Post-Seg 1	SMA provides estimated arrival times to TFM, which passes them on to CDM users. Possible Future enhancement for SMA, which also provides this data on a graphic display to TMCs or other external users?
0	Flight Data Trajectofy	electronic	Flight Data	Provide common trajectory for tower display	Parameter time before departure time. Amendments when previously sent data is amended.	ARTCC ATC	Distribute flight data	ATCT ATC	Maintain flight data	Once, then as needed	Tactical	Post-Seg 1	For use when tower does not have radar coverage. Ops concept and requirement TBD.
0	Estimated Surface Times for Arrivals	electronic	Predicted Arrival/Dept Flight Data	Provide airport arrival demand, including surface demand	Position reports, event detections	ATCT TFM, ARTCC TFM, TRACON TFM	Predict surface demand	ATCT ATC	Surface management		Tactical	Post-Seg 1	TFM provides predicted surface event times, including surface queues, predicted delays, taxi times, etc. ATC uses for common situational awareness. *ATCT concept of use is TBD and therefore no system data exchange is provided.*
0	TFM Departure Status (Flight Status)	electronic	TFM Flight Status/Event	Provide departure status for specific flight	Event detection by TFM automation	ATCT TFM, ARTCC TFM, TRACON TFM	Coordinate expected departure time	ATCT ATC	Predict departure flight demand	On Event	Tactical	Post-Seg 1	TFM will provide its Flight Status and Event data to ATCT. *ATCT concept of use is TBD and therefore no system data exchange is provided.*
0	Estimated Surface Times for Departures	electronic	Predicted Arrival/Dept Flight Data	Provide airport departure demand, including surface demand	Position reports, event detections	ATCT TFM, ARTCC TFM, TRACON TFM	Predict surface demand	ATCT ATC	Surface management		Tactical	Post-Seg 1	TFM provides predicted surface event times, including surface queues, predicted delays, taxi times, etc. ATC uses for common situational awareness. *ATCT concept of use is TBD and therefore no system data exchange is provided.*

IDs		Information Description				Source	Destination	Performance		Scope	
Sys ID# (future)	Op ID (future)	Current System Data Description	Data Category	Purpose	Trigger	Producer (Node)	Consumer (Node)	Frequency	Timelines s	SWIM Seg	Remarks
		Tower to TFM									
3	1, 8, 17	FlightData (full flight data and information updates)	Flight Data	Provide flight data, including EDCT, to ARMT for display to tower/TRACON TMC	Data sent by ERAM to Tower Automation (could be parameter)	EFS	ARMT	Once, then as needed.	Within 1 minute	Seg 1	Multli-system data exchange that includes a Terminal to TFM (ARMT) segment. (ERAM--EFS, EFS-ARMT). This flight data is no longer limited to flight strip data, but can include the full flight plan data that is available from ERAM. This exchange includes both the initial data and any revisions. *Note that it is assumed EFS will replace both EFSTS and FDIO at relevant sites.*
5	18, 20	Start taxi	Terminal Flight Status/Event	Provide status of departure	Updating of flight status by tower controller.	EFS	ARMT	Once	Within 1 minute	Seg 1	Electronic flight status/event update to indicate flight has started to taxi will be provided by tower to TFM (and other domains). May involve an intermediate data distribution system (e.g., TDDS). Updates flight status at ARMT in tower and TRACON TMU.
31	18, 20	Start taxi	Terminal Flight Status/Event	Provide status of departure	Updating of flight status by tower controller.	EFS	TFM/ DFM	On event	Within 1 minute	Seg 1	Provide updated flight status to TFM.
6	6, 20	Takeoff message	Terminal Flight Status/Event	Provide status of departure	Updating of flight status by tower controller.	EFS	ARMT	On event	Within 1 minute	Seg 1	Takeoff message may not be needed since ARMT also gets ARTS track messages.
32	6, 20	Takeoff message	Terminal Flight Status/Event	Provide status of departure	Updating of flight status by tower controller.	EFS	TFM/ DFM	On event	Within 1 minute	Seg 1	Provide updated flight status to TFM.
33	17	Flight Plan	Flight Data	Provide VFR or other flight plans to TFM and NAS	Tower controller enters FP into FDIO	EFS	ERAM (Intermediate system)	On event	Within 1 minute	Seg 1	Tower controllers enter flight plans. The physical exchange is via En Route flight data.
14	8	FP amendment	TMI Execution	Enter amendment to reroute pre-departure flight	Amendment entry by tower controller	EFS	ERAM (Intermediate system)	On event	Within 1 minute	Seg 1	This system exchange is the first step in the multi-system tower-TFM data exchange that supports the Ops exchange when a tower controller enters an amendment. It uses an intermediate ATC system to ATC system exchange between different system nodes.

IDs		**Information Description**				**Source**	**Destination**	**Performance**		**Scope**	
Sys ID# (future)	**Op ID** (future)	**Current System Data Description**	**Data Category**	**Purpose**	**Trigger**	**Producer (Node)**	**Consumer (Node)**	**Frequency**	**Timelines s**	**SWIM Seg**	**Remarks**
15	8, 17	Updated Flight Plan data	Flight Data	Distribute updated flight data	ERAM receives flight data or amendment message from tower controller	ERAM (Intermediate system)	TFMS	On event	Within 1 minute	Seg 1	This is a multi-system data exchange that supports the Ops exchange when a tower controller enters a flight plan or an amendment and the updated data is provided to TFM systems. *Assume TFM/DFM also.*
7	8, 17	Updated Flight Plan data	Flight Data	Distribute updated flight data	ERAM receives amendment message from tower controller via ATCT EFS	ERAM (Intermediate system)	DSP	On event	Within 1 minute	Seg 1	This is a multi-system data exchange that supports the Ops exchange when a tower controller enters an amendment and the updated data is provided to TFM systems, including DSP.
12	8, 17	Updated flight plan data	Flight Data	Distribute updated flight data	ERAM receives amendment message from tower controller via ATCT EFS, AND Current time is within parameter for transmission of data	ERAM (Intermediate system)	ARTS (Intermediate System)	On event	Within 1 minute	Bline	This is a multi-system data exchange that supports the Ops exchange when a tower controller enters an amendment and the updated data is provided to TFM systems.
13	8, 17	Updated Flight Plan data	Flight Data	Distribute updated flight data	Updated flight data received from Host	ARTS (Intermediate System)	ARMT	On event	Within 1 minute	Bline	This is a multi-system data exchange that supports the Ops exchange when a tower controller enters an amendment and the updated data is provided to TFM systems.
34	54	Enhanced Departure Flight Data	Flight Data	Provide additional flight data, such as departure runway, heading, initial altitude	Tower controller updates flight data with specific departure information	EFS	TFM/ DFM	On event	Within 1 minute	Seg 1	This is a multi-system data exchange that supports the Ops exchange when a tower controller enters additional flight data and the updated data is provided to TFM systems. Could include departure procedures as well as individual data elements.
35	41	Clearance Delivery Status Data	Terminal Flight Status/Event	Provide clearance status for decision making, i.e., identify flights that have not yet received a pre-departure clearance	Tower automation transmits clearance to cockpit or AOC.	TDLS	TFM/ DFM, TFMS	On event	Within 1 minute	Seg 1	This is a multi-system data exchange that supports the Ops exchange when a tower controller provides a clearance to aircraft (departure or taxi) and the updated status is provided to TFM and other systems, via intermediate systems (e.g., ERAM, TDDS).

IDs		**Information Description**				**Source**	**Destination**	**Performance**		**Scope**	
Sys ID# (future)	**Op ID** (future)	**Current System Data Description**	**Data Category**	**Purpose**	**Trigger**	**Producer (Node)**	**Consumer (Node)**	**Frequency**	**Timeliness**	**SWIM Seg**	**Remarks**
36	41	Clearance Delivery Status Data	Terminal Flight Status/Event	Provide clearance status for decision making, i.e., identify flights that have not yet received a pre-departure clearance	Tower controller delivers clearance to pilot by voice	EFS	TFM/ DFM, TFMS	On event	Within 1 minute	Seg 1	This is a multi-system data exchange that supports the Ops exchange when a tower controller provides a clearance to aircraft (departure or taxi) and the updated status is provided to TFM and other systems, via intermediate systems (e.g., ERAM, TDDS).
46	41	Clearance Delivery Status Data	Terminal Flight Status/Event	Provide clearance status for decision making, i.e., identify flights that have not yet received a pre-departure clearance	Tower automation transmits clearance to cockpit or AOC or tower controller deliver clearance by voice.	TDLS, EFS	ARMT	On event	Within 1 minute	Seg 1	*May be provided via internal terminal data distribution, but still considered a Terminal-TFM system exchange.*
37	42	Departure Parking Gate Assignment	Flight Data	Provide departure parking gate assignment for situational awareness and trajectory modeling.	Gate assignment received by tower automation from AOC in response to departure clearance	TDLS	TFM/ DFM, ARMT	Once	Within 1 minute	Seg 1	This is a multi-system data exchange that supports the Ops exchange for updated flight data available in the tower being distributed to TFM systems, for use in more accurate departure predictions. The intermediate systems are not shown for brevity.
38	2, 4, 5, 6, 20	Surface location of aircraft	Surface Surveillance Data	Provide status of departure and update predicted trajectory	ASDE-X position report	ASDE-X	TFM/DFM	2/sec	Near Real-time	Seg 1	The surveillance data provided by tower automation is used by TFM to derive flight status and detect flight events, such as starting to taxi. This updated data is used to improve trajectory predictions and improve surface metrics (e.g., taxi delays) calculations.
39	9	APREQ Departure Request	TMI Execution	Indicate to ARTCC TMC that flight is ready to depart and request APREQ time	Pilot check-in	EFS/EFSTS	TFM/DFM	On event	Within 1 min	Seg 1	The specific intermediate systems are TBD. Could be a direct interface in ATCT between EFS and DFM, or via an external data distribution, e.g., TDDS.

IDs		**Information Description**				**Source**	**Destination**	**Performance**		**Scope**	
Sys ID# (future)	**Op ID** (future)	**Current System Data Description**	**Data Category**	**Purpose**	**Trigger**	**Producer (Node)**	**Consumer (Node)**	**Frequency**	**Timeliness**	**SWIM Seg**	**Remarks**
		TFM to Tower									
1	13	Controlled Dept Time/EDCT	TMI Execution	Send EDCT to ATCT ATC	Ground delay or AFP program has been executed, and time within 60 min before departure	TFMS	ERAM(Intermediate system)	As needed	60 - 0 min < Ptime	Seg 1	The operational exchange is from TFM (ATCSCC) to ATC (Tower), but system exchange goes via En Route automation. The EDCT is applied within TFM automation whenever the GDP is executed, but is sent to ERAM 60 min prior to departure time. Revised EDCTs are sent using same framework, as needed.
2	13	Controlled Dept Time/EDCT	TMI Execution	Provide EDCT to ATCT ATC for implementation of controlled departure time	ERAM receives EDCT from TFMS	ERAM (Intermediate system)	EFS	As needed	60 - 0 min < Ptime	Seg 1	The operational exchange is from TFM (ATCSCC) to ATC (Tower), but system exchange goes via En Route automation. *EFS is first phase of Tower Flight Data Management system.*
30	13	Controlled Dept Time/EDCT	TMI Execution	Provide EDCT to ATCT ATC for implementation of controlled departure time	ERAM receives EDCT from TFMS and it is time to print tower strip	ERAM (Intermediate system)	ATCT FDIO	As needed	30-45 min < Ptime	Bline	The operational exchange is from TFM (ATCSCC) to ATC (Tower), but system exchange goes via En Route automation. Legacy flight strip system data exchange.
9	10	TFM Advisory	TMI Execution	General Information notification, such as GDP or reroutes, from TFM to ATC	TFM operational decision	TFMS	ERAM (Intermediate system)	As needed	Strategic (1-2 hrs before TMI takes effect)	Bline	Currently, GI messages that provide situational awareness of TFM TMIs, usually entered by ARTCC TMU. Uses En Route automation General Info Message capability to provide to tower automation to support operational exchange
10	10	TFM Advisory	TMI Execution	General Information notification, such as GDP or reroutes, from TFM to ATC	TFM operational decision	ERAM (Intermediate system)	EFS	As needed	Strategic (1-2 hrs before TMI takes effect)	Seg 1	Currently, GI messages that provide situational awareness of TFM TMIs, usually entered by ARTCC TMU. Uses En Route automation General Info Message capability to provide to tower automation to support operational exchange
18	19	Fuel Advisory Delay Data	TMI Execution	Provide a default EDCT for flights that get an average delay based on TMC entry	Previous FA message and entry of flight plan eligible for FA processing	TFMS	ATCT FDIO	As needed	Within 60 second of flight plan entry or when strips are due to print	Bline	Actual interface is through En Route. Note: Not used much or at all operationallly,and is expected to be deleted from TFMS-ERAM interface.

IDs		Information Description				Source	Destination	Performance		Scope	
Sys ID# (future)	Op ID (future)	Current System Data Description	Data Category	Purpose	Trigger	Producer (Node)	Consumer (Node)	Frequency	Timelines s	SWIM Seg	Remarks
16	16	FP amendment	TMI Execution	Enter amendment to reroute pre-departure flight	ARTCC TMC enters amendment	TFMS	ERAM (Intermediate system)	On event	On event	Seg 1	This amendment is processed first by En Route automation. System data exchange is TFM (TFMS) to ATC (ATCT EFS), via En Route (ERAM)
8	16	FP amendment	TMI Execution	Enter amendment to reroute pre-departure flight	ZNY departure complex (PIT) enters amendment	DSP	ERAM (Intermediate system)	On event	On event	Seg 1	This amendment is processed first by En Route automation. System data exchange is TFM (TFMS) to ATC (ATCT EFS), via En Route (ERAM). This system exchange may include intermediate systems, e.g., revised ATM IPOP or Flight Object mechanism, which are not shown for simplicity.
20	16	Updated Flight Plan data	Flight Data	Send revised flight data to tower in response to a TFM reroute amendment	ERAM processes amendment message from TFMS	ERAM (Intermediate system)	EFS	On event	Within 1 minute	Seg 1	This system exchange supports many operational threads whenever TFM updates flight data, then the intermediate En Route system provides the updated data to ATC automation in the tower, which then distributes it within tower automation (e.g., TDLS/PDC, EFSTS, ARMT). *Note that legacy exchange to non-EFS sites same as current and not shown.*
40	12	Controlled Dept Time/APREQ Release Time)	TMI Execution	Provide departure time/window to tower controllers for individual flights	TMC or TFM automation assigns APREQ Dept Time	DFM, TFMS	EFS	As needed	Within 1 minute	Seg 1	The specific intermediate systems are TBD. Could be a direct interface in ATCT between EFS and DFM, or via an external data distribution, e.g., ER Flight Object, SWIM or TDDS.
		Tower to En Route									
21	23, 24, 25	Flight Plan, Amendment, Departure, Remove Strip, Request Route Conversion, Strip Request	Flight Data	To enter new flight plan or update flight data or cause en route automation to reconvert route (and re-process preferential routes)	Tower controller data entry	EFS	ERAM	On event	Within 1 min	Seg 1	Baseline flight data processing by En Route automation from tower flight data entry.
22	26	Flight Plan Readout Request	Flight Data	Request additional flight data.	Tower controller data entry	EFS	ERAM	As needed	Tactical	Seg 1	

IDs		Information Description				Source	Destination	Performance		Scope	
Sys ID# (future)	Op ID (future)	Current System Data Description	Data Category	Purpose	Trigger	Producer (Node)	Consumer (Node)	Frequency	Timelines	SWIM Seg	Remarks
41	48	Departure Status (Flight status)	Terminal Flight Status/Event	To provide other systems outside tower with flight status.	Tower controller data entry	EFS	ERAM	As needed	Tactical	Seg 1	Provide the status and/or location of a specific flight, i.e. is it still at the gate, subject to deicing, or taxiing, for situational awareness and coordination. This is primarily for flights within 20-30 min of departure.
42	50	Enhanced departure flight data	Flight Data	Provide additional flight data, such as departure runway, heading, initial altitude, or departure gate.	Tower controller updates flight data with specific departure information	EFS	ERAM	On event	Tactical	Seg 1	Could include departure procedures as well as individual data elements. Specific data captured may vary by facility, based on current procedures.
43	49	Clearance Delivery Status	Terminal Flight Status/Event	Provide clearance status for decision making, i.e., identify flights that have not yet received a pre-departure clearance	Tower automation transmits clearance or CD delivers to pilot by voice	TDLS	ERAM	On event	Tactical	Seg 1	This is the electronic transfer of clearance delivery status from tower to other domains, regardless of whether the actual clearance was done manually (voice) or by automation (datalink).
44	52	Runway Visibility Data	Airport Status	Distribute runway visibility data	Request or data from airport sensors (RVR)	RVR	ERAM	Once, then as needed	Strategic and Tactical	Seg 1	ARTCC controller uses to plan arrivals, e.g., determine if airborne holding is likely.
28	48	Start taxi	Terminal Flight Status/Event	Provide status of departure	Updating of flight status by tower controller.	EFS	ERAM	once	On event	Seg 1	Provide updated departure flight status
45	22, 25	Takeoff message	Terminal Flight Status/Event	Provide status of departure	Updating of flight status by tower controller.	EFS	ERAM	once	On event	Seg 1	Provide updated departure flight status
		En Route to Tower									
23	28, 51	Flight Data	Flight Data	Provide flight data to tower controller	Initial when available. Updates are output as data changes.	ERAM	EFS, TDLS	On initial parameter or on update	Within 1 minute	Seg 1	Assumes that tower has EFS. Includes more than flight strip data, e.g., full route of flight, AAR, ICAO associated data. Data would be available when available in ERAM, but expect initial data transfer using an automation system time parameter before Proposed time of departure.

IDs		Information Description				Source	Destination	Performance		Scope	
Sys ID# (future)	Op ID (future)	Current System Data Description	Data Category	Purpose	Trigger	Producer (Node)	Consumer (Node)	Frequency	Timeliness	SWIM Seg	Remarks
24	27, 28	Flight Strip Data	Flight Data	Provide flight strip data to tower controller	Initial distribution a parameter time prior to departure and then updated when previously sent data changes.	ERAM	EFS, TDLS	On initial strip printing or on update	Within 1 minute	Seg 1	In addition to flight plan data, ERAM provides flight strip data to tower automation. This is generated by En Route automation and made available in addition to flight plan data.
24	27, 28	Flight Strip Data	Flight Data	Provide flight strip data to tower controller	Initial distribution a parameter time prior to departure and then updated when previously sent data changes.	ERAM	FDIO	On initial strip printing or on update	Within 1 minute	Bline	Legacy FDIO
29		Response to Flight Plan Readout	Flight Data	Provide additional flight data such as full route to tower controller	Controller enters request	ERAM	EFS, FDIO	As needed	Within 60 sec of update or request.	Seg 1	Should not be needed with EFS, but still needs to be supported.
		Tower to TRACON									
11	29	"Rolling report"	Terminal Flight Status/ Event	Provide take off information for the departed flight	Takeoff	ATCT EFS	TRACON EFS	Once	Tactical	Seg 1	This is electronic equivalent of today's EFSTS swipe.
17	31	Tower-Added Flight Data	Arrival/Dept Flight Data	Provide additional data such as departure runway, initial heading, initial altitude.	Flight strip processing	ATCT EFS	TRACON EFS	Once	Tactical	Seg 1	This is auxiliary data that is added to flight strip by the tower, such as departure procedure or runway.
		TRACON to TFM									
19	39	RVR (Runway Visual Range)	Airport Status	For use by TFM and users n capacity planning.	Data from various airport sensors	RVR	TFMS	Every 2 sec	Tactical	Bline	Currently available for about 50 airports. Data is collected at server in TRACON and sent to ETMS. *Note that ETMS makes available to users.*
		TRACON to En Route									

IDs		Information Description				Source	Destination	Performance		Scope	
Sys ID# (future)	Op ID (future)	Current System Data Description	Data Category	Purpose	Trigger	Producer (Node)	Consumer (Node)	Frequency	Timelines s	SWIM Seg	Remarks
19	52	RVR (Runway Visual Range)	Airport Status	For use by TFM and users n capacity planning.	Data from various airport sensors	RVR	ERAM	Every 2 sec	Tactical	Seg 1	Currently available for about 50 airports. Data is collected at server in TRACON.
		En Route to TRACON									
25	36, 37	Flight Data	Flight Strip, Flight Plan Information Update, Response to Flight Plan Readout	Provide flight data to TRACON controller	Initial when available. Updates are output as data changes.	ERAM	TRACON EFS	On initial parameter or on update	Within 1 minute	Seg 1	Assumes thatTRACON has EFS. Includes more than flight strip data, e.g., full route of flight, AAR, ICAO associated data, as may be available in the ERAM Flight Object. Data would be available when available in ERAM, but expect initial data transfer using an automation system time parameter before Proposed time of departure.
24	33	Flight Strip Data	Flight Data	Provide flight data to TRACON controller	Initial distribution a parameter time prior to departure and then updated when previously sent data changes.	ERAM	TRACON EFS, TRACON FDIO	On initial strip printing or on update	Within 1 minute	Seg 1	In addition to flight plan data, ERAM provides flight strip data to TRACON automation. This is generated by En Route automation and made available in addition to flight plan data.
24	38	NAS/ARTS Flight Plan or Amendment	Flight Data	Provide flight data to TRACON controller	Flight Plan sent a parameter time before departure time. Amendments when previously sent data is amended.	ERAM	ARTS/STARS	As needed	Within 60 sec of timer-based time or of entry of update or request.	Bline	Legacy interface not expected to change in SWIM Seg 1 timeframe

IDs		Information Description				Source	Destination	Performance		Scope	
Sys ID# (future)	Op ID (future)	Current System Data Description	Data Category	Purpose	Trigger	Producer (Node)	Consumer (Node)	Frequency	Timeliness	SWIM Seg	Remarks
	The following system data exchanges are not expected to be supported by SWIM Seg 1.										
	These are included for completeness and as potential candidates for SWIM Seg 2.										
0	0	Airport Configuration - Current or Planned	Airport Status	Distribute initial or future airport/runway configuration. For use by TFM in capacity planning and needed for arrival metering	Operational decision	EFS, IDS	All TFM, ERAM	Once, then as needed	Strategic and Tactical	Post-Seg 1	Assume that IDS or EFS in ATCT or TRACON will be the primary source for both current and planned configuration data and that it will be distributed electronically outside the ATCT. *Note that TFM includes TMA, DSP, NTML, ARMT, etc., and any future TFM, e.g., DFM.*
0	0	Airport Configuration - Current or Planned	Airport Status	Distribute initial or future airport/runway configuration.	Operational decision	Any TFM	EFS, IDS	Once, then as needed	Strategic and Tactical	Post-Seg 1	TFM may be secondary source for both current and planned configuration data that it will be distributed electronically to the ATCT and TRACON. *Note that TFM includes TMA, DSP, NTML, and any future TFM, e.g., DFM.*
0	14	Controlled Dept Time/DSP Time	TMI Execution	Provide departure time to tower controllers for individual flights to comply with departure sequencing, as currently done by DSP.	ARTCC TMC applies Departure Fix rates	DSP	EFS	As needed	Strategic and Tactical	Post-Seg 1	Limited to only a few sites (ZNY) but represents a CDT type of data that covers several similar exchanges, such as EDCTs and APREQs. Operational data exchange from ARTCC TMU to tower via DSP-DSP system exchange, which is not expected to be modified in this timeframe.
0	34	IFR or VFR Flight Plan	Flight Data	To enter a new flight plan or amend an existing flight plan for an IFR or a VFR flight.	TRACON controller data entry	ARTS or STARS	ERAM	As needed	Within 1 minute	Post-Seg 1	This adds the capability for a TRACON controller to enter or amend an IFR or VFR flight plan via ARTS/STARS so that use of FDIO is not necessary. *Note that IFR is no longer in Seg 1; baseline capability for VFR remains.*

Appendix B Operational Threads for Terminal Data Exchange SWIM FF COI Analysis

A separate attachment contains the following operational threads:

1. **Current and Future Enhanced Clearance Delivery**
2. **Current and Future Departure Flow Management**
3. **Current and Future Execution of Pre-Departure Reroute**
4. **Current and Future Airport Configuration Change**

These thread diagrams represent selected operational capabilities planned for SWIM Segment 1 that involve data exchange from the ATCT to other domains. Note that SWIM is shown as a “cloud” on these diagrams, but there is no separate data storage capability in SWIM Segment 1 – data will still be exchanged between the relevant domains. In addition, the future diagrams show ***notional*** systems and system-system interfaces in order to provide a more clear understanding of the logical data exchange and possible system impacts. These diagrams may be updated in the future once the terminal architecture and design, such as expected for the Terminal Data Distribution System (TDDS) is more mature.

CENTER FOR ADVANCED AVIATION SYSTEM DEVELOPMENT (CAASD)

Operational Threads for Terminal Data Exchange SWIM FF COI Analysis

MP070070 Appendix B

May 2007

Operational Threads Overview

- Scope
  - Focus is on new data exchange capabilities
    - Goal is to provide insights into what is not well understood or involves multiple domains
    - Minimize documenting known exchanges that are being automated, e.g., flight strip
  - Describe data exchanges that will be facilitated by SWIM but implemented by domains
    - Domains will provide the infrastructure to support the data exchange, using SWIM framework
    - Threads minimize depiction of SWIM as a physical entity
    - Notional, not design or architecture diagrams
  - CAASD data exchange analysis represents the terminal portion of the FF COI threads
    - TFM/ En Route data exchanges, such as for pre-departure reroutes, are not in scope for this document
    - Other sub-teams within the FF COI are documenting the other data exchanges
  - Includes some relevant TFM, Terminal, En Route and Data Comm capabilities for completeness only
    - Focus is on cross-domain exchanges, not the functions/capabilities that provide the data or intra-domain data flow, i.e. few details of how TFM reroutes are planned or constructed
    - Subject to updating as domains refine capabilities, e.g., departure clearance revisions by data communication
- Operational Threads need validation along with rest of terminal data exchange concepts
  - Focus has been on defining systems engineering data exchanges, not necessarily validating the operational data exchanges

SWIM FF COI Capabilities and Terminal Data Exchange Analysis

Flow and Flight COI Operational Capabilities

- **Trajectory Based Operations**
  - Flight Object Data Sharing via SWIM
  - TRACON Flight Data Capabilities*
- **Collaborative ATM**
  - Flight planning
  - Oceanic track metering times
  - Execution of flow strategies for pre-departure flights, including departure flow management
  - NAS airport and airspace status sharing
- **High Density Arrival/Departure Terminals and Airports**
  - Enhanced clearance delivery
  - Preferential routes
  - Airport arrival metering (Time based metering)
- **Flexible Terminals and Airports**
  - Terminal infrastructure consolidation

CAASD Terminal Data Exchange Concept Areas cover a subset of the FF COI capabilities for the following:

- Enhanced Clearance Delivery
- Departure Flow Management
- Execution of Flow / Pre-Departure Reroutes
- Airport Status Sharing *

Included Data Categories:

- Flight Data
- Flight Status/Event Data
- Clearance Delivery Data
- Surface Position Data
- RVR Data
- Airport Configuration Data *
- TFM Initiative Data
- Predicted Flight Data *

** post-SWIM Segment 1*

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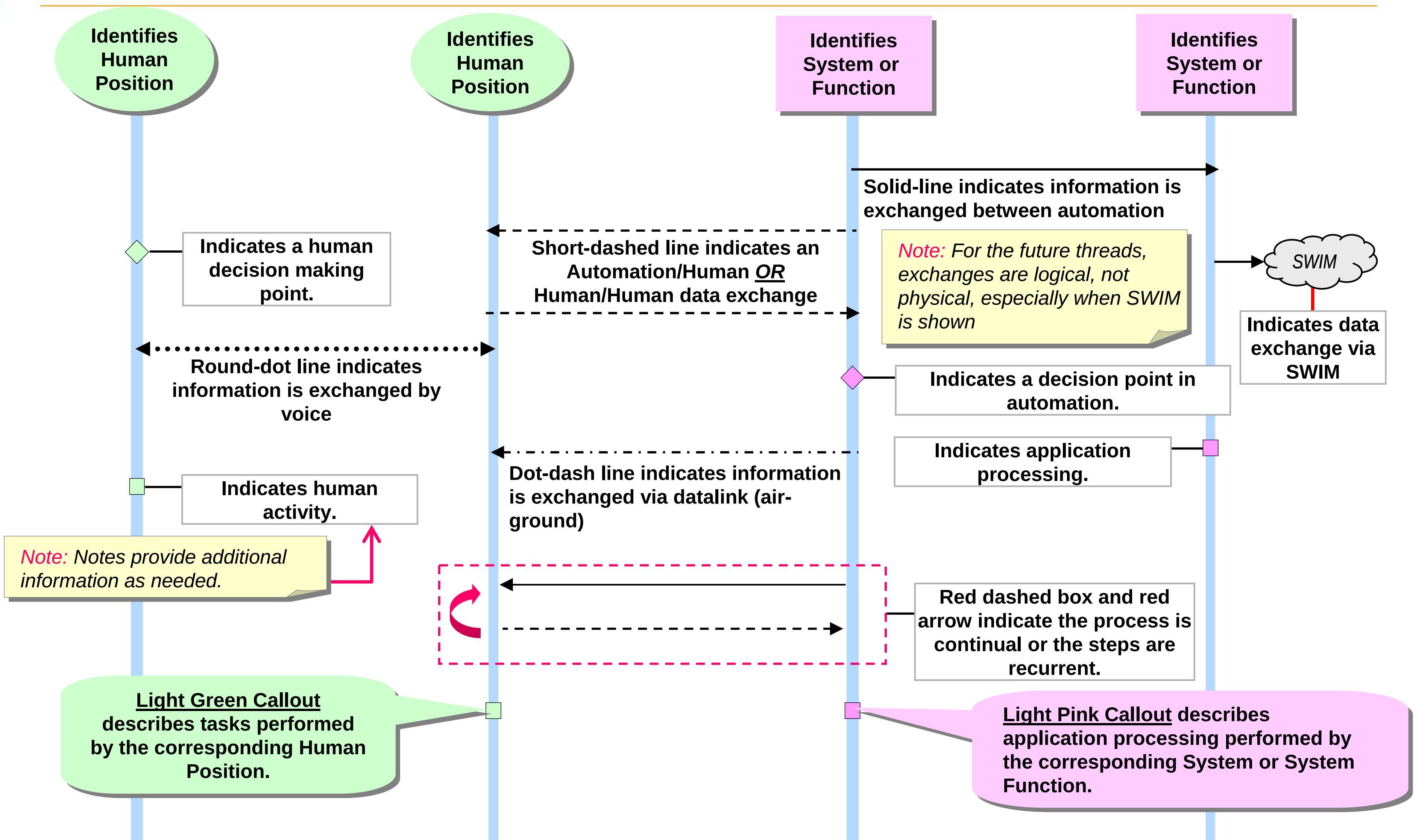
How to Read a Thread



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How to Read a Thread

- The text slides that accompany the diagrams are loosely organized around a template with the following components.

Predecessors/Triggers:

- Environment and preceding events

0. Triggering event or action.

Nominal Steps:

1. Stepwise description of the operational activities and system data exchanges
2. Represents the basic capability and usual path through the thread (referred to as the "happy path" in UML notation)

Alternate Path:

3. Some threads have alternate paths. The starting step is identified by the starting number, e.g., Step 3

Post-Conditions:

Activities or data exchanges that subsequent to the specific thread but are included for operational completeness.

** Notes are usually in italics*

Selected Threads

- **Enhanced Clearance Delivery**
  - **1.1 – Current Initial Departure Clearance Delivery (TDLS/PDC)**
  - **1.2 - Future Initial Departure Clearance Delivery (Data Comm)**
  - **1.3 - Current Initial Departure Clearance Delivery (Voice)**
  - **1.4 - Future Initial Departure Clearance Delivery (Voice)**
  - **1.5 – Future Revised Departure Clearance**
- **Departure Flow Management**
  - **2.1 - Current Coordinate APREQ/CFR**
  - **2.2 – Future Coordinate APREQ/CFR – Controller Initiated**
  - **2.3 – Future Coordinate APREQ/CFR – Automation Initiated**
  - **2.4 – Current Coordinate Departure Management**
  - **2.5 - Future Coordinate Departure Management**
- **Execution of Flow Strategies**
  - **3.1 - Current Execution of Flow Strategies – Pre-Departure Reroute: prior to strip printing**
  - **3.2 - Current Execution of Flow Strategies – Pre-Departure Reroute: after strip printing**
  - **3.3 - Future Execution of Flow Strategies – Pre-Departure Reroute : after strip printing**
- **Airport Status Sharing (future SWIM segment)**
  - **4.1 - Current Airport Configuration Change**
  - **4.2 - Future Airport Configuration Change**

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Enhanced Clearance Delivery Threads

- Initial Clearance Delivery via TDLS/PDC or Voice
- Revised Clearance Delivery
- Thread details still being worked by Data Comm teams, but data exchange is stable

Data Category	Thread?	Summary/Comments
Flight	Y	Full flight data from ERAM
Flight Status/Event		
Clearance Delivery Status	Y	Departure Clearance Delivery Status to SWIM
Surface Position		
Airport Status (RVR)		
Airport Configuration		
TFM Initiative	Indirect	Indirect via TMI data that may be used in clearance delivery, e.g., FRC required
Predicted Flight Data		

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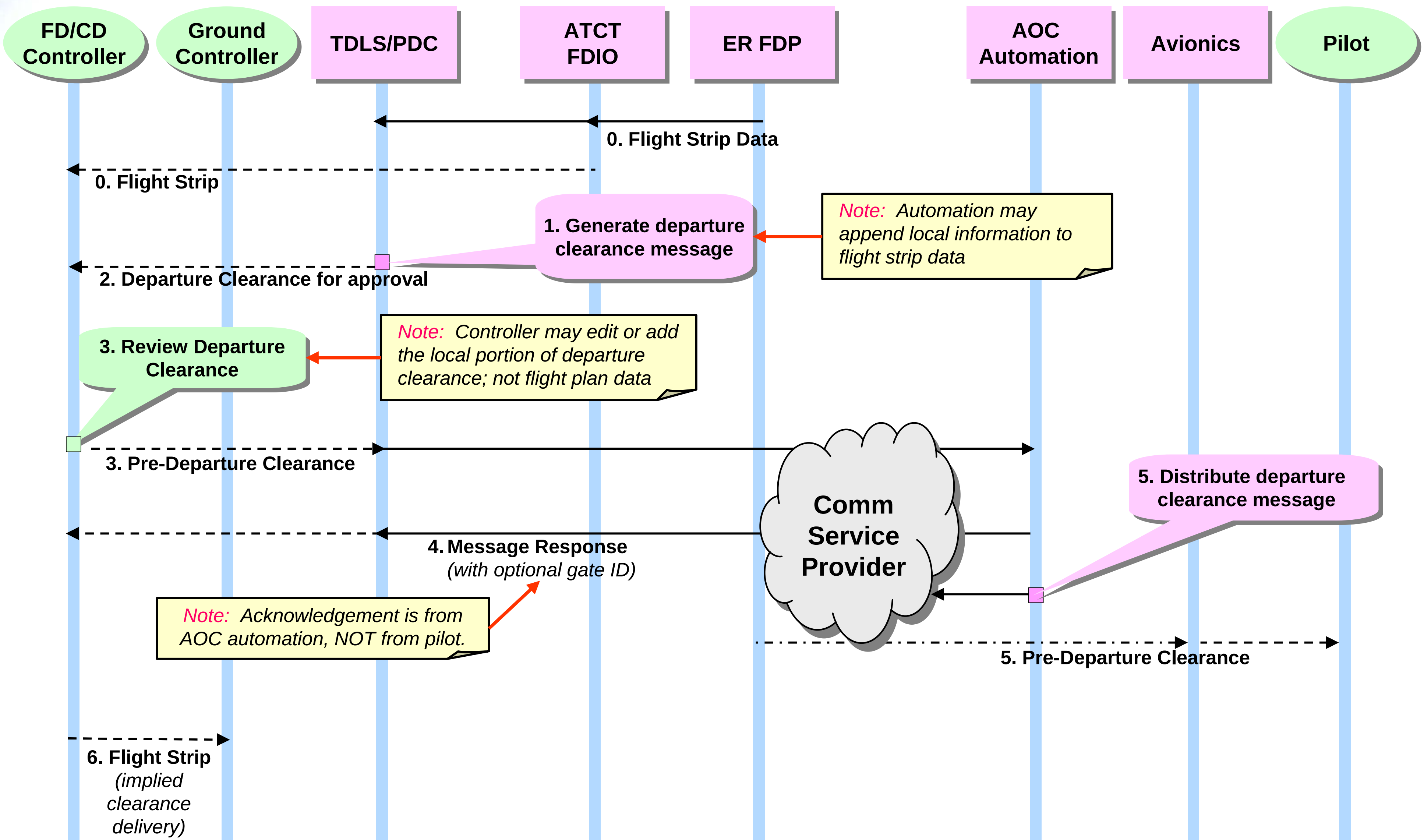
1.1 Current Pre-Departure Clearance Delivery– TDLS/PDC



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1.1 Current Pre-Departure Clearance Delivery – TDLS/PDC

Predecessors/Triggers:

- For designated aircraft, pre-departure clearance capabilities via data communications may be provided. Note that the clearance is provided by the FAA to the AOC (Airline Operations Center), not the aircraft. Communications Service Provider (CSP) provides actual data communications to aircraft.
- Aircraft must have appropriate Data Communications equipage to receive PDC via datalink from AOC.

0. Approx. 30 minutes prior to P-time, En Route FDP sends flight strip data to ATCT FDIO, which forwards to Data Comm (TDLS/PDC). In addition, FDIO prints tower strip.

Nominal Steps:

1. On receipt of flight strip data from FDIO, TDLS/PDC in tower uses it to generate a Pre-Departure Clearance. It may also append local information, e.g., departure procedure, to the flight strip data in the clearance.
2. The pre-departure clearance is displayed at Clearance Delivery position.
3. The Clearance Delivery position reviews the clearance and may add or modify local information. The CD cannot edit the flight strip data portion of the clearance. The controller uses TDLS/PDC to send the Pre-Departure Clearance to the AOC Host computer.
4. AOC host computer acknowledges receipt of pre-departure clearance message. In some cases, this may include a departure gate assignment. This information is displayed to the CD position.
5. AOC host sends pre-departure clearance to aircraft via data communications. Note that the AOC automation may reformat the pre-departure clearance.
6. Clearance Delivery marks the flight strip, then passes it to Ground Controller. Note that this implies the clearance was delivered, i.e. CD sees it was sent by TDLS/PDC.

Post-Conditions:

- *Note: Since the delivery and response is not known, no exchanges other than nominal PDC delivery are shown.*
- When pilot calls Ground Controller for taxi clearance, pilot usually informs GC they already have departure clearance.

1.1 Current Pre-Departure Clearance Delivery – TDLS/PDC – continued

Alternate Path 1 (Auto-mode):

2.–3. In auto-mode, there is no controller involvement. The clearance is sent to AOC automation as soon as TDLS/PDC processes it in the tower.

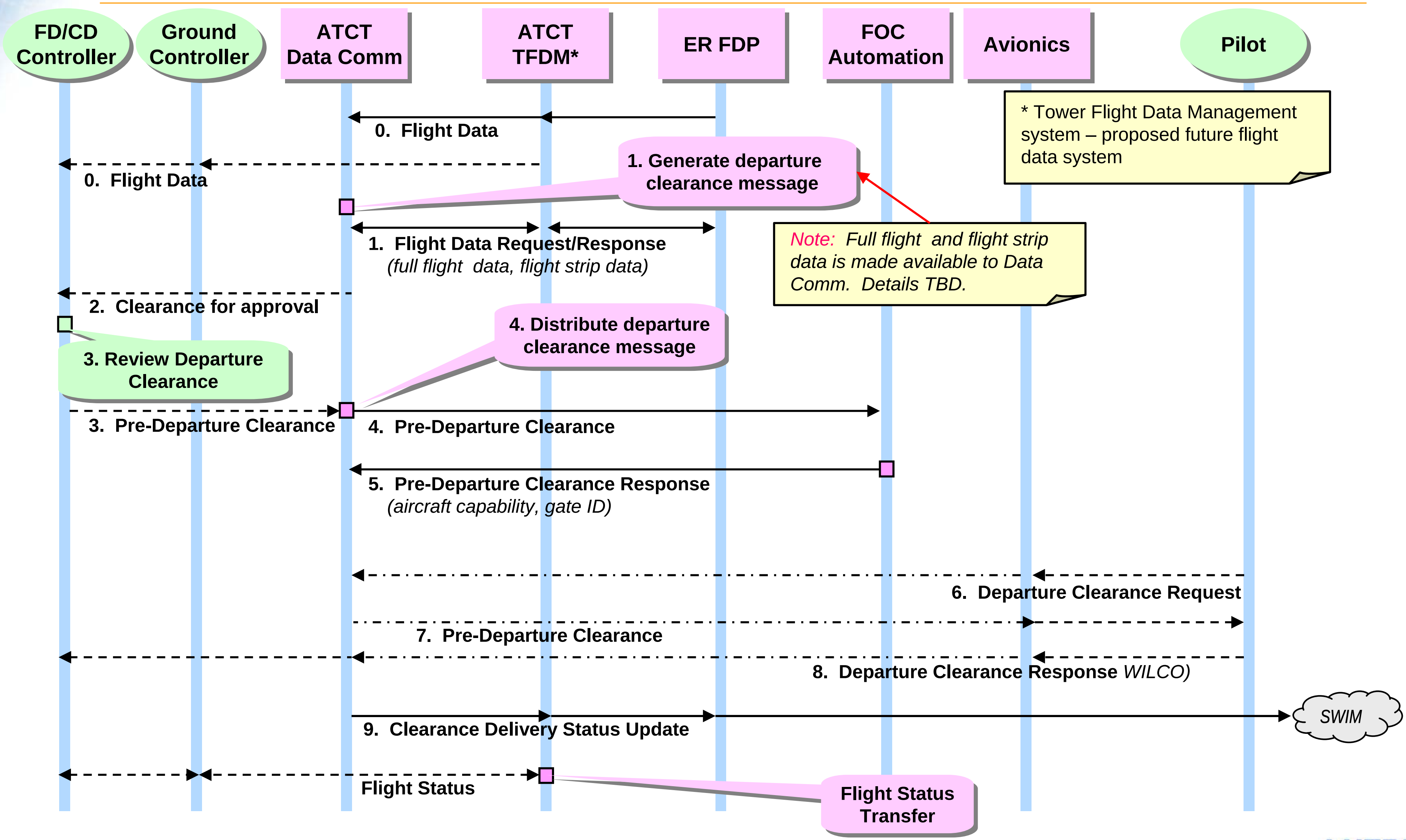
Alternate Path 2 (AOC Delivery modes):

5. AOC may provide pre-departure clearance to pilot via gate printer or other mechanisms

Alternate Path 3 (DSP):

6. In those towers using DSP (New York Metro), the controller may update the flight status in the DSP display to reflect clearance delivery by scanning the flight strip as it is passed to Ground Controller.

1.2 - Future Initial Departure Clearance Delivery – Data Comm



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1.2 Future Initial Departure Clearance Delivery – Data Comm

Predecessors/Trigger:

Aircraft must have appropriate Data Communications equipage. This is a different capability than required for current TDLS/PDC.

0. Tower Automation receives flight data. Initially, this occurs approx. 30-45 min before proposed departure time. In Segment 1 timeframe, it is expected that Tower FDP will have access to full flight data when it becomes available to En Route automation.

Nominal Steps:

1. Data Comm generates Pre-Departure Clearance. This may include verification of flight data and data comm data to ensure positive correlation and/or requesting additional flight data. This can also include adding local data, such as departure runway assignment.
2. Tower automation displays Pre-Departure Clearance at Clearance Delivery position. *Note that this is shown as Data Comm on diagram for simplicity.*
3. Clearance Delivery controller reviews and approves.
4. Data Comm sends Pre-Departure Clearance to AOC.
5. AOC responds with aircraft capability code and departure gate.
6. At some future time, Pilot requests Departure Clearance directly from tower via Data Comm
7. Data Comm sends approved Departure Clearance to aircraft avionics, which displays to pilot
8. Pilot response is sent back to Tower Data Comm. Tower displays are updated to reflect departure clearance status
9. Clearance Delivery Status is made available to other systems (e.g., ER, TFM or SWIM).

Post-Conditions:

- FD/CD transfers flight to Ground Controller. *Note that this is automated version of strip transfer, and is shown here for completeness only. Details TBD.*

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1.2 Future Initial Departure Clearance – Data Comm – cont'd

Alternate Path 1: (Reject)

6. Pilot requests Departure Clearance via Data Comm
7. If no automated clearance can be delivered, a negative response (e.g., unable) is returned.
8. Tower displays are updated to indicate a rejected automated clearance.

9.-10. Pilot and controller may coordinate by voice. (See voice thread)

Alternate Path 2: (Legacy PDC)

5. For flights not using Data Comm to request and receive a departure clearance directly from the FAA, the AOC delivers the clearance to the aircraft via legacy mechanisms. See "current" thread.

6.-8. Not applicable

9. No separate clearance delivery status update is expected to be provided for legacy PDC flights in this timeframe.
10. When FD/CD transfers flight to Ground Controller, there could be an implied clearance delivery status update in the tower automation (see U.C. 1.4). It is an open question if this implied status will be disseminated outside the tower.

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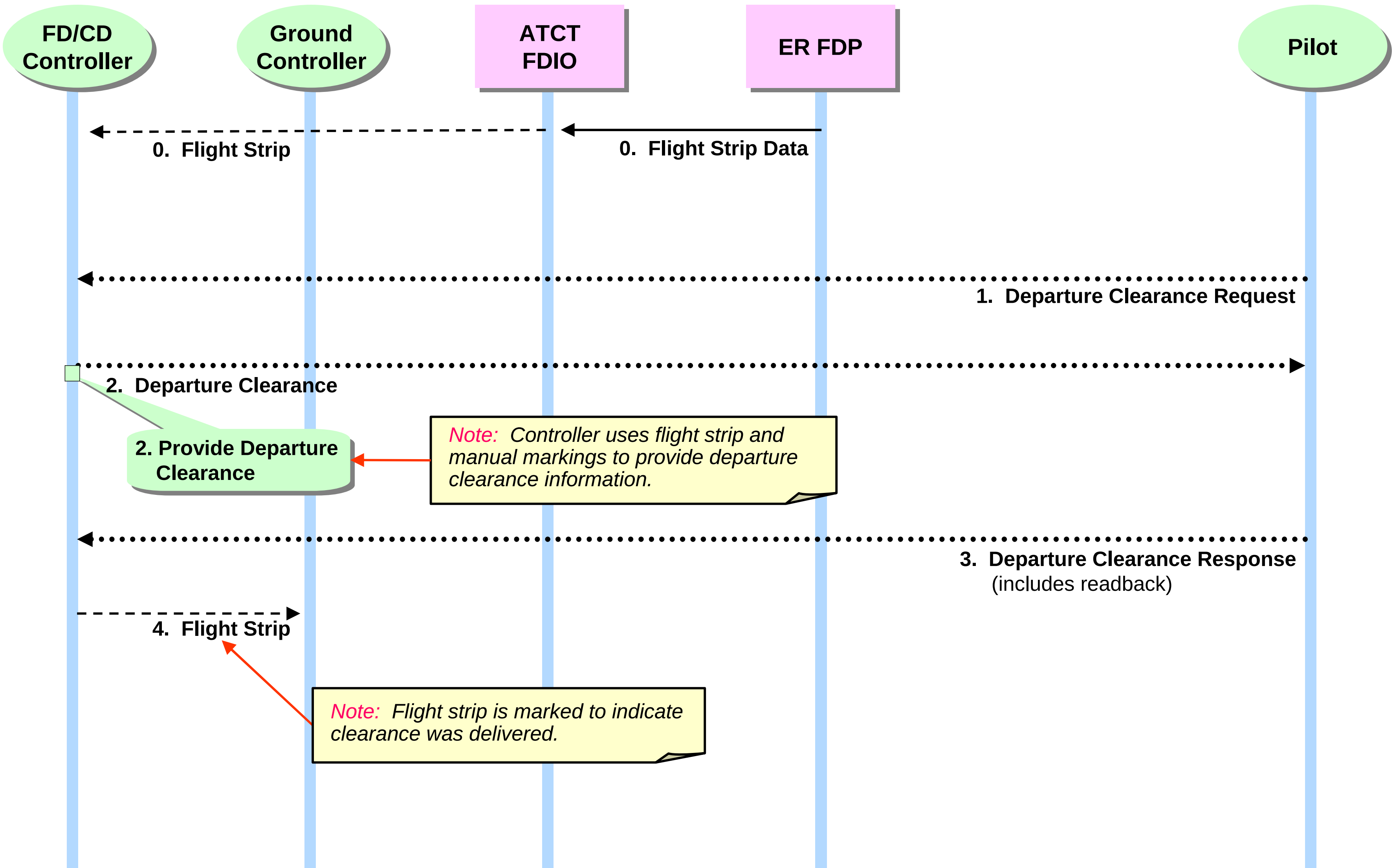
1.3- Current Departure Clearance Delivery – Voice



1.3 Current Departure Clearance Delivery – Voice

Predecessors/Triggers:

0. **Approx. 30 minutes prior to P-time, En Route FDP sends flight strip data to ATCT FDIO, which prints tower strip via Flight Strip Printer.**

Nominal Steps:

1. **Pilot calls Flight Data/Clearance Delivery position in tower requesting a Departure Clearance. *Note that procedures mandate that pilots have a departure clearance prior to pushback from the gate.***
2. **Clearance Delivery position uses flight strip data to provide a Departure Clearance via voice. Controller may add local information, e.g., departure runway, to the flight data in the clearance.**
3. **The Pilot responds with a voice readback of the clearance to validate the voice communications**
4. **FD/CD controller usually marks the flight strip to indicate the clearance has been delivered. The FD/CD then passes it to the Ground Controller.**

Post-Conditions:

When pilot calls Ground Controller for taxi clearance, pilot usually informs GC they already have departure clearance.

Alternate Path 2 (Revisions):

There is no current capability for sending revised clearances via automation. Therefore any revisions are handled as a voice clearance.

1. **Optional. Pilot may know there is a revision (from their AOC), and request an updated clearance.**
2. **When revised flight strips are printed, the FD/CD retrieves the earlier flight strip and may coordinate with Ground Control. If pilot is already communicating with Ground Control via voice, GC tells pilot to call FD/CD and get revised clearance and then call back for a taxi clearance. In other cases, tower FD/CD controller will usually call the pilot with revision.**

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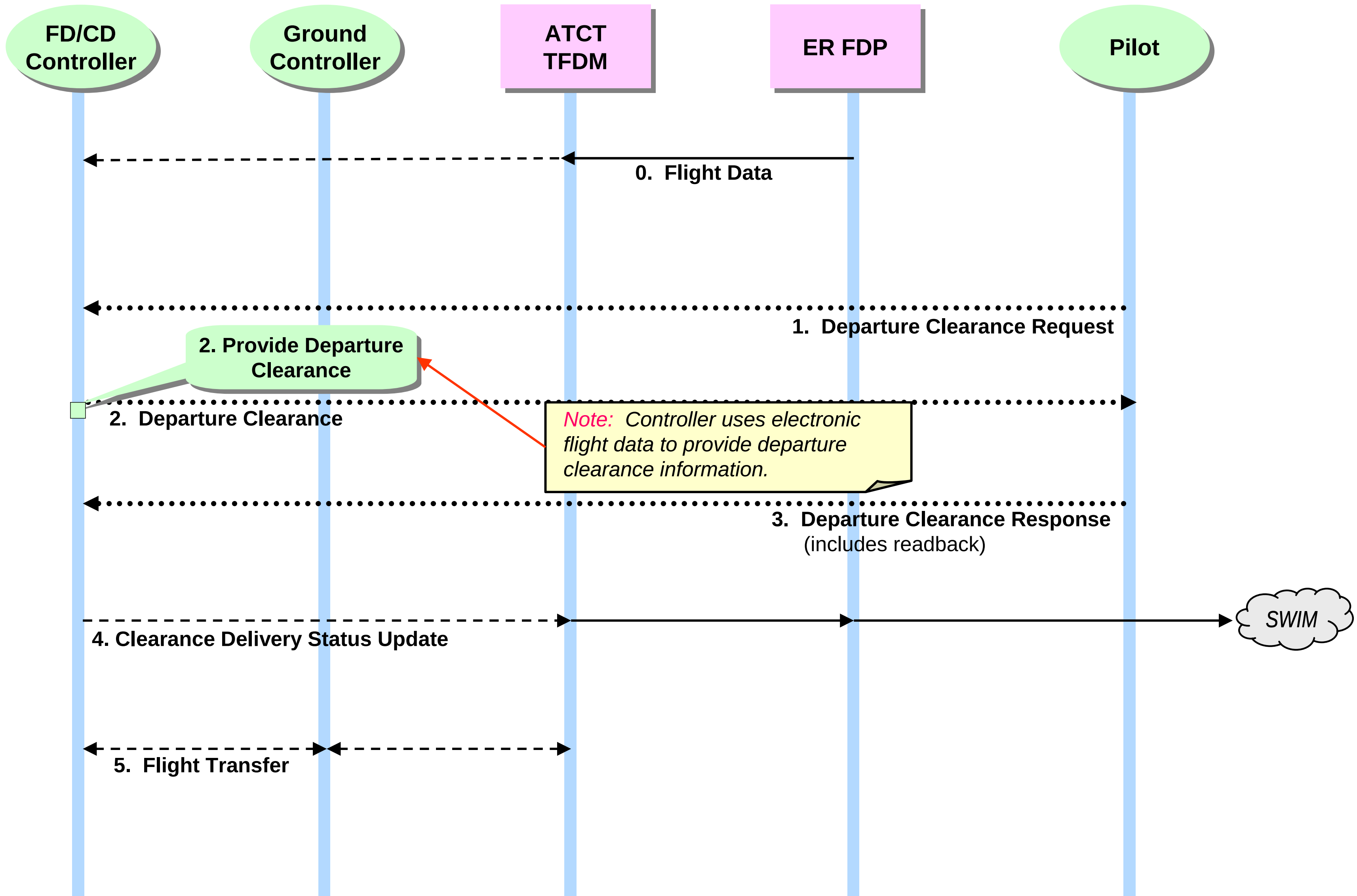
1.4- Future Departure Clearance – Voice



1.4 Future Departure Clearance – Voice

Predecessors/Triggers:

0. Approx. 30 minutes prior to P-time, En Route FDP makes flight data available to ATCT Flight Data Management automation

Nominal Steps:

1. Pilot calls Flight Data/Clearance Delivery position in tower requesting a Departure Clearance. *Note that procedures mandate that pilots have a departure clearance prior to pushback from the gate.*
2. Clearance Delivery position uses flight data available electronically to provide a Departure Clearance via voice. Controller may add local information, e.g., departure runway, to the flight data in the clearance.
3. The Pilot responds with a voice readback of the clearance to validate the voice communications
4. FD/CD Controller updates Flight Data Management capability to indicate Clearance was delivered. Clearance Delivery Status is made available to other systems (e.g., ER, TFM or SWIM)
5. FD/CD transfers flight to Ground Controller. Note that this is automated version of strip transfer, and is shown here for completeness only. Details TBD. (Steps 4 & 5 may be combined)

Alternate Path (Revisions):

1. Optional. Same as done today. Pilot may know there is a revision already, and request an updated clearance.
2. If pilot is communicating with Ground Control, GC tells pilot to call FD/CD and get revised clearance and then call back for taxi clearance. In other cases, tower FD/CD controller will usually call the pilot with revision.

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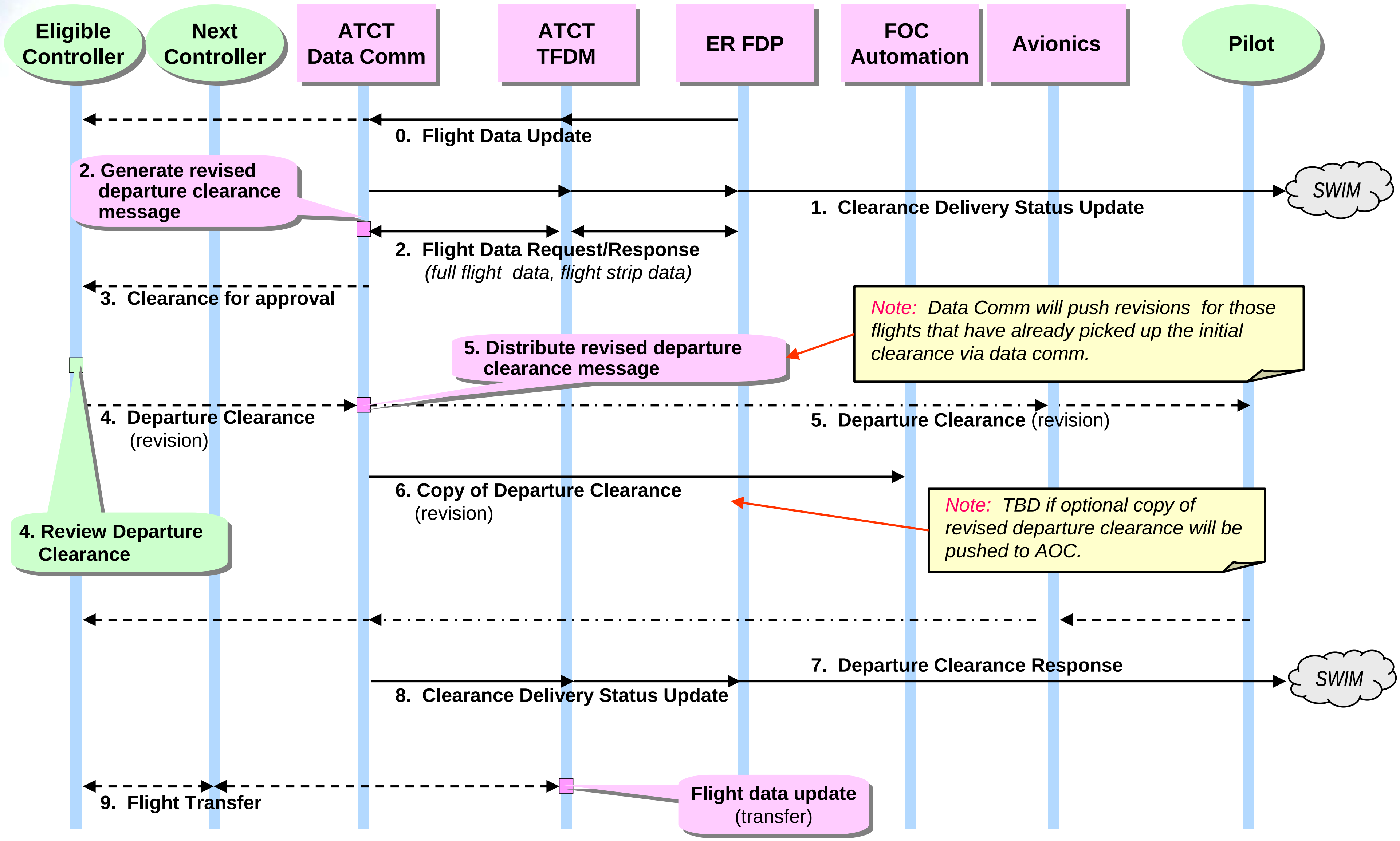
1.5 - Future Revised Departure Clearance Delivery – Data Comm



1.5 Future Revised Departure Clearance Delivery – Data Comm

Predecessors/Trigger:

Aircraft must have appropriate Data Communications equipage. This is a different capability than required for current TDLS/PDC.

0. Tower Automation receives revised flight data and displays to appropriate controller. As it does today, the revised flight data includes a flight plan revision number and any other relevant flight data that is conveyed to the tower, e.g. TFM initiative remarks

Nominal Steps:

1. Tower automation updates clearance delivery status and disseminates to show that the flight has a pending revised clearance. *(Note this could be allocated to FDP)*
2. Data Comm in tower generates a revised Departure Clearance. Data Comm optionally verifies flight data and data comm data to ensure positive correlation. This may include requesting additional flight data as well as determining which flights are eligible to receive a revision via data comm.
3. Data Comm provides revised Departure Clearance to appropriate position. The clearance will include the full route and could include adding local data, such as departure runway assignment. *Note: The Clearance Delivery position or the Ground Controller could be the "appropriate" controller, depending on whether the initial clearance had been delivered already. Operational procedures will determine which controller actually delivers the revision; it is assumed that the FD/CD position or Ground Metering position will review and deliver the revised clearance to minimize heads down time for the Ground Controller.*
4. Tower Controller reviews and approves the revised Departure Clearance.
5. For those flights that have already picked up the previous clearance, Data Comm sends approved Departure Clearance to aircraft avionics, which displays to pilot.
6. Optionally, a copy of the revised clearance is sent to the AOC. There is still an open question about whether this will be sent at all, sent only for those flights with data comm equipage or sent for legacy flights also.
7. Pilot response is sent back to Tower Data Comm. Tower displays are updated to reflect departure clearance status
8. Clearance Delivery Status is made available to other systems (e.g., ER, TFM or SWIM).
9. If applicable, FD/CD transfers flight to Ground Controller using tower automation. Note that this is automated version of strip transfer, and is shown here for completeness only. Details TBD.

Departure Flow Management Threads

- **Coordinate APREQ/CFR - In this context, "Approval Request" refers to controlled departure time, i.e., Call For Release (CFR)**
- **Coordinate Departure Management - Details for internal TFM automation TBD**

Data Category	Thread ?	Summary/Comments
Flight		
Flight Status/Event	Y	Flight status/event data from tower used to schedule departures and predict departure time
Clearance Delivery Status		
Surface Position	Y	Surface data from tower used to update flight status and predict departure time
Airport Status (RVR)		
Airport Configuration		
TFM Initiative	Y	TFM provides scheduled departure times and other TFM TMI data (e.g., sequence, delays)
Predicted Flight Data*	Y	* In future segments, TFM provides predicted flight and event times

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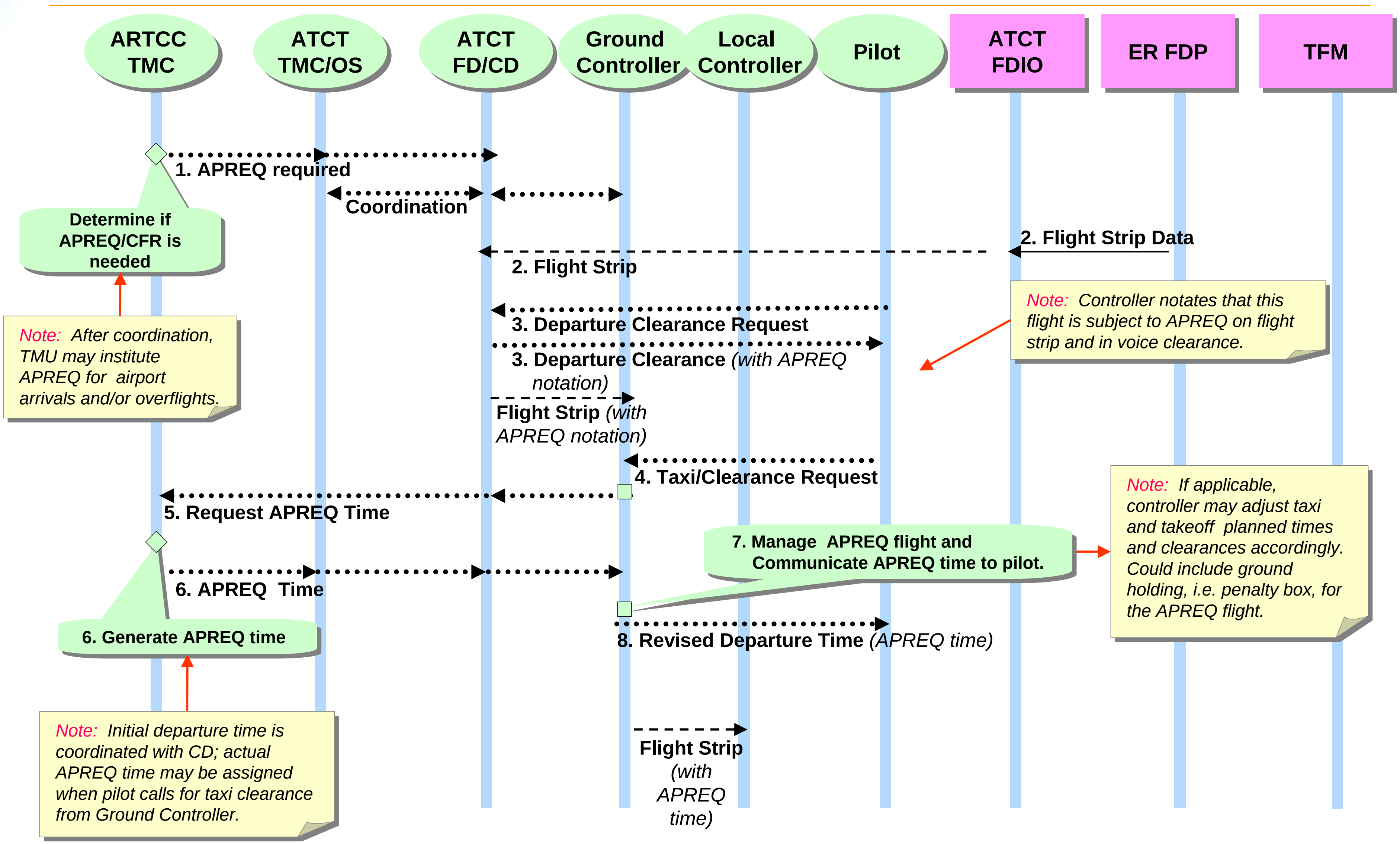
2.1 Current Coordinate APREQ/CFR



Note: Not all handoff/voice actions shown for simplicity.

2.1 Current Coordinate APREQ Thread

Predecessors/Trigger:

- **The TMU (Traffic Management Unit) staff at an ARTCC constantly monitor the expected traffic demand and capacity for arrival, departures, and en route over flights. In order to efficiently sequence departures into an en route stream or to control the arrival flow of airports within the ARTCC, traffic managers often use Approval Request (APREQ)/Call for Release (CFR) procedures. APREQ may be used for a specific departure fix or the destination airport. Some ARTCCs, such as Chicago, refer to this process as En Route Spacing (ESP), i.e., procedural metering.**

Nominal Steps:

1. **When APREQ procedures are in effect, tower controllers must contact the ARTCC TMU (or in some cases the TRACON TMU) for a release time for each flight destined to the specific airport or departure fix. This is communicated to tower controllers by the tower traffic management coordinator or controller-in-charge who is monitoring the APREQ releases.**
2. **When flight strips are printed (30-45 min prior to departure time), flight data or clearance delivery controllers in the ATCT mark the flight strips for the affected flights to show they need an APREQ release. This marking is used later to alert other tower controllers.**
3. **If pilots call in for a departure clearance, the controller usually informs them they are under an APREQ/CFR.**
4. **When ready to taxi, the flight calls Ground Controller for a taxi instructions and clearance**
5. **The tower controller contacts the ARTCC TMU for an APREQ release time. In some cases, this APREQ release time is provided by the TRACON TMU instead of the ARTCC. *Note: The tower TMC may get the APREQ release times instead of the FD/CD position. The TMC may also be very active in working the taxi queue with the ground controller.***
6. **ARTCC traffic managers mentally calculate a departure release time or window that will sequence the departure into the en route or arrival stream at the desired time, and provide this time, often a window, to the tower controller. *For those ARTCCs actively using TMA (Traffic Management Advisor), TMCs may use TMA automation to calculate the optimal release time.***
7. **The tower controller manually determines if there are any taxi changes, such as holding or queue re-sequencing, as a result of the release time. *Note that controller may defer taxi clearance and simply provide revised departure clearance.***
8. **The APREQ time is communicated to the pilot as an updated departure time, via voice communication.**

Post-Conditions:

- **The flight strip is marked with the release time and transferred at the appropriate time to the local controller for final departure processing.**
- **Local controller departs aircraft within APREQ time.**

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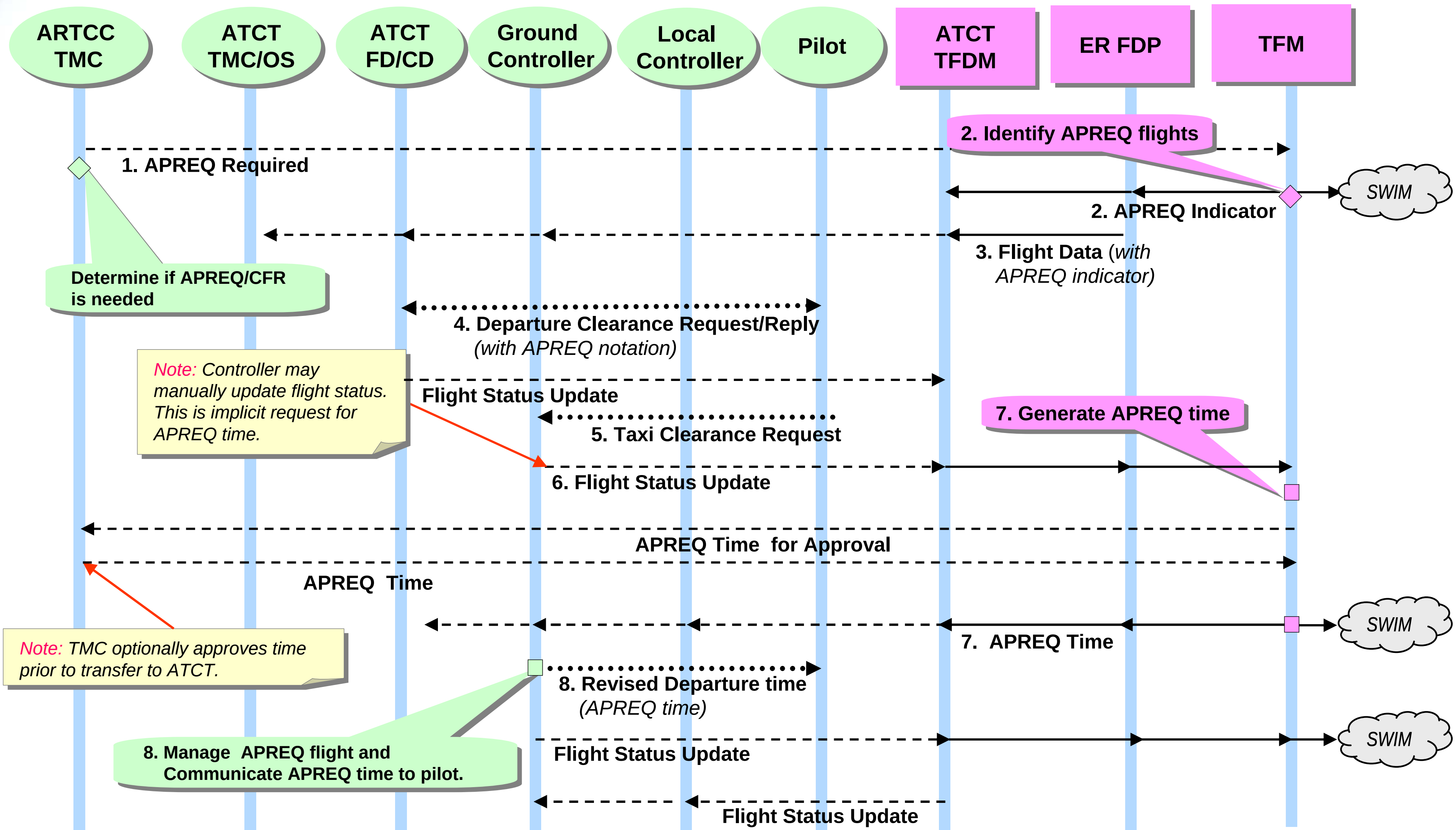
2.2 Future Coordinate APREQ/CFR – Controller Initiated



2.2 Future Coordinate APREQ/CFR– Controller Initiated

Predecessors/Trigger:

- As done today, the TMU (Traffic Management Unit) staff at an ARTCC constantly monitor the expected traffic demand and capacity for arrival, departures, and en route over flights. In order to efficiently sequence departures into an en route stream or to control the arrival flow of airports within the ARTCC, traffic managers often use Approval Request (APREQ)/Call for Release (CFR) procedures. APREQ may be used for a specific departure fix or the destination airport. ARTCC traffic managers use TFM departure management automation to identify the affected flights and to generate a departure release time or window that will sequence the departure into the en route or arrival stream at the desired time.

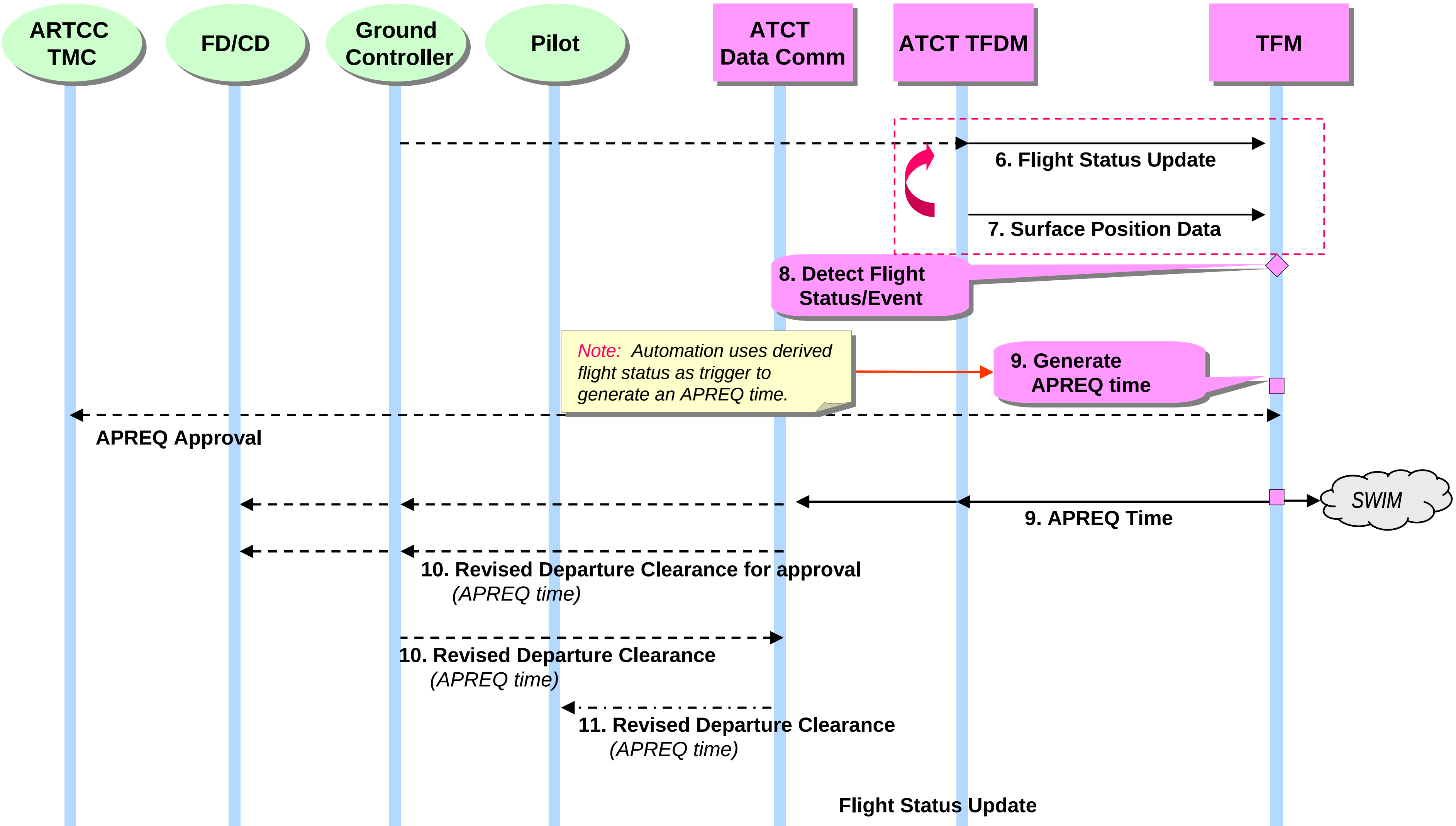
Nominal Steps:

1. Traffic managers determine that APREQ/CFR procedures are needed and provide the relevant information to TFM automation. *Note that some of these are standard and could be the default but others may be dynamic.*
2. When APREQ procedures are in effect, affected flights are identified by TFM automation and this data is made available as part of the flight data.
3. When flight data is available in the tower (30-45 min prior to departure time), the flights affected by APREQ are identified in the Flight Data Management automation. This notifies tower controllers that a release time is required for each flight destined to the specific airport or departure fix.
4. When pilots call in for a departure clearance, the controller usually informs them they are under an APREQ/CFR.
5. When ready to taxi, the flight calls Ground Controller for taxi instructions and clearance
6. The tower controller updates the flight status to indicate the flight is ready for taxi clearance. This is an implicit request for an APREQ time. *Note that there could be an explicit request to TFM automation; details TBD.*
7. On receipt of the updated flight status, the TFM automation generates an APREQ departure release time. Optionally, this is provided to the ARTCC TMC for approval. This controlled departure time (APREQ time) is then made available to tower automation for display to tower controllers.
8. The tower controller manually determines if there are any taxi changes, such as holding or queue re-sequencing, as a result of the release time. The APREQ time is communicated to the pilot as an updated departure time, via voice communication. *Note that this could be done by data communications also.*

Post-Conditions:

- The flight status is updated and the flight is transferred at the appropriate time to the local controller for final departure processing.
- Local controller departs aircraft within APREQ time.

2.3 Future Coordinate APREQ/CFR – Automation Initiated



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2.3 Future Coordinate APREQ/CFR – Automation Initiated

Predecessors/Trigger:

- **Instead relying on the controller manually updating the flight status when the pilot calls for a taxi clearance, automation uses derived flight status to determine when to generate the APREQ time.** ***Note that the system allocation of this flight status/event derivation function is expected to migrate to terminal automation but the timeframe is TBD. It is currently shown under TFM to represent an initial allocation based on current R&D efforts.***

Nominal Steps:

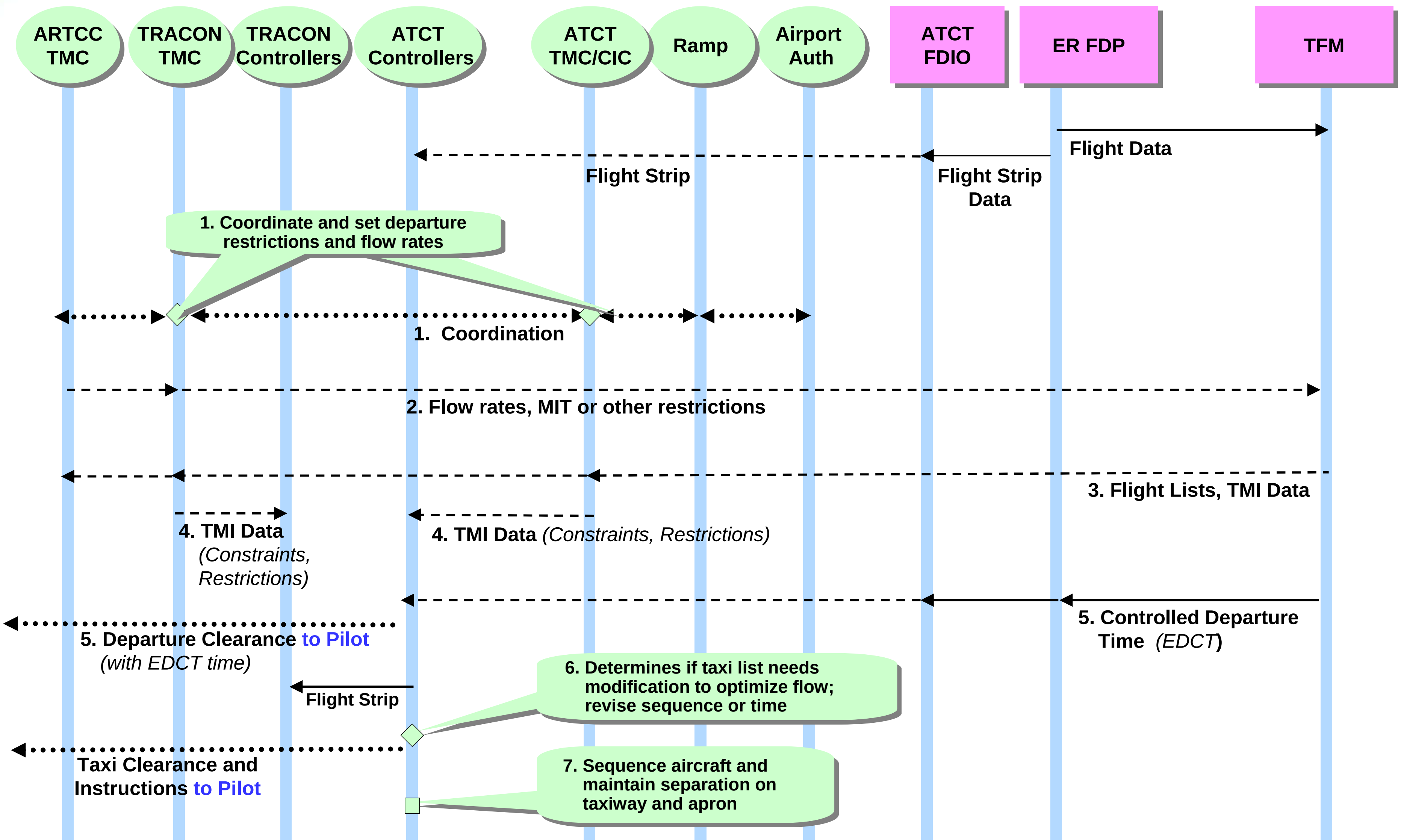
The first 5 steps are the same as in 2.1

1. **Traffic managers determine that APREQ/CFR procedures are needed and provide the relevant information to TFM automation.** ***Note that some of these are standard and could be the default but others may be dynamic.***
2. **When APREQ procedures are in effect, affected flights are identified by TFM automation and this data is made available as part of the flight data.**
3. **When flight data is available in the tower (30-45 min prior to departure time), the flights affected by APREQ are identified in the Flight Data Management automation. This notifies tower controllers that a release time is required for each flight destined to the specific airport or departure fix.**
4. **When pilots call in for a departure clearance, the controller usually informs them they are under an APREQ/CFR.**
5. **When ready to taxi, the flight calls Ground Controller for taxi instructions and clearance**
6. **The tower controller updates the flight status as flight receives clearances, or indicates it is ready to taxi, etc.**
7. **TFM automation is receiving updates from surface position automation for flights that have pushed back from the gate or entered movement areas.** ***This may be used as backup information for flight status evaluation.***
8. **Automation uses flight status and position data to determine that the flight is ready for an APREQ time assignment.**
9. **The TFM automation generates an APREQ departure release time. Optionally, this is provided to the ARTCC TMC for approval.   This controlled departure time (APREQ time) is then made available to tower automation for display to tower controllers.**
10. **The tower controller manually determines if there are any taxi changes, such as holding or queue re-sequencing, as a result of the release time.**
11. **The APREQ time is communicated to the pilot as an updated departure time, via data communication.** ***Note that this could be done by GC or FD/CD controller, and could also be done via voice.***

Post-Conditions:

- **The flight status is updated and the flight is transferred at the appropriate time to the local controller for final departure processing.**
- **Local controller departs aircraft within APREQ time.**

2.4 Current Coordinate Departure Management



2.4 Current Coordinate Departure Management

Predecessors/Trigger:

- **Departure flow management in an ATCT or TRACON may result from national or local strategic flow strategies. Constraints at destination airport or airspace may be passed back to hold aircraft on the ground at the departure airport. Departures may also be affected by MIT restrictions that are levied on the departure facility by the receiving facilities (e.g., downstream ARTCC) that constrain the departure flow over the facility boundary. In addition, local runway or airspace congestion, often caused by weather, may cause departure flow constraints to be applied by tower or TRACON traffic managers or supervisors.**

Nominal Steps:

1. **Terminal traffic managers coordinate with the weather units to assess predicted environmental conditions in order to maximize airport throughput and improve overall system efficiency. Using existing flight data and situational awareness data provided by various automation systems, ATCT and TRACON traffic managers review the predicted departure demand on the airport and departure airspace. They coordinate the airport configuration with the local airport authority as well as other facilities. Tower traffic managers and supervisors also coordinate predicted push-back times with users, which helps in determining the predicted demand. Users, both AOCs and ramp controllers, have more knowledge of predicted push-back than tower personnel or current automation. In the current system, this coordination is primarily manual, i.e., by phone between ramp control and tower. *Note that this is an opportunity for future automation.* In addition, traffic managers and supervisors coordinate the predicted departure demand with TMs at other facilities. This is not so much for individual flights as for departure flows in general. Coordination is particularly important when gate areas start to get congested or flights are delayed enough that they miss their revised departure times levied by TFM or other schedulers, e.g., miss the EDCT window.**

   The ATCT TMC/OS/CIC also coordinates with ramp controllers to ensure efficient flow from ramp areas to movement areas, overall status of flights, and to identify any potential changes that would optimize the departure flow. Departure flows are closely coordinated within the TRACON and ATCT with arrival flows. Although arrivals and departures are generally separated by airspace utilization or separate runways, manual coordination among traffic managers and supervisors is still required to optimize airport and airspace efficiency, while ensuring safety during mixed operations.

2. **After the initial demand and capacity analysis, the ATCT TMC/OS/CIC manually coordinates with traffic managers at TRACON, ARTCC (and ATCSCC through ARTCC TMU) at a strategic level to set the airport departure rate, set flow restrictions for departure fixes or airspace, prioritize departure flows and integrate with arrival flows. Traffic managers may enter this constraint information into TFM automation. They also use the APREQ/CFR call for release programs to control the departure flow by determining the optimal time for satellite airport departures to take off in order to merge with the primary departure flow or en route stream.**

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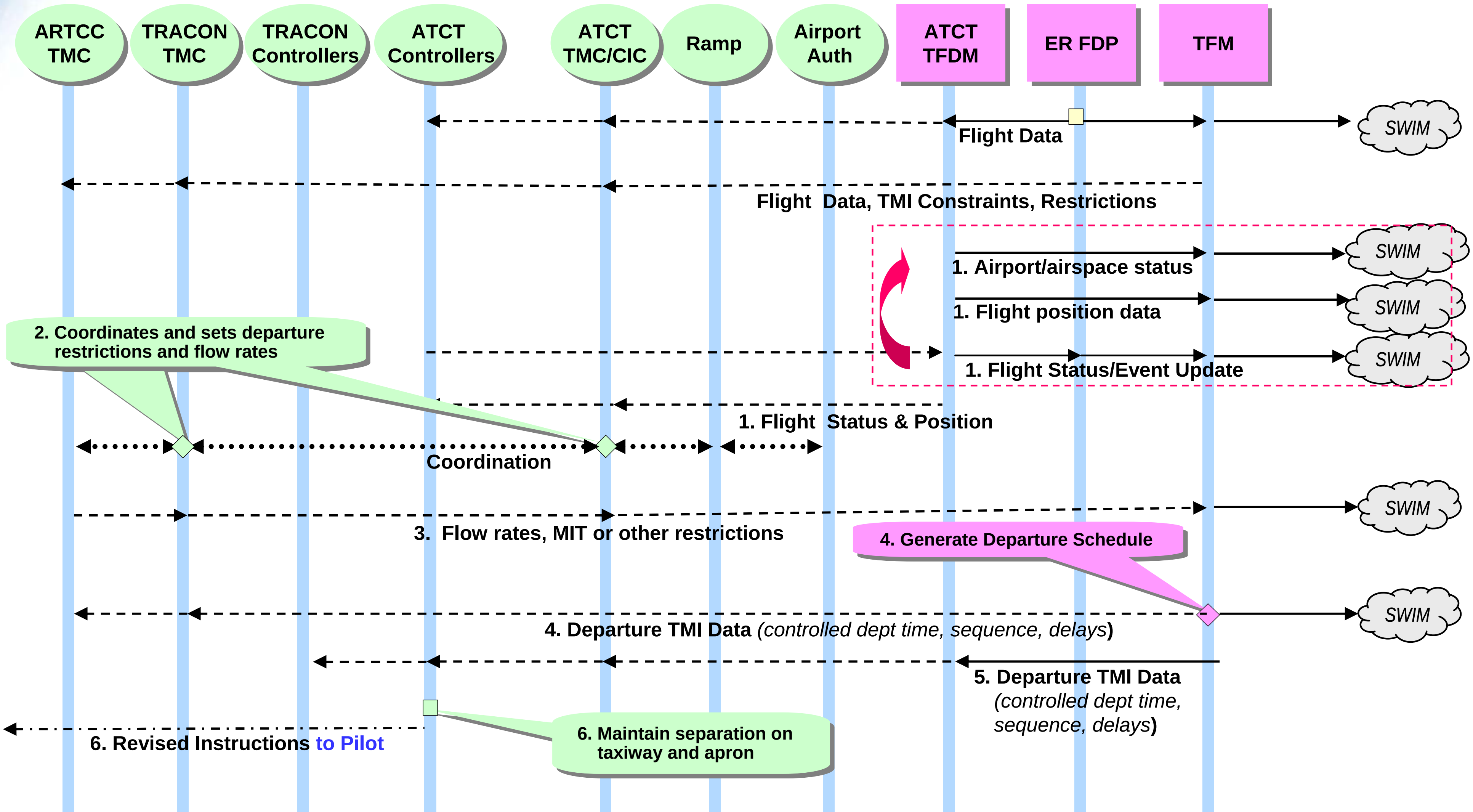
2.4 Current Coordinate Departure Management – continued

1. Currently, there is no widespread automation support for optimizing the departure flow by the ATCT or TRACON traffic managers or controllers. Flight data from En Route automation (Host) provides predicted demand on departure runways and fixes. Traffic managers use TFM automation to view strategic departure flow information, including predicted demand at fixes or other selected points.
2. Traffic managers and supervisors communicate the overall strategy to controllers, who then develop the flight-specific tactics.
3. If there are national controlled departure times, such as EDCTs from a ground delay program, then these are taken into account by the ATCT and TRACON traffic managers and controllers when manually optimizing the departure flow. Some sites have a more tactical TFM departure tools, such as ARMT or DSP, that provide departure demand information and assist the tower and TRACON personnel to optimize the departure flow.
4. At the more tactical level, terminal controllers develop and evaluate implementation options to optimize departure flows both on the surface and in the TRACON airspace, using flight data and situational displays. In the tower, the flight data/clearance delivery controller and the ground controller, including any ground metering controllers, develop and implement any local tactics. The ground controller executes the optimized departure flow by maintaining the sequence and spacing while taxiing, ensuring that the local controller receives the flights in the desired order and time.
5. Tower controllers develop and communicate to the pilot the clearances that implement the optimized departure flow.

<u>**Post-Conditions:**</u>

- As aircraft depart the terminal environment, the controller must determine where and how to merge the departing flights into the surrounding traffic flows. In most facilities, this is handled through manual procedures with direct voice coordination between the ATCT controller or supervisor and a traffic manager in the TRACON or ARTCC. In the congested New York area, the Departure Spacing Program (DSP) provides departure time windows to controllers at participating airports that facilitate the merging of departing flights at shared departure fixes while maintaining an acceptable demand level on NAS resources (departure fixes and sectors).

2.5 Future Coordinate Departure Management



2.5 Future Coordinate Departure Management

Predecessors/Trigger:

- The exchange of arrival and departure flight demand data, airport constraints, and surface sequencing constraints among ATCT personnel, users (ramp and/or AOC), and airport authorities could benefit from automation. This would facilitate the coordination and collaborative decision making processes in determining the capacity and demand on the airport, and thereby reduce current manual coordination by phone or other methods. Pre-departure collaboration with the users also provides improved departure demand predictions, which are then available for surface sequencing.

- The manual transfer and marking of flight strips, such as writing a scheduled controlled departure time on the strip itself, and other flight data processes in the ATCT and TRACON that are indirectly related to sequencing, are automated. Electronic flight data replaces physical flight strips as primary flight data information medium. (Flight strips remain available during transition and as back-up.) The manual (physical) transfer of control via strips or phone evolves to automated transfer of control. This includes both intrafacility and interfacility (tower-TRACON) flight data information transfer.

Nominal Steps:

1. Airport and Airspace status information is provided Terminal automation to TFM and other users. ***(Note that this may not occur in SWIM Seg 1).*** Flight position information and flight status information (e.g., the flight has started to taxi) is also provided from tower controllers and tower automation. ATCT and TRACON personnel have automated access to arrival, departure, and surface traffic demand/capacity information and current environmental data (constraints, WX, surface configuration, etc.) This includes information from other FAA domains and NAS users that improve the quality of surface congestion predictions. In later increments, surface sequencing is integrated with arrival/departure sequencing in the terminal domain, and is coordinated with en route sequencing and traffic flow initiatives.

2. Coordination among ATCT, TRACON and other FAA operational personnel is reduced by access to common situational data. ATCT and TRACON personnel have access to local, regional and national traffic flow information, which provides common situational awareness and specific constraints. Increased coordination between the ATCT TMC/CC and the ATCSCC is facilitated by the TFMS trial planning capability expected to be available in the ATCT. This provides the opportunity for the TMC/CC to modify airport constraints and do a “what if” evaluation of the effect, and then share the trial plan electronically with TRACON and ARTCC TMUs during the coordination phase.

2.5 Future Coordinate Departure Management – continued

3. ATCT and TRACON traffic management personnel use departure management automation to enter runway configuration, departure rates and other departure constraints.

4. TFM automation generates a departure sequence. This includes merging flights into overhead streams and scheduling flights from multiple airports that are using the same departure fixes. The traffic manager or supervisor has the capability to perform trial resolutions ("what if") that optimize departure sequencing and overall airport throughput, and then implement a selected plan. This departure sequence and controlled times, included delays, are provided to traffic managers.

5. Tower and TRACON controllers are provided with the constrained departure flow initiative information via electronic data exchange between TFM automation and terminal flight data management automation. Flights subject to departure flow management constraints are identified so that controllers do not have to figure out which flights are affected by any restrictions. Controlled departure times for runways and departure fixes, delays, and possibly the departure sequence, are available for controller display.

6. Tower controllers communicate the instructions that implement the optimized departure flow to the pilot. Note that in this timeframe, these instructions are expected to be provided by data communications at the busiest towers. *Note that if there is a new route, then this will be a revised departure clearance.*

Post-Conditions:

- As aircraft depart the terminal environment, the departure sequence has already taken into account how to merge the departing flights into the surrounding traffic flows.

Execution of Flow Strategies – Pre-Departure Threads

Data Category	Thread?	Summary/Comments
Flight	Y	Full flight plan and route status used by TFM to generate TFM-proposed reroute
Flight Status/Event	Indirect	Indirect, as TMCs use this information to determine whether and when to execute the reroute
Clearance Delivery Status	Indirect	Indirect, as TMCs use this information to determine whether and when to execute the reroute
Surface Position	Indirect	Indirect, as TMCs use this information to determine whether and when to execute the reroute
RVR		
Airport Configuration		
TFM Initiative	Y	TFM provides reroute initiative data, such as reroute segment identification
Predicted Flight Data		

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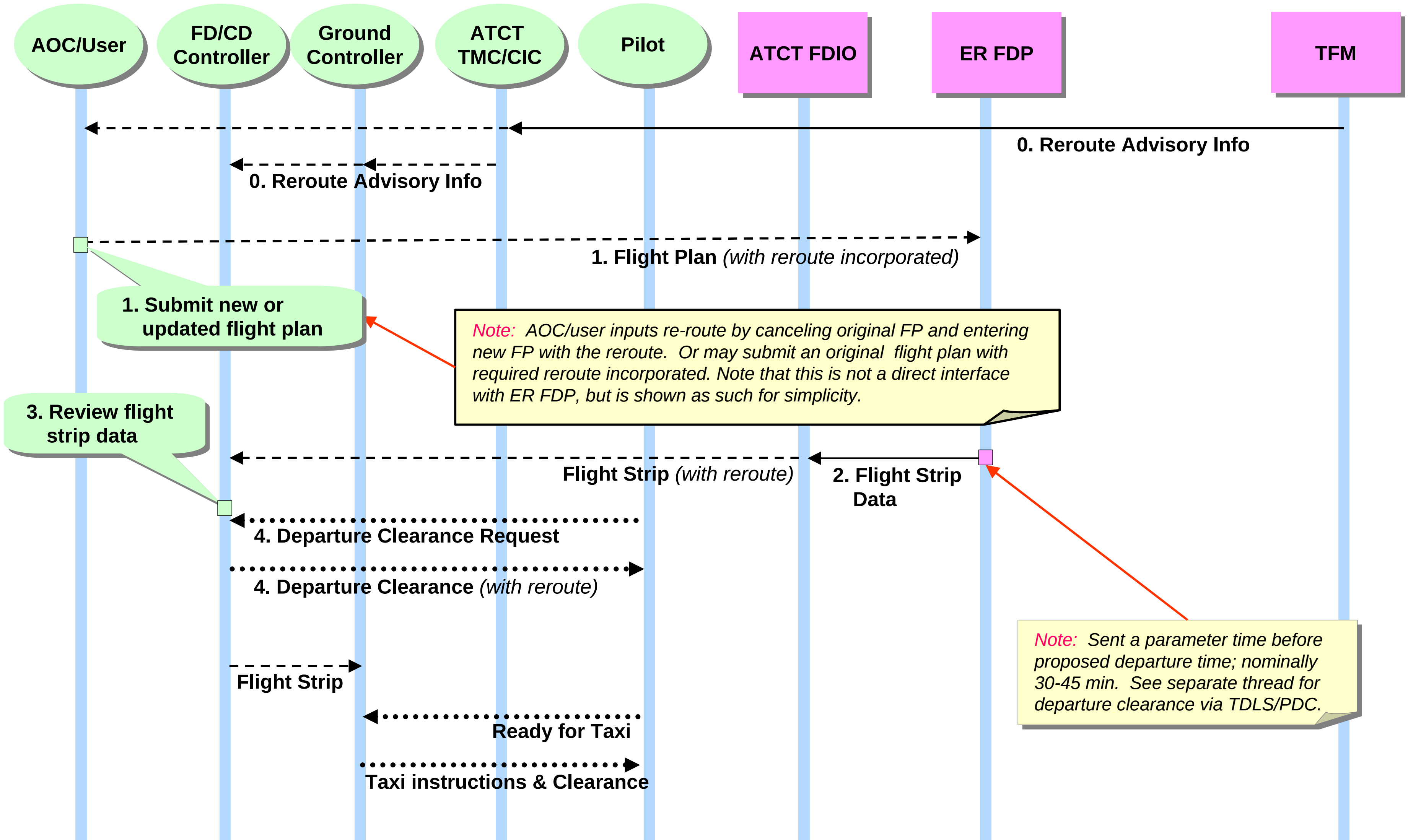
3.1 Current Execution of Flow Strategies – Pre-Departure Reroute Prior to Strip Printing



Note: Not all handoff/voice actions shown for simplicity.

3.1 Current Execution of Flow Strategies – Pre-Departure Reroute Prior to Strip Printing

Predecessors/Trigger:

- **The rerouting thread is initiated when the ATCSCC Traffic Management Specialist (TMS), the affected ARTCC Traffic Management Coordinator (TMC), and the NAS users agree that predicted severe weather or congestion requires rerouting. This usually occurs during the normally scheduled Strategic Planning Teleconference (SPT), but may be initiated at separate teleconferences. The ARTCC TMCs suggest reroute alternative strategies and provide impact to their center's workload. Tower and TRACON TMUs in large or key areas, such as NY Metro, may be also be involved in the telecons, providing local conditions and capacity information as well as preferred resolutions. The NAS users indicate their preferences for reroute strategies and participants agree to a reroute strategy.**

0. The ATCSCC TMS uses TFM automation to distribute the reroute advisory and flight information, including towers and TRACONs with TFM automation. The ATCSCC TMS posts the reroute advisory on the ATCSCC Webpage, where it is available for those towers or TRACONs that do not have TFM automation (but do have a browser). ARTCC TMCs also use En Route automation, such as General Information message in HCS) to provide the reroute advisory to tower and TRACON personnel

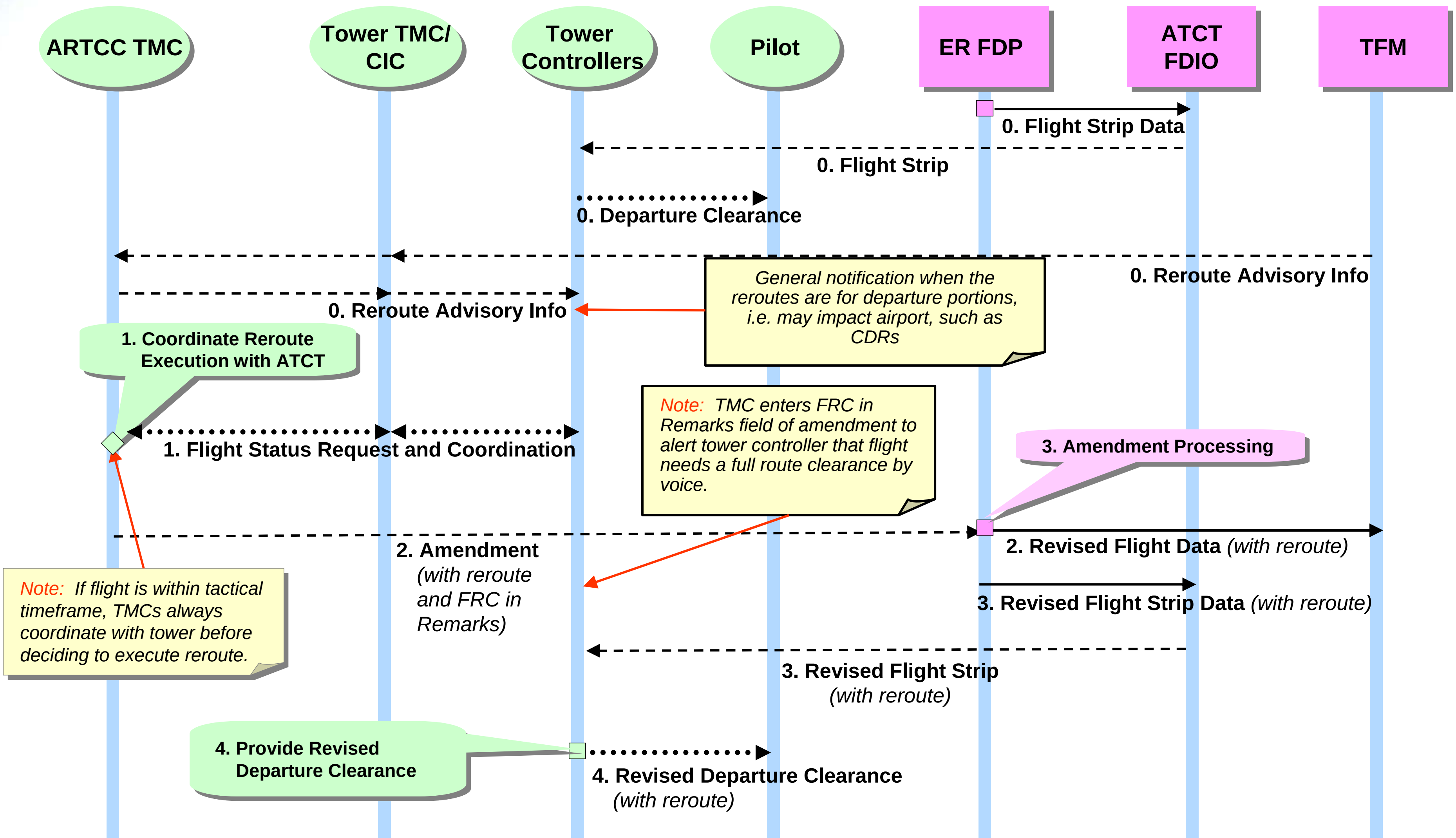
Nominal Steps:

1. **Prior to the printing of flight strips in the tower, nominally 30-45 minutes prior to departure, the NAS users may modify flight plans for the flights affected by the reroutes. This is often done by cancelling the original filed flight plan and resubmitting a new flight plan with the reroute. In other cases, no flight plan was yet filed, and the users submit the initial flight plan for the reroute. *The NAS users may also request exemptions for rerouting of flights from the ATCSCC TMS and the ARTCC TMUs via phone calls.***
2. **En Route automation distributes the flight strip data to Tower automation at the appropriate time (30-45 min prior to departure). This flight strip data includes the reroute incorporated into the route of flight.**
3. **The tower Flight Data position reviews the flight strip and adds appropriate operational information, such as departure runway.**
4. **When the pilot requests a Departure Clearance, the Clearance Delivery controller uses it to provide a departure clearance to the flight crew. This departure clearance may be delivered via automation in some facilities without any pilot request. (See separate thread for departure clearance).**

Post-Conditions:

- **The flight strip is transferred to the Ground controller.**
- **When ready, the pilot calls the Ground Controller for a taxi clearance and departure activities proceed.**

3.2 Current Execution of Flow Strategies – Pre-Departure Reroute After Strip Printing



Note: Not all handoff/voice actions shown for simplicity.

Note: Handoff actions not shown for simplicity.

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3.2 Current Execution of Flow Strategies – Pre-Departure Reroute After Strip Printing

Predecessors/Trigger:

- **Flight strips have already been printed and the initial departure clearance has already been delivered, either via voice or by PDC**

0. **A TFM reroute is implemented by traffic managers. The ATCSCC TMS uses TFM automation to distribute the reroute advisory and flight information, including towers and TRACONs with TFM automation. ARTCC TMCs also use En Route automation, such as General Information message in HCS) to provide the reroute advisory to tower and TRACON personnel**

Nominal Steps:

1. **When a TFM reroute initiative is implemented, the ARTCC TMC contacts the tower to coordinate reroutes and determine the status of candidate flights. The TMC may request information about a specific flight or request the tower to identify those flights that can be rerouted. After this coordination, an assessment is made whether the reroute can be executed feasibly prior to departure and operational procedures usually define who is going to make the flight data amendment that is agreed upon.**
2. **The ARTCC TMC usually enters the reroute amendment into en route automation. The revised flight data is distributed to TFM and other users.**
3. **En route automation provides revised flight strip data to tower automation, which prints a revised flight strip.**
4. **The tower controller (Flight Data/Clearance Delivery) reviews the revised flight strip, manually marks as appropriate, and provides the revised clearance to the pilot via voice communication. If the flight is under ground control, then FD/CD coordinates and may retrieve the previous flight strip from the ground controller in order to ensure the revised clearance is delivered to the aircraft.**

Post-Conditions:

- **The flight strip is transferred to the Ground controller.**
- **When ready, the pilot calls the Ground Controller for a taxi clearance and departure activities proceed**

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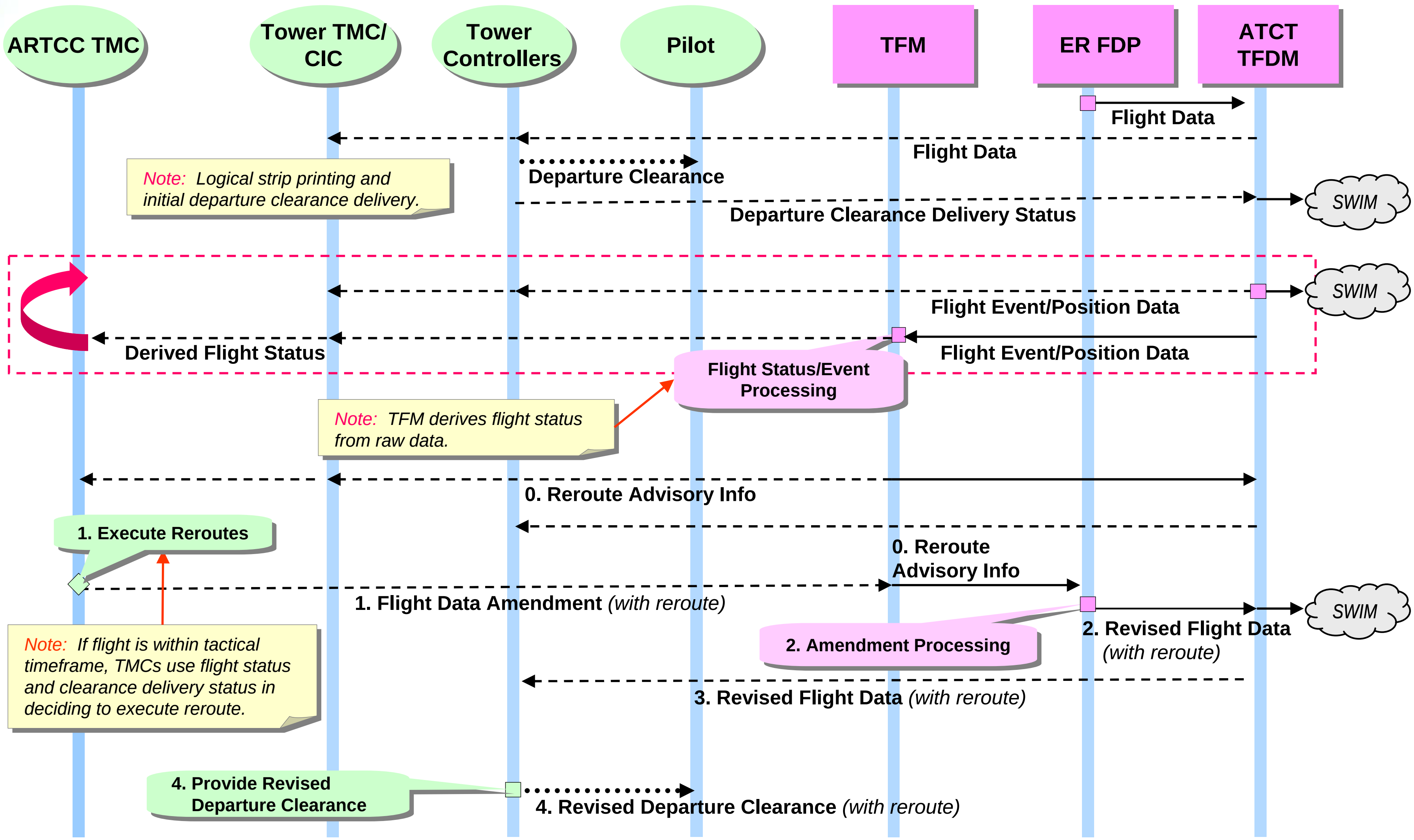
3.3 Future Execution of Flow Strategies – Pre-Departure Reroute After Strip Printing



Note: Not all handoff/voice actions shown for simplicity.

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3.3 Future Execution of Flow Strategies – Pre-Departure Reroute After Strip Printing

Predecessors/Trigger:

- **Flight data is available to tower controllers (strips have already been printed, if applicable). In this timeframe, it is expected that electronic flight data will be available to a significant number of towers, but legacy strip printing will continue to be supported.**
- **The initial departure clearance has been delivered, either by voice or by data comm (see separate thread)**
- **Tower automation and TFM automation provide updated flight status/event data to traffic managers and controllers, as well as SWIM users. *Note that this shows TFM as current provider of "derived" status, whereas tower controllers have access to the "raw" data.***

0. **A TFM reroute is implemented by traffic managers. The ATCSCC TMS uses TFM automation to distribute the reroute advisory and flight information, including to traffic managers and Tower automation. Tower automation makes this reroute advisory information available to tower controllers.**

Nominal Use Case Steps:

1. **ARTCC TMC reviews flight status and clearance delivery status available on TFM automation to determine whether the reroute can be feasibly executed for this flight. Optionally, the TMC may coordinate with the tower controller or supervisor by phone. *If the flight has already received its taxi clearance, there may still be an opportunity to provide the revised route clearance, such as when there are significant taxi queues or de-icing delays. The traffic manager and relevant tower personnel coordinate and decide collaboratively.***
2. **ARTCC TMC amends the route, using TFM automation, which then sends the updated flight plan data to En Route automation. *TFM automation optionally provides an indicator to identify that this flight is a TFM reroute.***
3. **The flight plan amendment is processed by En Route automation and the updated flight data is made available to Tower automation, to Data Comm and other subscribers (including TFM, which updates TMC displays). As it does today, the revised flight data includes a flight plan revision number, any other legacy flight strip data.**
4. **The tower flight data automation indicates a flight plan update, or a flight strip is reprinted. The tower controller reviews the revised flight data and provides a revised clearance to the pilot. At applicable facilities, Data Comm is used to send the revised Departure Clearance. If the flight is already under ground control, then FD/CD coordinates with the Ground Controller to ensure the revised clearance is delivered to the aircraft.**

Post-Conditions:

- **The flight is transferred to the Ground controller, either electronically or via legacy strips.**
- **When ready, the pilot calls the Ground Controller for a taxi clearance and departure activities proceed**

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4.1 Airport Status Sharing: Airport Configuration Change

- **This data exchange capability is no longer anticipated for SWIM Segment 1. These threads are included as candidates for future segments.**

Data Category	Thread?	Summary/Comments
Flight	Y	Tower uses flight demand to determine when to change configuration. Flight data attributes, such as runway assignment, may be updated as result of configuration change
Flight Status/Event		
Clearance Delivery Status		
Surface Position		
RVR		
Airport Configuration	Y	Terminal or TFM provides current and/or planned airport configuration change
TFM Initiative	Indirect	Indirectly. Tower can use to determine when to change configuration, and then TFM provides amended TMI data as result of configuration change
Predicted Flight Data	Y	Tower can use to determine when to change configuration. Predicted flight data is also updated as result of configuration change.

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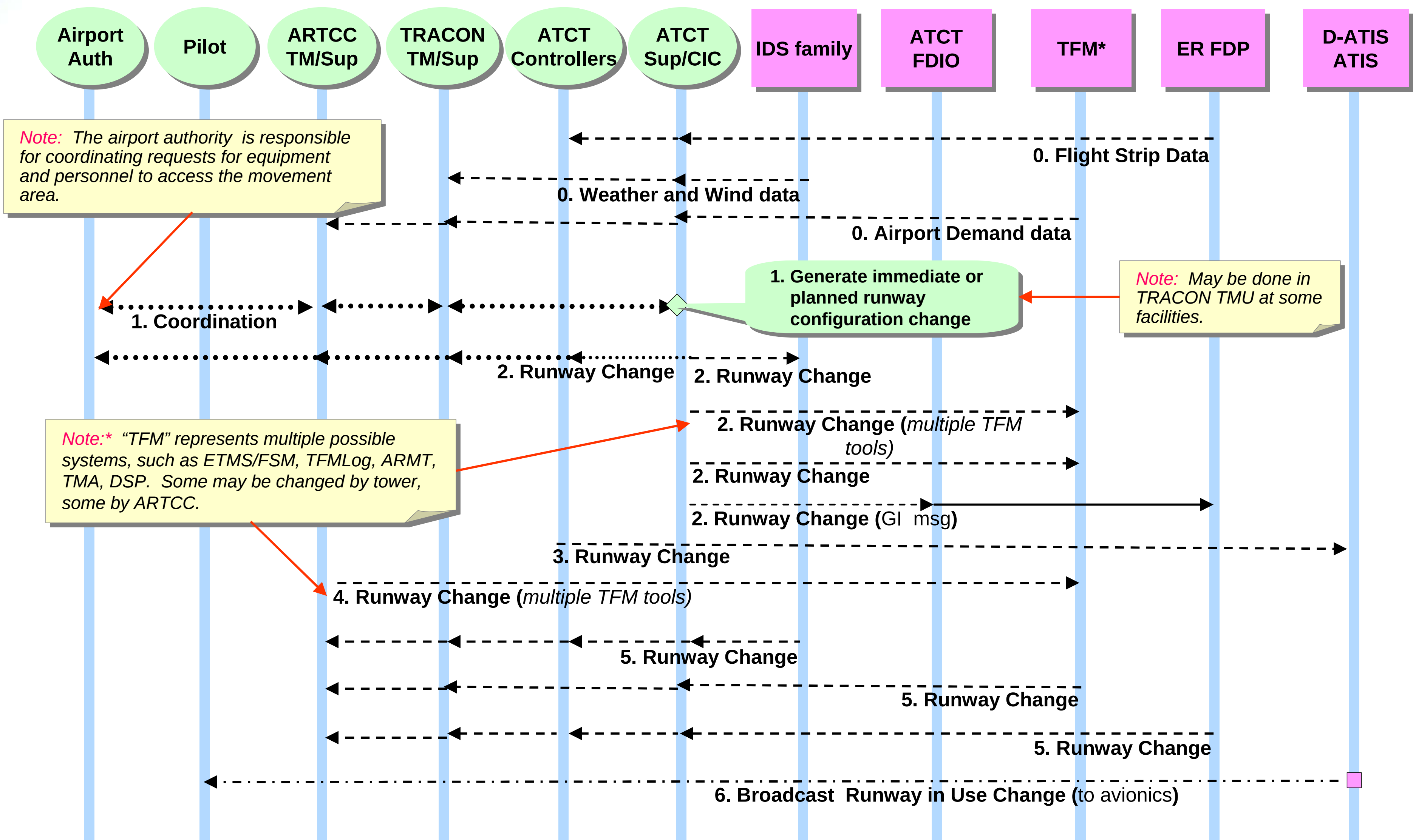
4.1 Current Airport Configuration Change



4.1 Current Airport Configuration Change

Predecessors/Trigger:

- The standard airport configuration, which is usually applicable when there are no wind considerations, is based on the preferred noise abatement configuration and on voluntary runway use programs or LOAs between aircraft operators/pilots, airport authorities, and Air Traffic.

0. When wind or other airport conditions indicate, tower supervisor personnel determine the optimal airport configuration. Besides wind, tower personnel will also consider other components, such as wind shear reported either by a pilot or the LLWAS, TDWR or ITWS; a thunderstorm in the initial take-off departure path; or snow, slush, ice, or standing water on a runway. In addition, braking action reports or crosswind component limitations for specific aircraft may affect the actual runway configuration chosen. Traffic demand and possible impact on Traffic Flow initiatives may be taken into account when determining when to change the runway configuration.

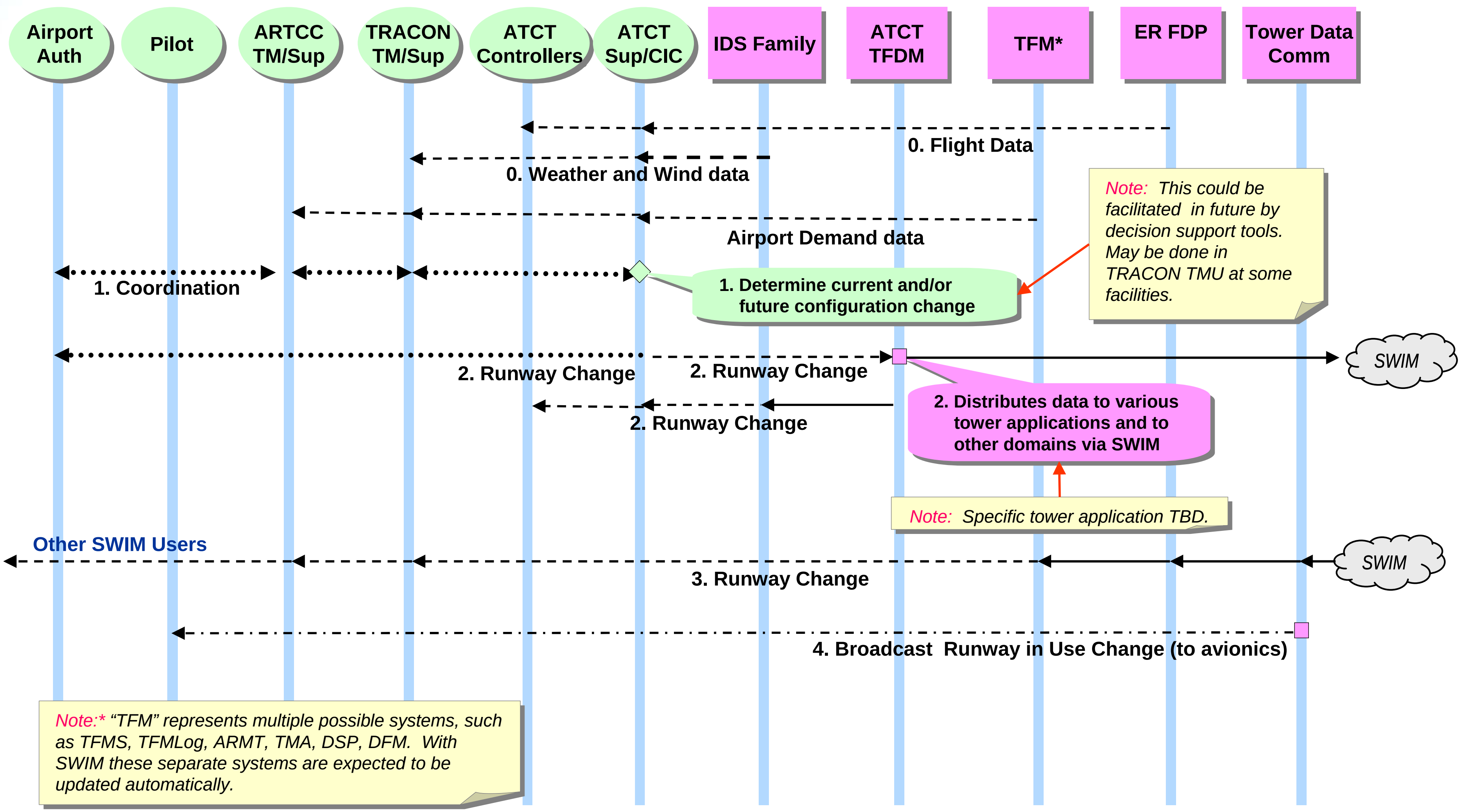
Nominal Steps:

1. In general, supervisory personnel in the tower coordinate the runway configuration in use with the airport authority and overlying TRACON. At some facilities (e.g., EWR), the final authority for runway configuration has been delegated to the TRACON because of the complex interactions between surrounding air traffic facilities.
2. Once the configuration is decided upon, tower and/or TRACON personnel communicate it to other facilities. Some of this is by phone and some is by entering the configuration information into various automation tools. *(Note that on the diagram, this is shown primarily as a tower activity to minimize clutter.)* Personnel enter the configuration into the tools separately. A GI message may be entered into FDIO in order to have ER automation distribute the configuration change.
3. A Tower controller updates the voice recording for ATIS information with new runways in use, as well as entering the new configuration into D-ATIS for broadcast via data communication.
4. ARTCC and TRACON traffic managers update other TFM tools, such as TMA.

Post-Conditions:

- Once other personnel and tools are aware of the configuration change, there are multiple and various operational activities, such as TFM tools using it to revise arrival or departure schedules.

4.2 Future Airport Configuration Change



4.2 Future Airport Configuration Change

Predecessors/Trigger:

- In general, supervisory personnel in the tower continue to coordinate the runway configuration is use with the airport authority and overlying TRACON. At some facilities (e.g., EWR), the final authority for runway configuration has been delegated to the TRACON because of the complex interactions between surrounding air traffic facilities.

Nominal Steps:

1. As is done today, tower and TRACON personnel will use weather, wind, airport environment and traffic demand data to determine if and when an airport configuration needs to be changed. Increased availability to predicted flight demand and airport/airspace status information via SWIM will facilitate this activity. In particular, the enhanced data availability via SWIM is expected to improve the coordination with TFM and ATC associated with determining the best time to execute a future configuration change. Tower, TRACON and ARTCC supervisory personnel will be able to use decision support tools to "what-if" a planned configuration change prior to making decisions.
2. Once the configuration is decided upon, tower and/or TRACON personnel communicate it to other facilities. In SWIM Segment 1 timeframe, this is expected to still be by phone. Tower personnel may be able to enter the configuration change information into a single tower automation system, and tower data distribution capabilities will distribute the data within the tower and to other domains via SWIM.
3. A Tower controller updates the voice recording for ATIS information with new runways in use, as is done today.
4. Tower Data Comm updates the D-ATIS automatically and makes the configuration change available via data communications.

Post-Conditions:

- Once other personnel and tools are aware of the configuration change, there are multiple and various operational activities, such as TFM tools using it to revise schedules.

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Appendix C Operational and System Context Diagrams for Terminal FF COI Data Exchange

A separate attachment contains the following system-level context diagrams:

1. **Current and Future Tower – TFM Data Exchange**
2. **Current and Future Terminal – En Route Data Exchange**

These diagrams provide an overview of the domain-specific data exchange contained in the more detailed matrices. They are designed to show the ***notional*** operational and system nodes and data flows between terminal and TFM and terminal and En Route that support the SWIM Segment 1 capabilities. As with the other diagrams in this document, SWIM is not shown as a physical entity at this time; architecture diagrams will be developed as the concept matures and is implemented by the individual domains.

CENTER FOR ADVANCED AVIATION SYSTEM DEVELOPMENT (CAASD)

Operational and System Context Diagrams for Terminal FF COI Data Exchange

MP070070 Appendix C

May 2007

CAASD

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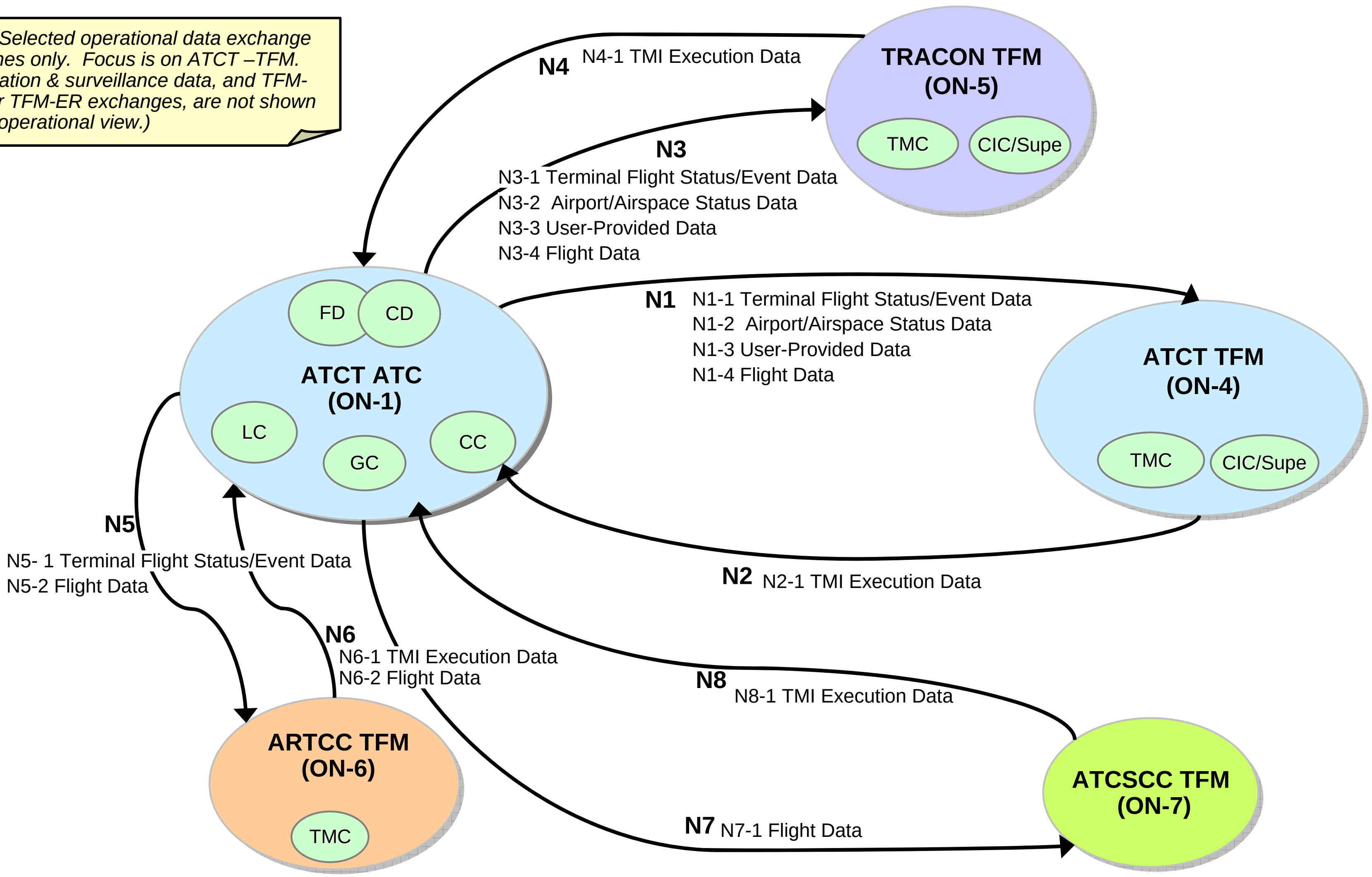
Current Tower-TFM Data Exchange Notional Operational Nodes (OV-2)

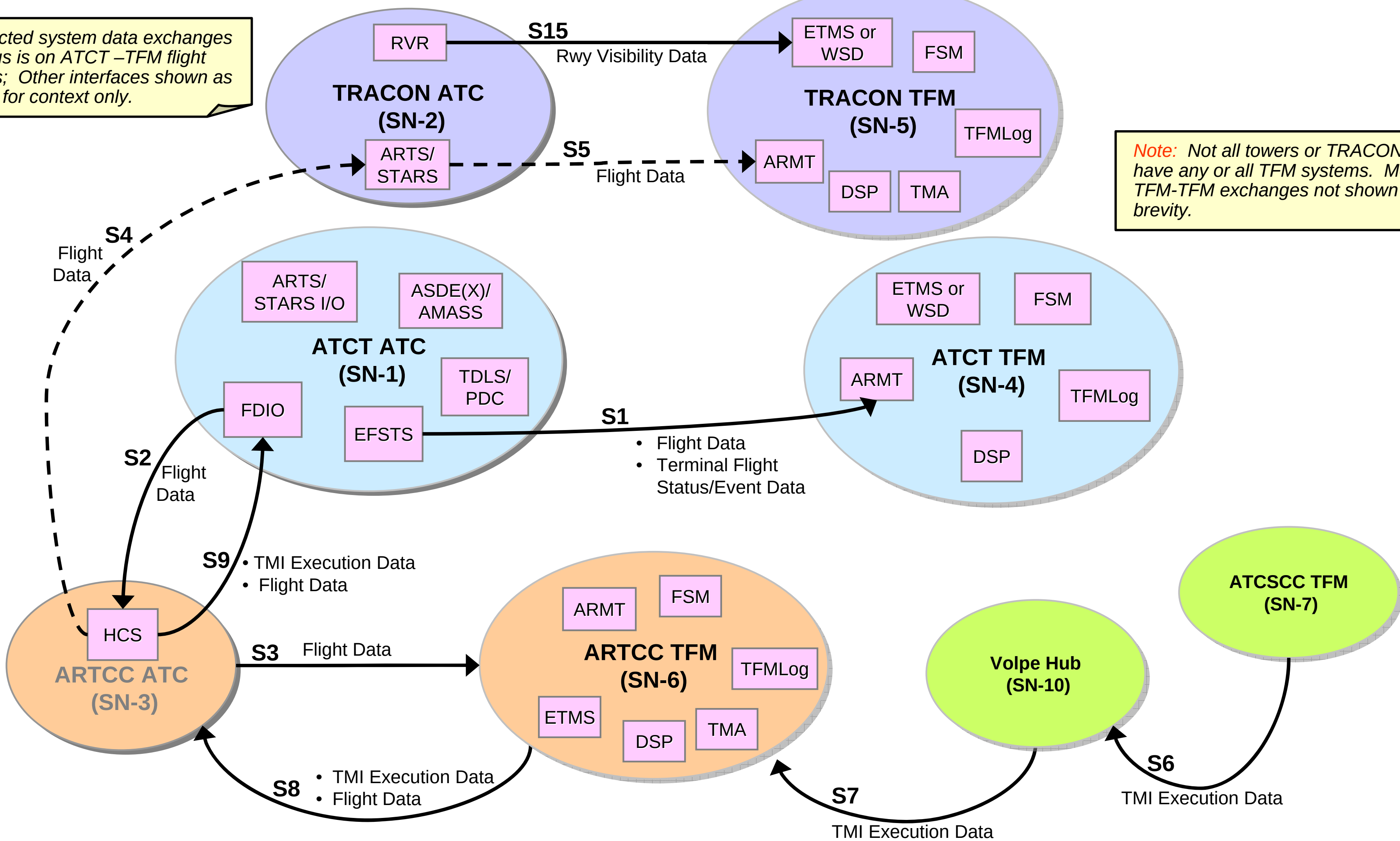
Note: Selected operational data exchange needlines only. Focus is on ATCT –TFM. (Adaptation & surveillance data, and TFM-TFM or TFM-ER exchanges, are not shown in this operational view.)



Legend:
- *ON-x is operational node identifier*
- *Ny is operational needline identifier*

Current Tower-TFM Data Exchange Notional System Interface (SV-1)

Note: Selected system data exchanges only. Focus is on ATCT –TFM flight data/status; Other interfaces shown as dotted line for context only.



Note: Not all towers or TRACONS have any or all TFM systems. Most TFM-TFM exchanges not shown for brevity.

Legend:
- *SN-x is system node identifier*
- *Sy is system data exchange identifier*

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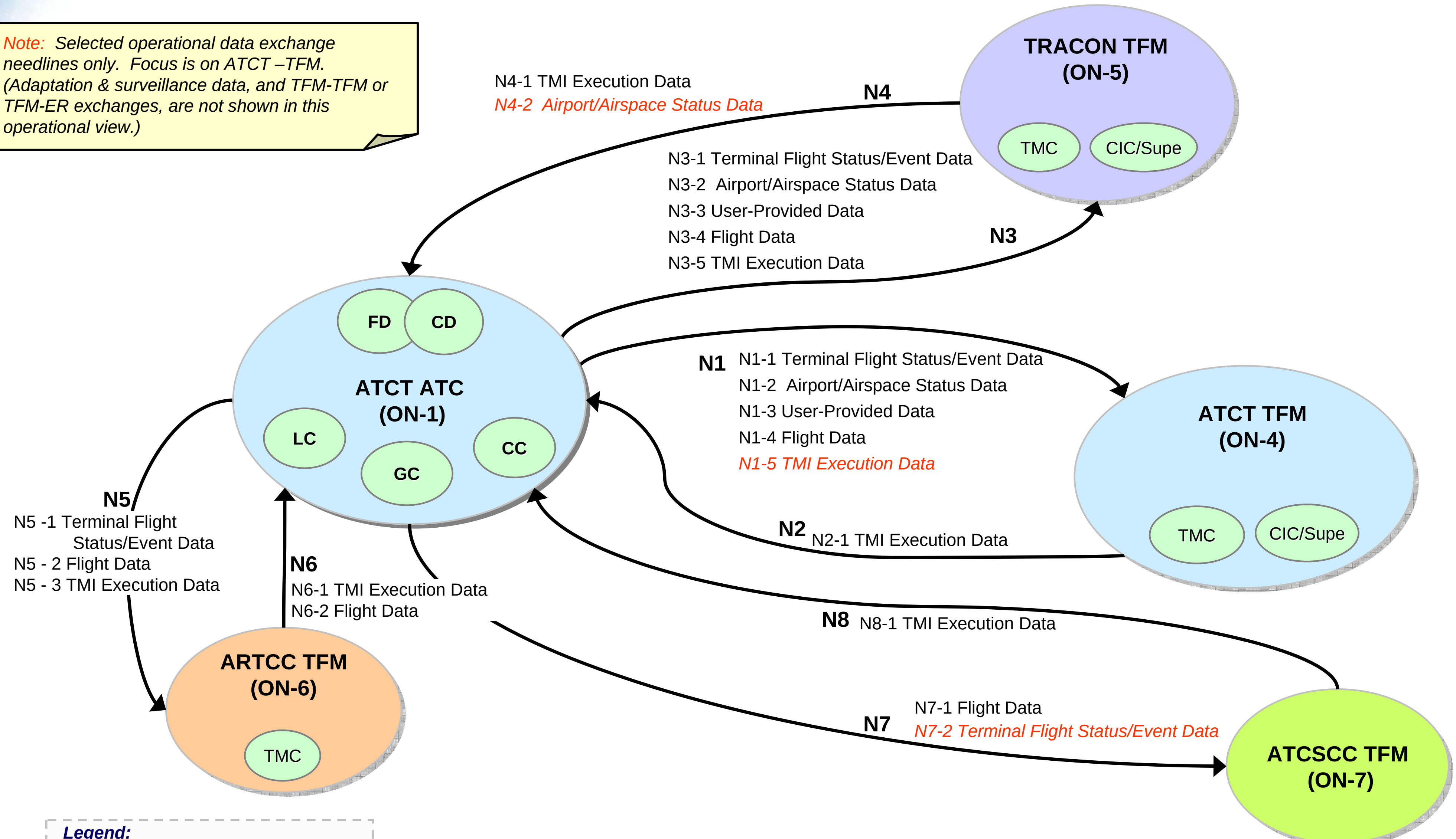
Future SWIM Segment 1 Tower-TFM Data Exchange Notional Operational Nodes (OV-2)

Note: Selected operational data exchange needlines only. Focus is on ATCT –TFM. (Adaptation & surveillance data, and TFM-TFM or TFM-ER exchanges, are not shown in this operational view.)



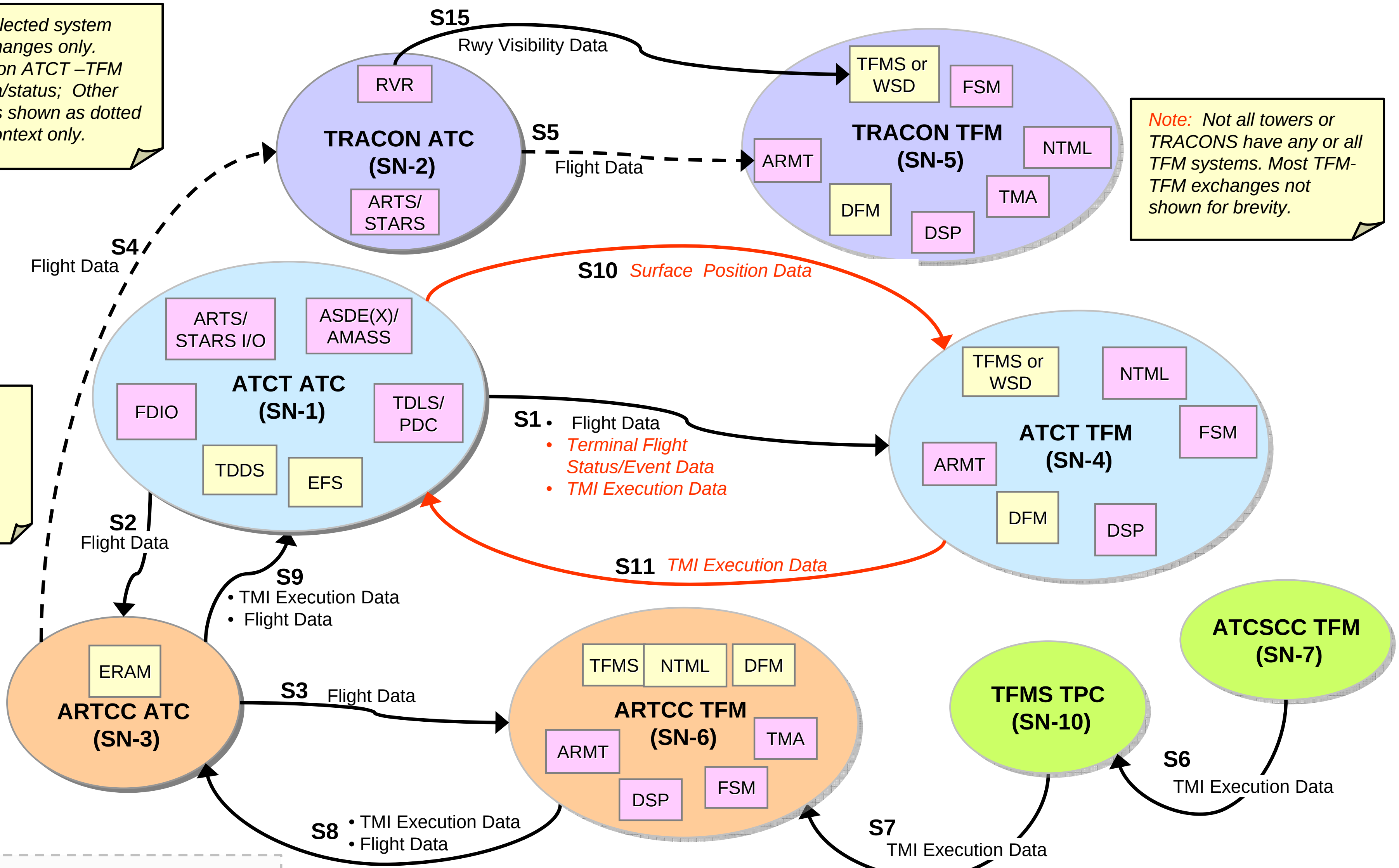
Legend:
- *ON-x is operational node identifier*
- *Ny is operational needline identifier*
- *New items are in red italics*

Future SWIM Segment 1 Tower-TFM Data Exchange Notional System Interface (SV-1)

Note: Selected system data exchanges only. Focus is on ATCT –TFM flight data/status; Other interfaces shown as dotted line for context only.

Note: Not all towers or TRACONS have any or all TFM systems. Most TFM-TFM exchanges not shown for brevity.

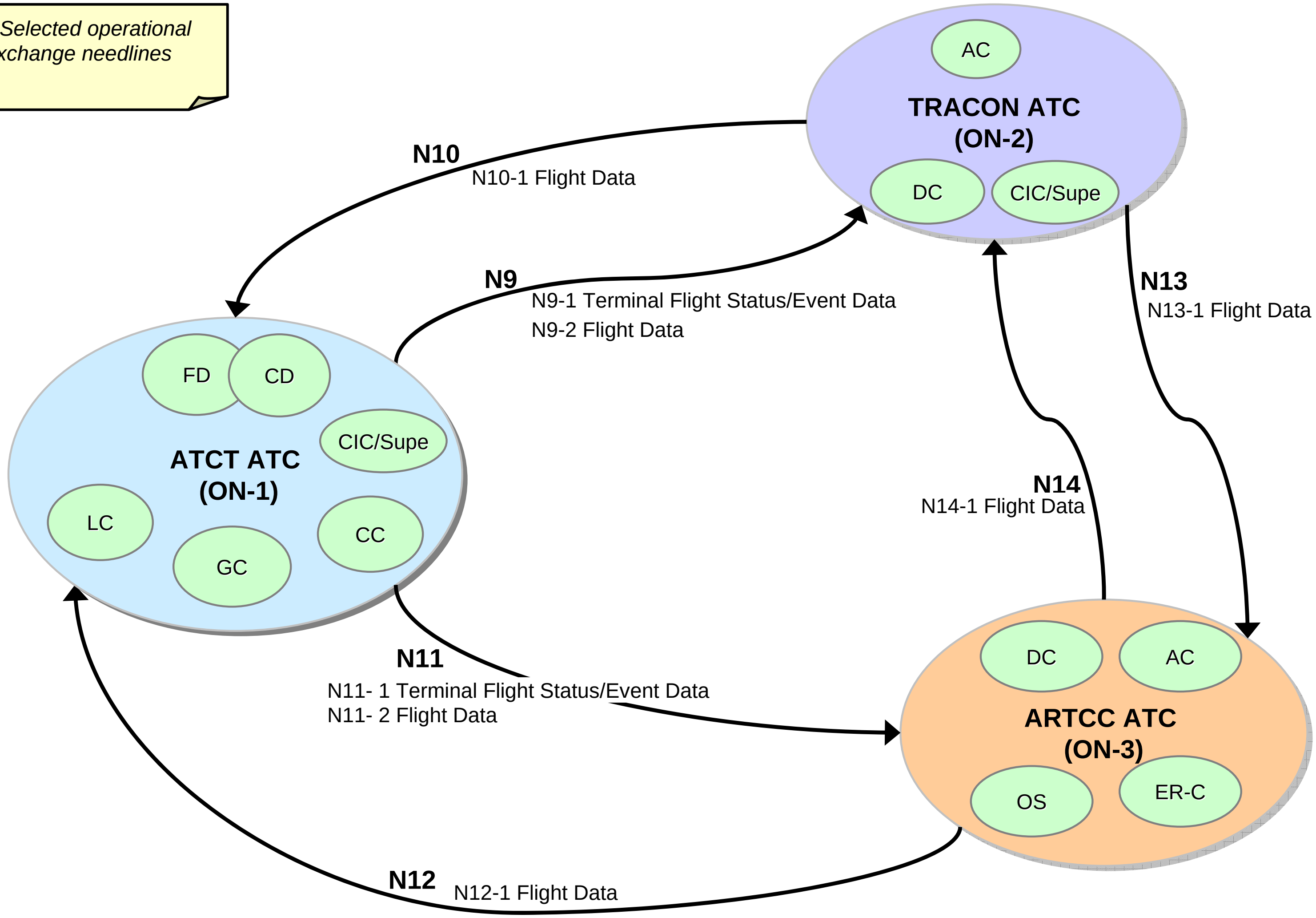
Note: Actual TFMS-ERAM interface is via ATM IPOP intermediate system.



Legend:
- *SN-x is system node identifier*
- *Sy is system data exchange identifier*
- *New items are in red italics or yellow shading*

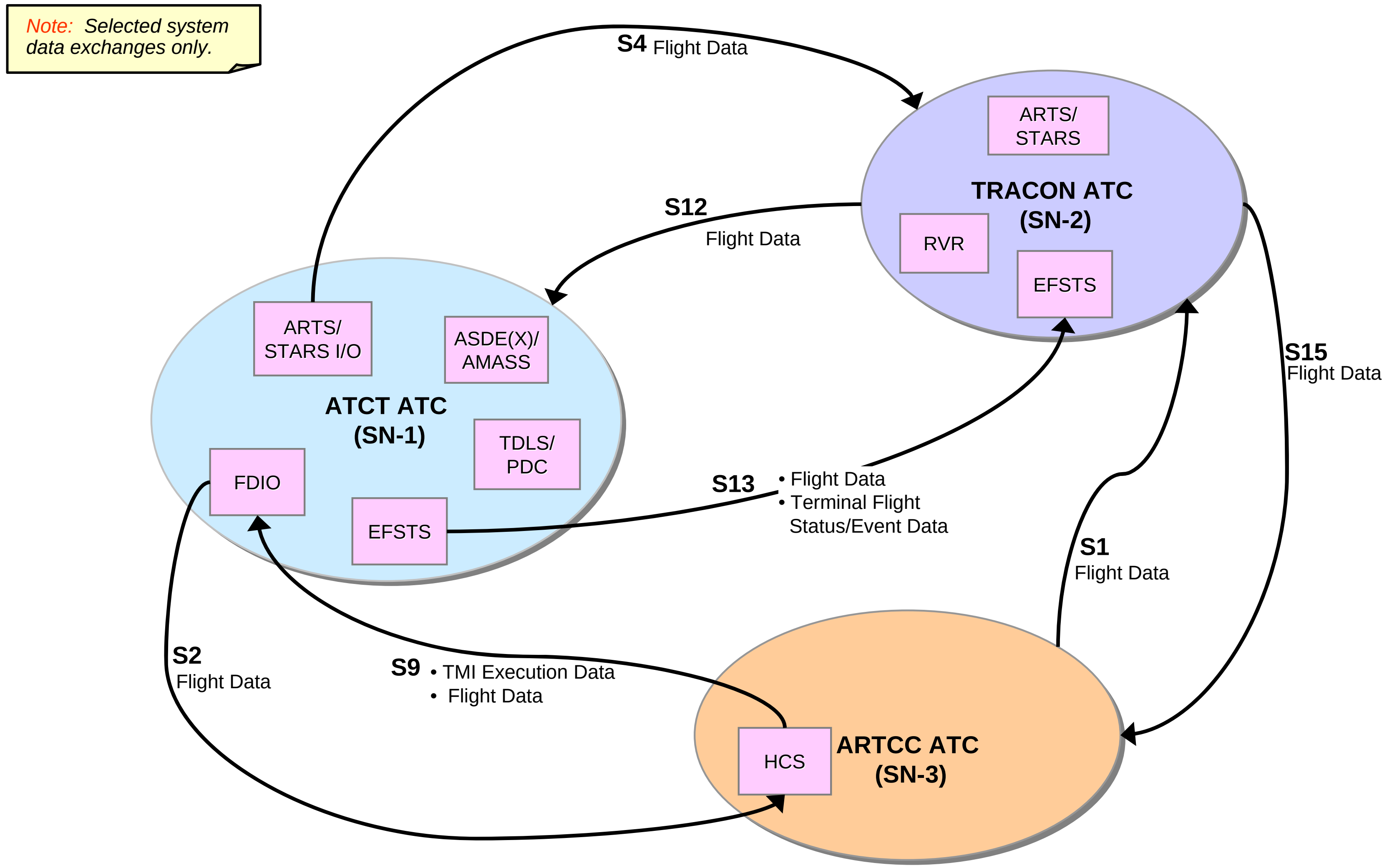
Current Terminal- En Route Data Exchange
Notional Operational Nodes (OV-2)

Note: Selected operational data exchange needlines only.



Legend:
- *ON-x is operational node identifier*
- *Ny is operational needline identifier*

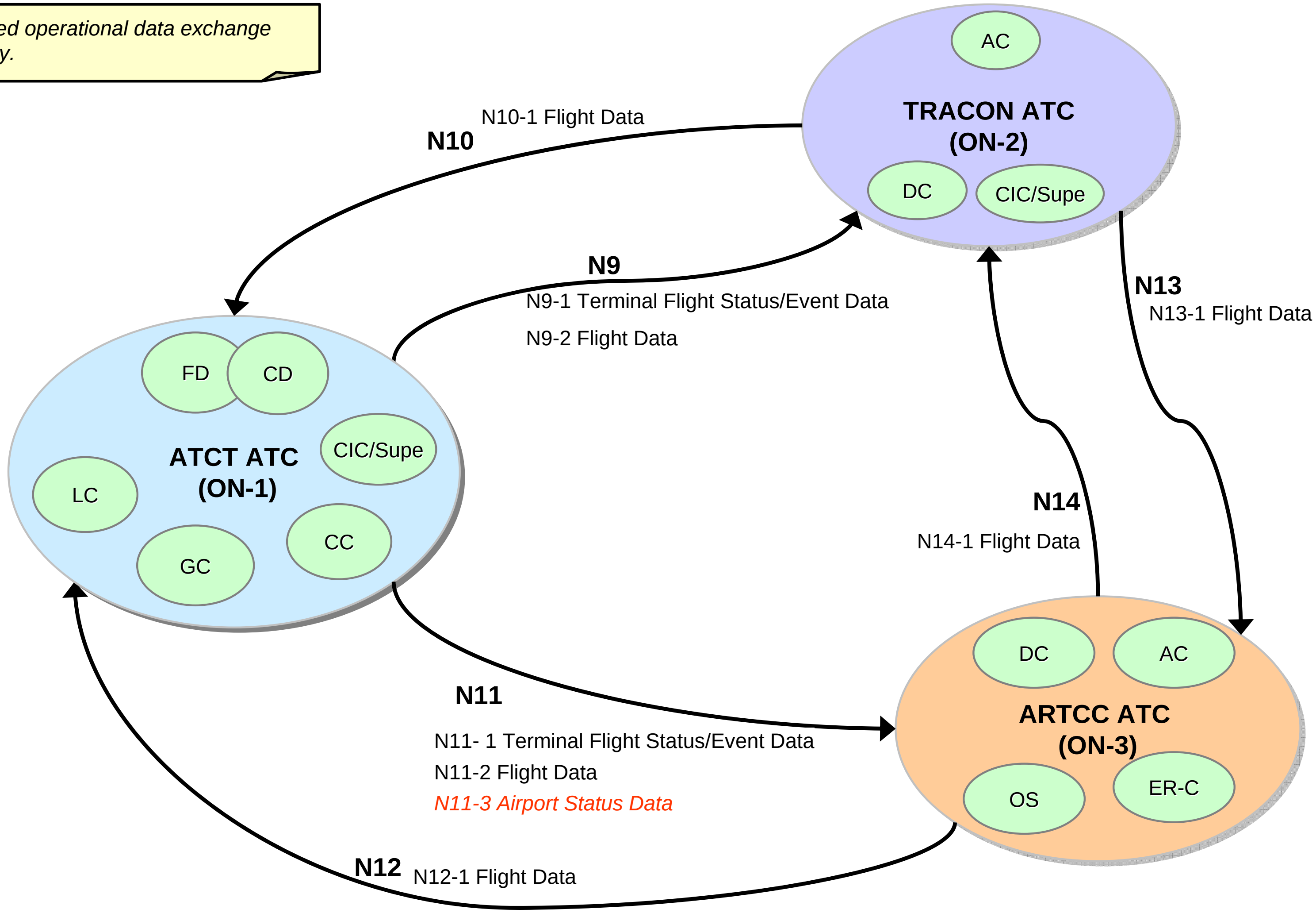
Current Terminal- En Route Data Exchange
Notional System Interface (SV-1)



Legend:
• SN-x is system node identifier
• Sy is system data exchange identifier

Future SWIM Segment 1 Terminal-En Route Data Exchange Notional Operational Nodes (OV-2)

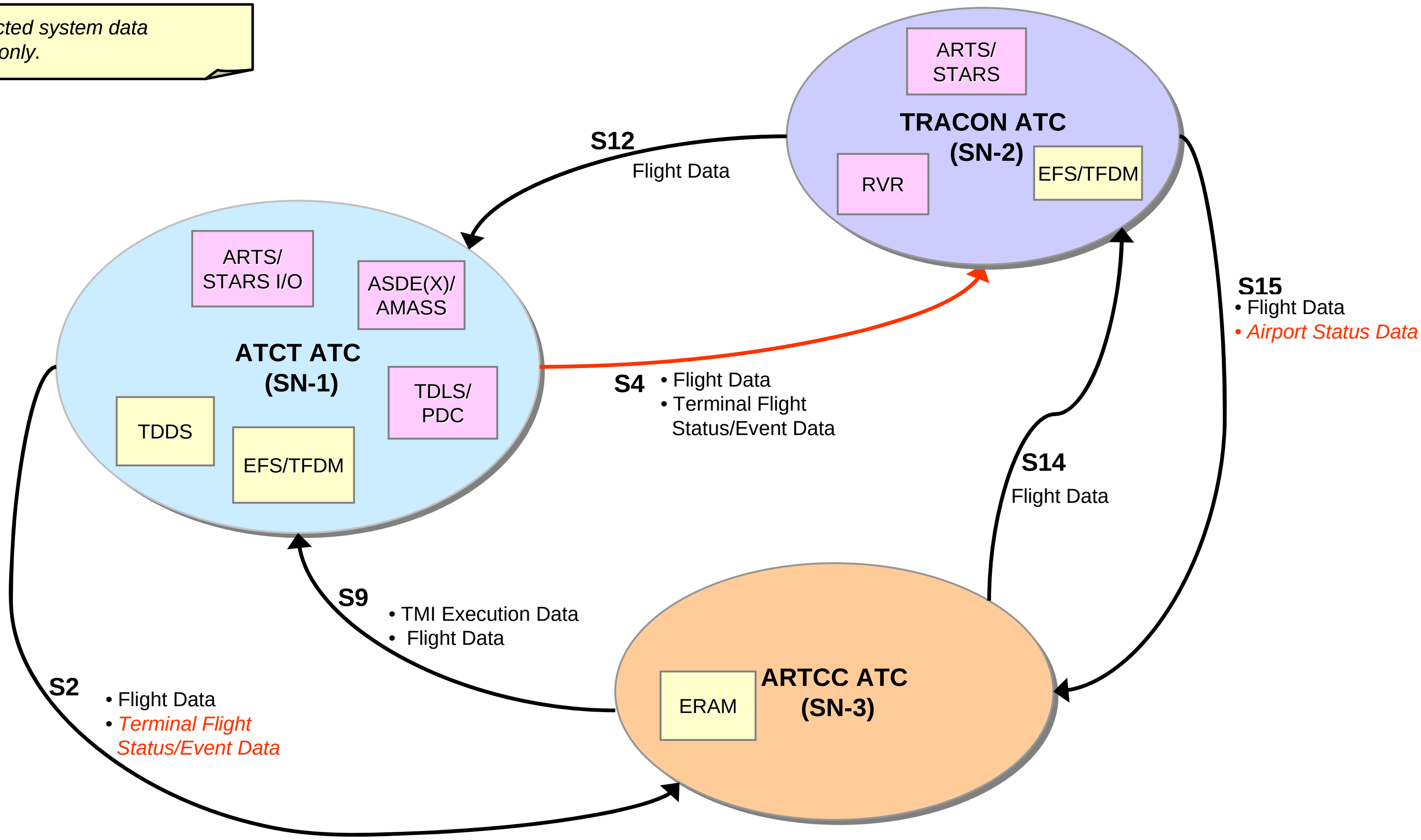
Note: Selected operational data exchange needlines only.



Legend:
- *ON-x is operational node identifier*
- *Ny is operational needline identifier*
- *New items are in red italics*

Future Terminal- En Route Data Exchange Notional System Interface (SV-1)

Note: Selected system data exchanges only.



Legend:
- *SN-x is system node identifier*
- *Sy is system data exchange identifier*
- *New items are in red italics or yellow shading*

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