

*Global Information
Management*

semNOTAM

Intelligent NOTAM Prioritization

Presented By: Eduard Gringinger

Date: August 27, 2015



Federal Aviation
Administration



**AIR TRANSPORTATION
INFORMATION EXCHANGE
CONFERENCE**

Global Information Management

August 25-27, 2015

NOAA Auditorium and Science Center • Silver Spring, MD



FREQUENTIS



Semantic DNOTAM

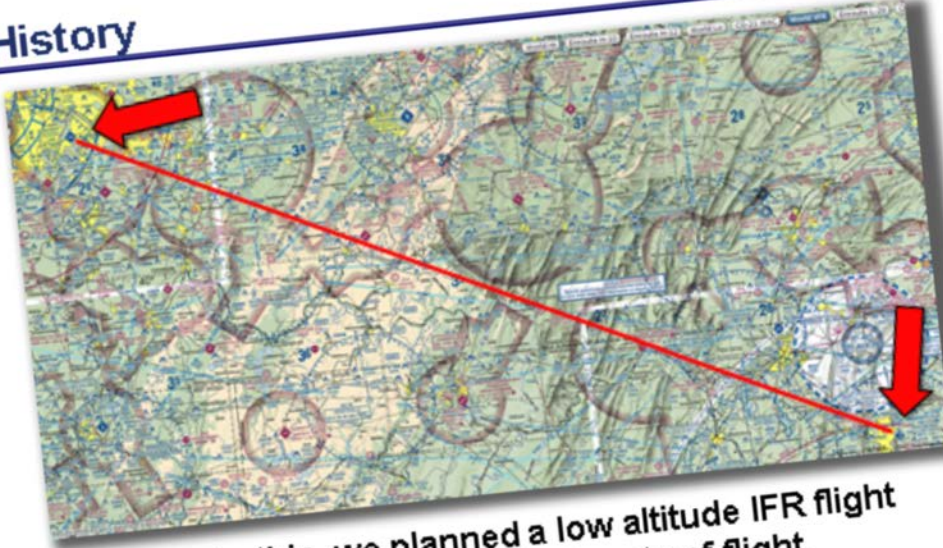
- Ontology-based prioritization & querying of DNOTAM
 - SWIM component which you can add to any application
 - Industrial Research & Experimental Development project founded by the Austrian Research Promotion Agency (FFG)
- Joint Undertaking of FREQUENTIS & University of Linz
 - Supported by AustroControl, Eurocontrol, various pilots & FAA FNS Distribution Service
- Ends December 2016

Motivation

- ❑ “The current pre-flight information bulletins contain on average 50% NOTAM messages that are irrelevant because it is not possible filter out, for example, information that does not concern that type of aircraft or that flight.” [1, p. 10]
- ❑ Intelligent querying and filtering of Digital NOTAMs has been identified as important [1]
- ❑ “[...] the current NOTAMs system is clumsy to use and that it is easy to make mistakes using it.” [2, p. 2]

NOTAM Industry Day 2014

History



To illustrate this, we planned a low altitude IFR flight from FDK to AGC, using a direct route of flight.



Federal Aviation
Administration

4

After closer evaluation of 389 NOTAMs, only 68 were applicable.

After fine-grade filtering only 32 NOTAMs affect the route of flight.

*presented by Ernie Bilotto during the NOTAM industry day 2014

NOTAM Industry Day 2014

Air Transportation Information
Exchange Conference -
Global Information Management

Pilot's Bill of Rights Act of 2012

Authorized NOTAM Improvement Program:

- Pertinent and timely
- Archived in a public, centralized location
- Filtered so pilots can prioritize
- More specific and relevant to route of flight

Filtered so pilots can prioritize

More specific and relevant
to route of flight

ATM Information Reference Model

Harmonized, common, digital reference for operational language which requires semantic interoperability:

■ Information Model

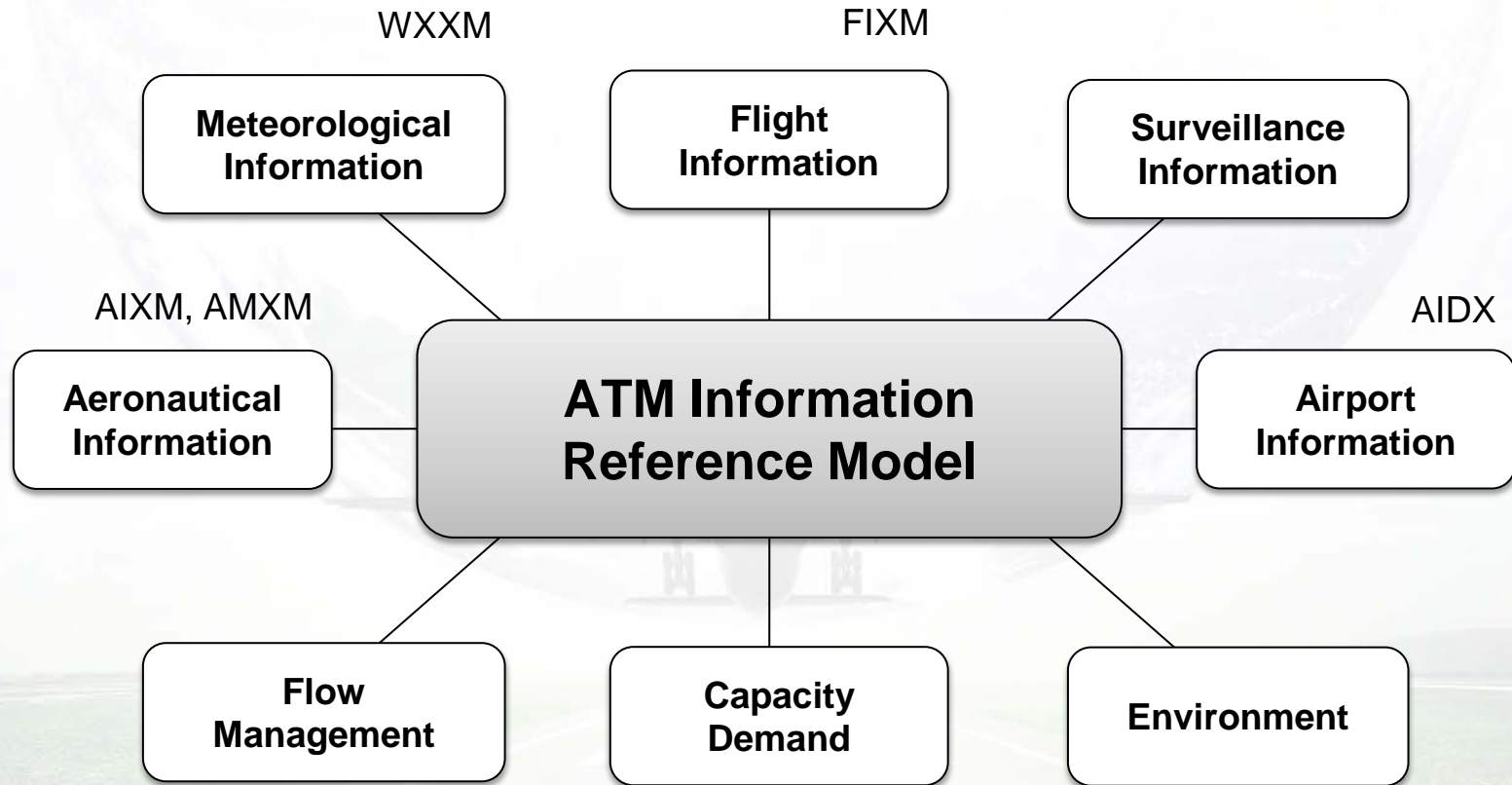
- Captures operational languages and dialects
- Provides a reference containing agreed and harmonized definitions and their interrelations

■ Logical Data Model

- Refines the Information Model to support system and service development

[3]

ATM Information Reference Model



[4]

Best Paper Award @ICNS 2015

Air Transportation Information
Exchange Conference -
Global Information Management



Requirements Analysis

- Identified scenarios:
 - Pilot Briefing (Flight Planning, Departure Briefing, and Debriefing)
 - Dispatcher Briefing (Flight Preparation, Flight Update, and Debriefing)
 - In-Flight Application (context of pilot briefing)
 - Controller Briefing

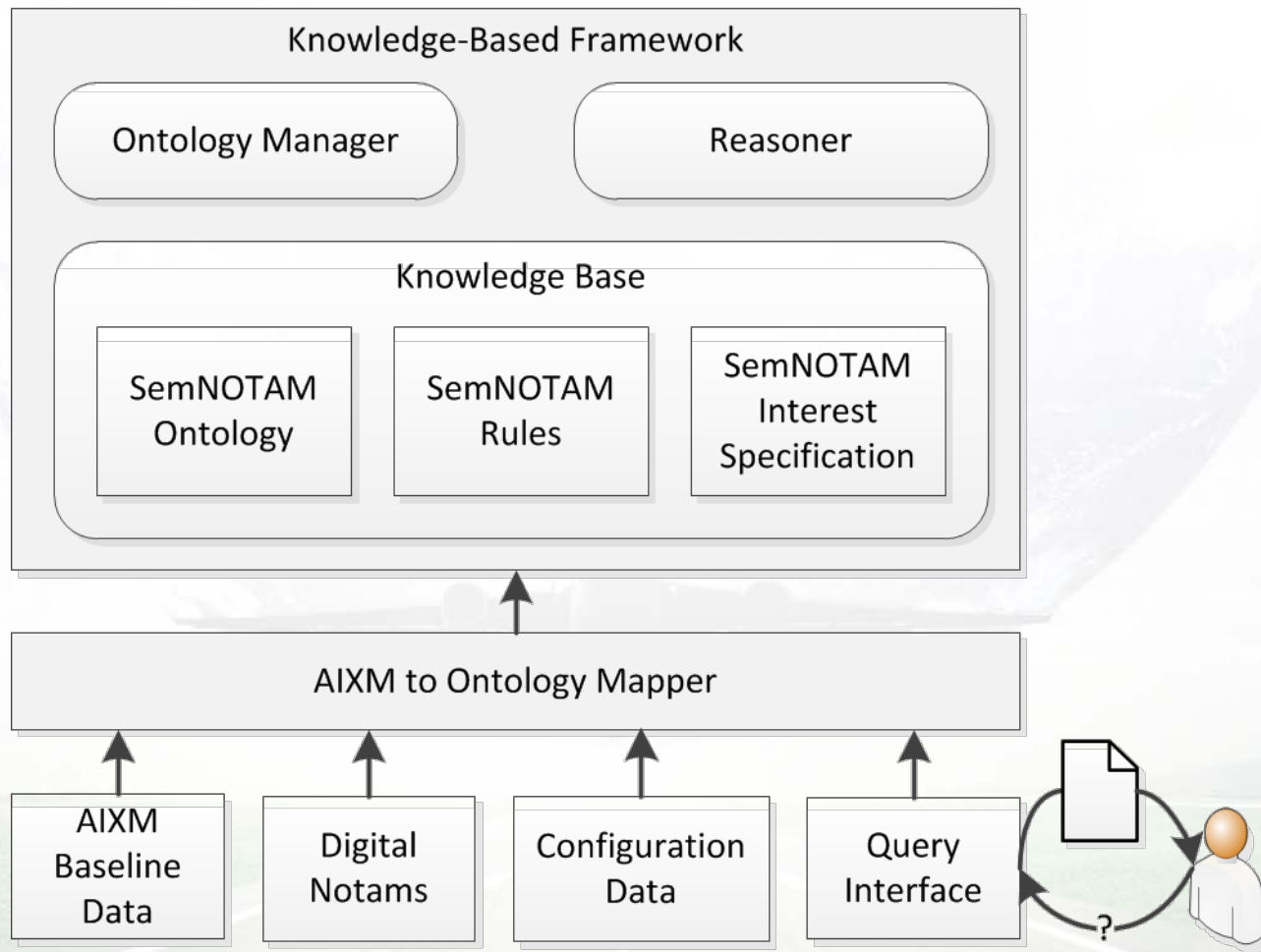
- Other requirements:
 - 100 % recall
 - Prioritization/Grouping
 - Customizing/Personalization
 - Delta queries

[5, 6]

Requirements Analysis

- DNOTAMS
 - Meaning in time and space
 - Event Scenarios (EuroControl/FAA)
- Business terms (AIRM, event scenarios, user-defined, etc.)
- Business rules
 - Use of business terms
 - Relevance rules
 - Annotation rules (e.g. importance)

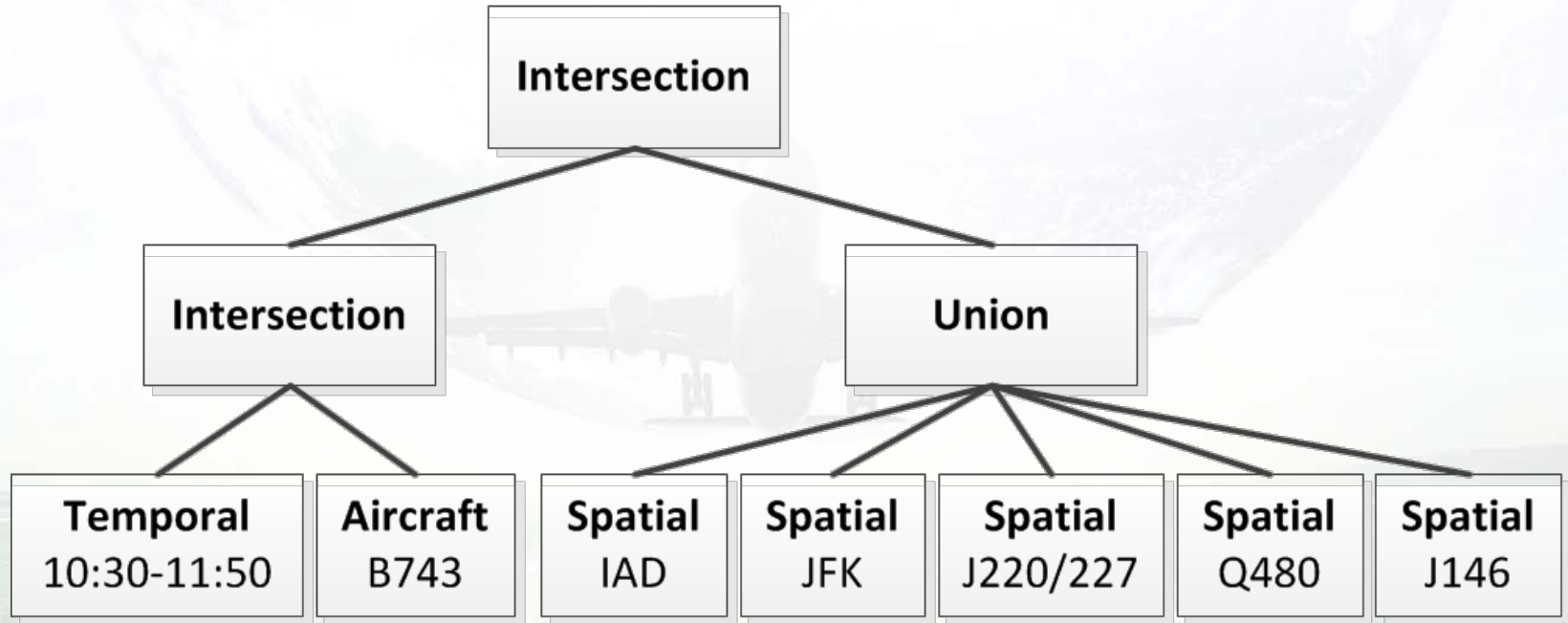
Architecture



Query Interface

Interest Specification

for flight from Washington (IAD) to New York (JFK)



Business Terms

- Business terms in SemNOTAM are defined in an intuitively understandable, precise, and machine-readable form called *concept*.
 - Concept contains all elements compliant
 - Part of the SemNOTAM Ontology
- Types of business terms:
 - NOTAM business terms (special type event scenarios)
 - Auxiliary business terms
- Relations between business terms

Business Relevance Rules

Business relevance rules are specified in an intuitively understandable, precise, and machine-readable form called *SemNOTAM Rule*.

Example NOTAMs:

- N1: Runway Closure for wingspan greater than 150ft
- N2: Airport closed for helicopters

Rules:

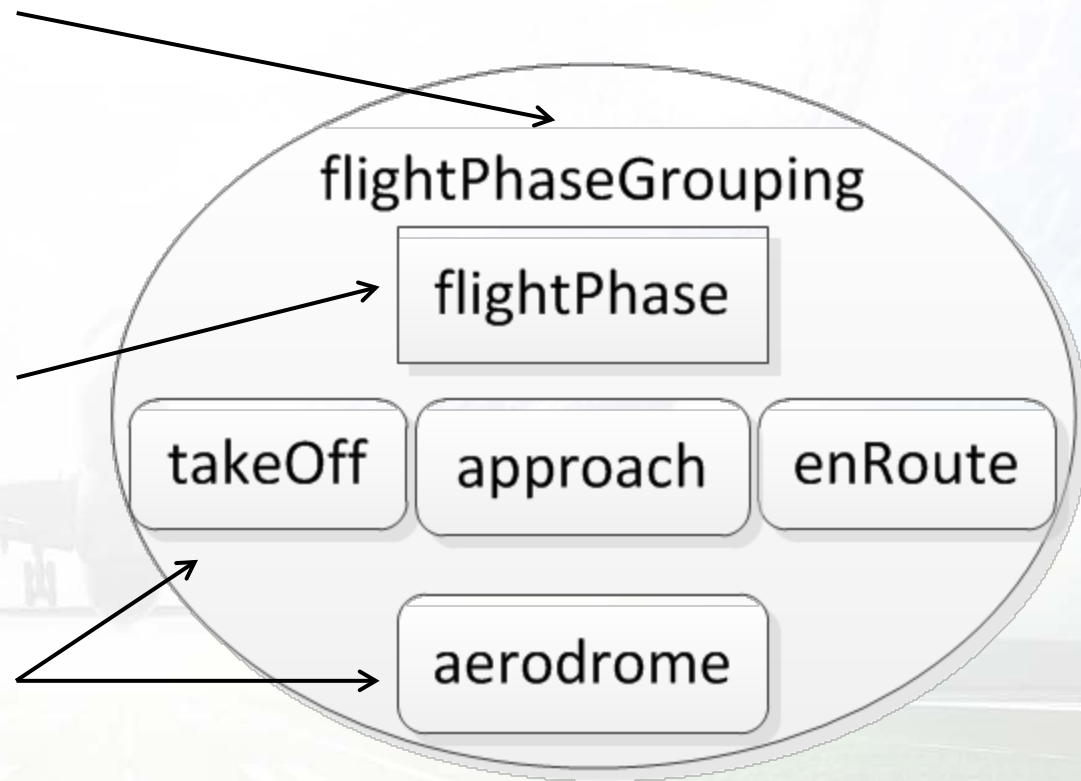
- An runway closure restricted to greater than x is irrelevant if the aircraft's wingspan is smaller than $x \pm$ buffer.
- An airport closure is irrelevant if the aircraft restriction does not meet the aircraft type.

Semantic Annotation

- Used for prioritization and grouping
- Topic groups and groupings
- Annotation rules
 - can use business terms
 - assign topic groups to NOTAMs
- Large number of rules can be split into sets
- Graphical arrangement specification

Groupings, Topics

- Grouping: used for linking
 - Either ordered
 - Must be complete
- Topic: name of a group of topic groups
- Topic group: semantically close NOTAMs



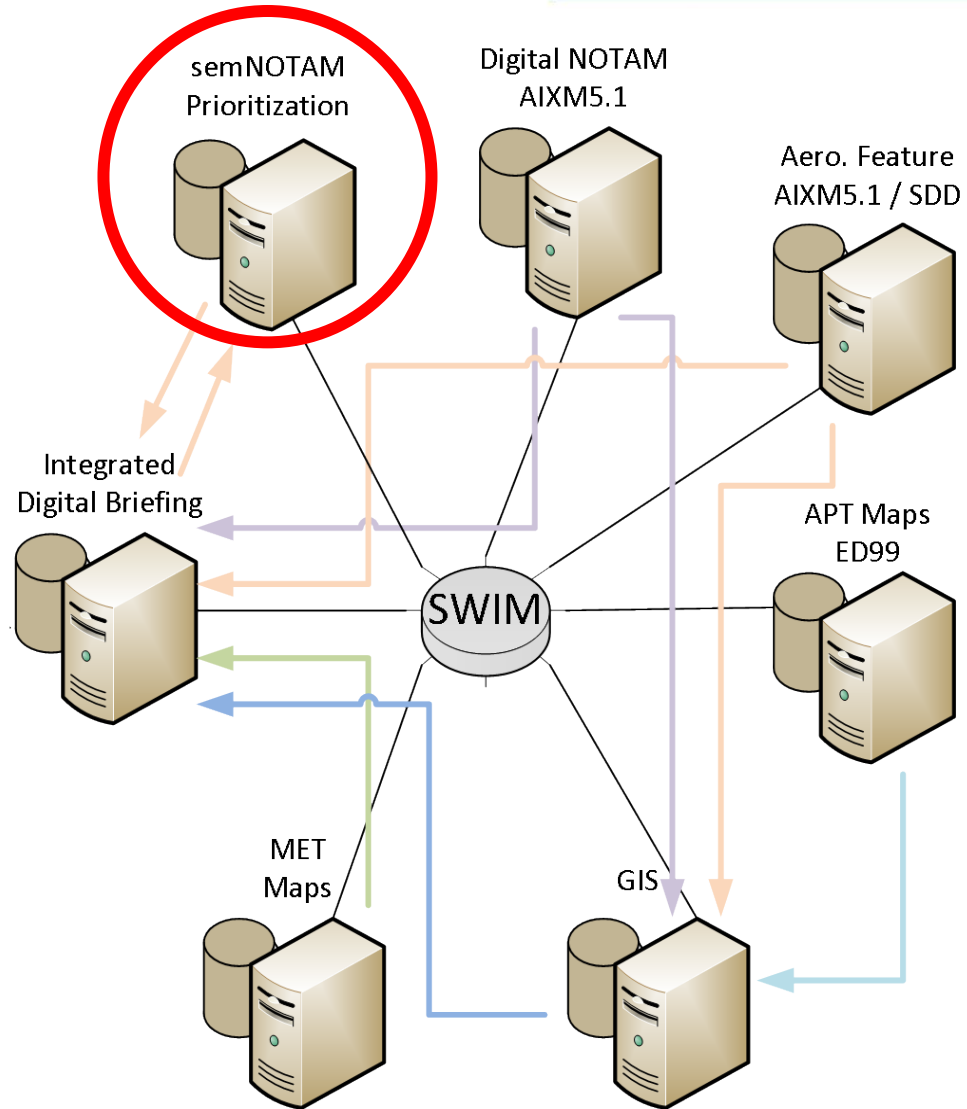
Ordered Viewing - Grouping Arrangement

- Two possibilities for ordered viewing
 - View single ordered grouping
 - Use grouping arrangements
- Grouping arrangement
 - Allows ordering of results regarding several groupings
 - Specified as a list of topics

semNOTAM Scenarios

- Integrated Digital Briefing
- In-Flight Prototype
 - DNOTAM events, MET (METAR, TAF, SIGMET)
 - Division into phases of flight
 - Representation as charts / text / timeline
 - semantic filtering and prioritization

semNOTAM Scenarios



Integrated Digital Briefing

Integrated Digital Briefing x

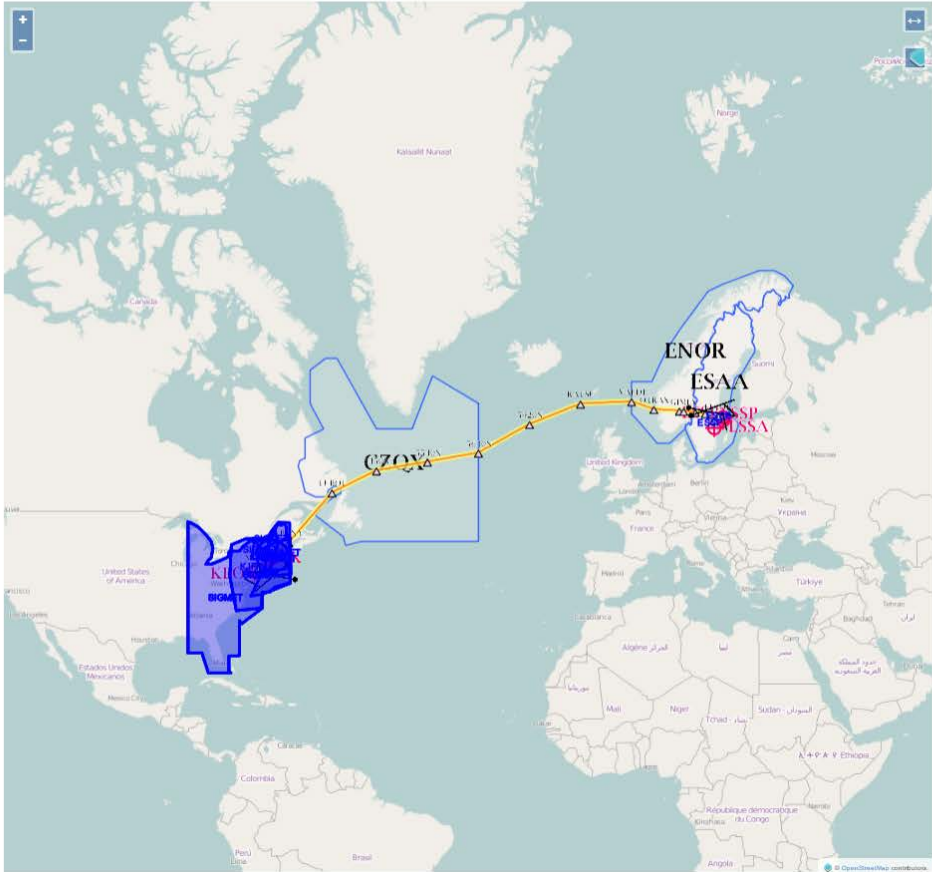
10.16.86.200:8082/BriefingHMI/#/main

FREQUENTIS Integrated Digital Briefing

Welcome dbriefing | logout | Generate ePIB

UAL 234 KJFK - ESSA 15-07-29 12:06

- Overview
- Aerodromes
- En-Route
- Settings
- Flight Plans



Request Date: Jul 29, 2015

Flight Number: UAL 234

Departure Aerodrome: KJFK JOHN F KENNEDY INTL

Destination Aerodrome: ESSA Stockholm-Arlanda

Alternate Aerodrome: ESSB STOCKHOLM/Bromma

Emergency Aerodromes: ESSP KBOS

FIR: KZBW CZQM CZUL CZQX EGGX BIRD ENOR ESAA

Generic Route: KJFK MERIT EBONY TUBOT 5450N 5640N 5630N 5920N RATSU VALDI OTRAX ADOPI GIMEX MASEV LEGPO TORVA ELTOK ESSA

Height Limits (lower/upper): First: 0/300 Other: 0/300 Last: 0/300

Width of Route: 33 NM

Radius around aerodrome: 25 NM

Integrated Digital Briefing

Integrated Digital Briefing x

10.16.86.200:8082/BriefingHMI/#/main

FREQUENTIS Integrated Digital Briefing

Welcome dbriefing [logout](#)

[Generate ePIB](#)

UAL 234 KJFK - ESSA 15-07-29 12:06

- Overview
- Aerodromes
 - DEP : KJFK
 - Airport
 - TMA
 - MET
 - ARR : ESSA
 - ALT : ESSB
 - Emergency
 - En-Route
 - FIR: KZBW
 - Config
 - MET
 - FIR: CZQM
 - FIR: CZUL
 - FIR: CZQX
 - Config
 - MET
 - FIR: EGGX
 - FIR: BIRD
 - FIR: ENOR
 - Config
 - MET
 - FIR: ESAA
 - Config
 - MET
 - Settings
 - Flight Plans

Time filter: 15-07-29 11:06 to 15-07-29 13:06 Edit

<input checked="" type="checkbox"/>	OTHER	Apr07 14:30 to Jul29 16:20	6297 A 2015
	RWY 04L/22R WIP const NE end.		
<input checked="" type="checkbox"/>	OTHER	Apr07 14:30 to Jul29 16:20	4157 A 2015
	RWY 22L PAPI relocated left side		
<input checked="" type="checkbox"/>	RWY Declared Distance Change	Apr07 15:16 to Jul29 18:10	145 A 2015
	RWY 31R declared distances: TORA 10000FT TODA 1000 ...		
<input checked="" type="checkbox"/>	TWY Closure	Apr07 18:11 to Jul29 15:50	7668 A 2015
	TWY LA between TERMINAL 2 RAMP and TWY A closed		
<input checked="" type="checkbox"/>	TWY Closure	Apr07 18:11 to Jul29 15:50	6907 A 2015
	TWY E between TWY Y and TWY C closed		
<input checked="" type="checkbox"/>	OTHER	Apr07 14:30 to Jul29 16:20	7876 A 2015
	RWY 22R 6000ft distance remaining sign left side m ...		
<input checked="" type="checkbox"/>	OTHER	Apr07 14:30 to Jul29 16:20	7877 A 2015
	RWY 22R 5000ft distance remaining sign left side m ...		
<input checked="" type="checkbox"/>	OTHER	Apr07 14:30 to Jul29 16:20	7572 A 2015
	RWY 04L/22R NE 1171ft closed. Declared distances: ...		
<input checked="" type="checkbox"/>	OTHER	Apr07 14:30 to Jul29 16:20	7629 A 2015
	RWY 13L holding position markings at RWY 04L/22R I ...		
<input checked="" type="checkbox"/>	OTHER	Apr07 14:30 to Jul29 16:20	3381 A 2015
	JFK RWY 13L/31R between TWY E and TWY D 600FT X 15 ...		
<input checked="" type="checkbox"/>	OTHER	Apr07 14:30 to Jul29 16:20	7321 A 2015
	RWY 13L/31R all holding position sign at the inter ...		
<input checked="" type="checkbox"/>	OTHER	Apr07 14:30 to Jul29 16:20	7878 A 2015
	RWY 04L 4000ft distance remaining sign right side ...		
<input checked="" type="checkbox"/>	OTHER	Apr07 14:30 to Jul29 16:20	7879 A 2015
	RWY 04L 5000ft distance remaining sign right side ...		
<input checked="" type="checkbox"/>	OTHER	Apr07 14:30 to Jul29 16:20	3949 A 2015
	RWY 13R PAPI commissioned. A straight-in and offse ...		
<input checked="" type="checkbox"/>	OTHER	Apr07 14:30 to Jul29 16:20	7024 A 2015
	RWY 31R holding position markings at RWY 04L/22R S ...		
<input checked="" type="checkbox"/>	APN closure	Apr07 17:45 to Jul29 15:30	443 A 2015
	East Cargo Ramp Closed.		
<input checked="" type="checkbox"/>	Approach Lights UNS	Apr08 10:45 to Jul29 15:20	4124 A 2015
	RWY 04L/22R Approach Lighting System (ALSF 2) Unse ...		

Integrated Digital Briefing

Air Transportation Information
Exchange Conference -
Global Information Management

Integrated Digital Briefing x

10.16.86.200:8082/BriefingHML/#/main

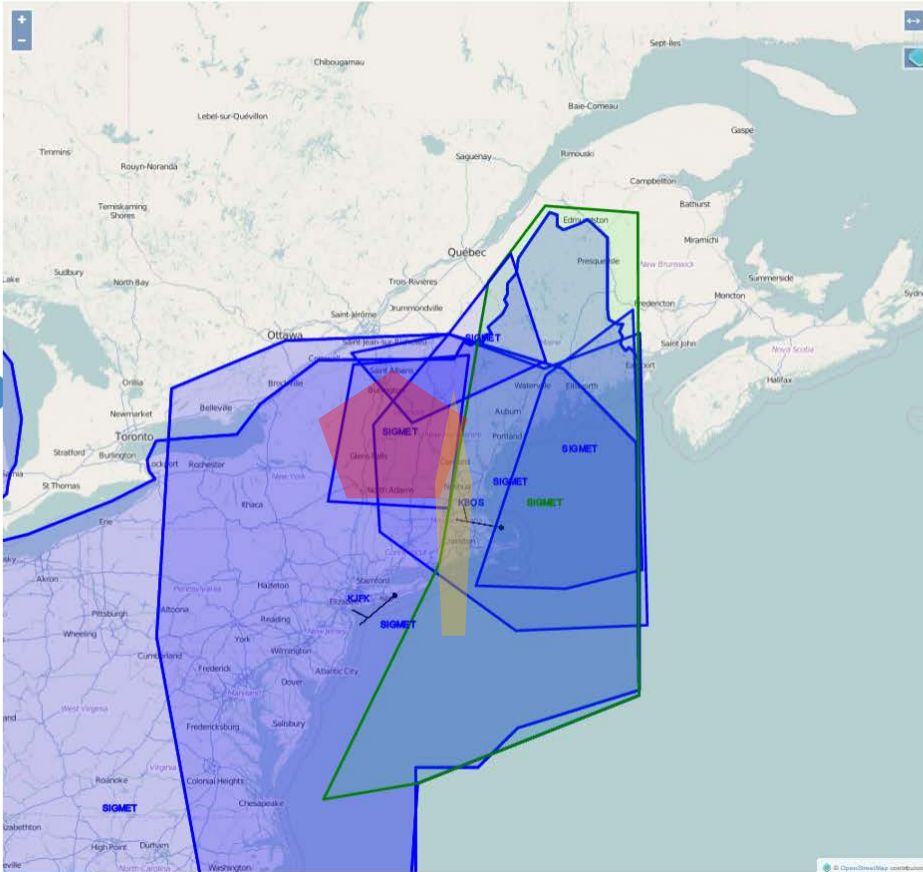
FREQUENTIS Integrated Digital Briefing

Welcome dbriefing [logout](#)

[Generate ePIB](#)

UAL 234 KJFK - ESSA 15-07-29 12:06

- Overview
- Aerodromes
 - DEP : KJFK
 - Airport
 - TMA
 - MET
 - ARR : ESSA
 - ALT : ESSB
 - Emergency
- En-Route
 - FIR: KZBW
 - Config
 - MET
 - FIR: CZQM
 - FIR: CZUL
 - FIR: CZQX
 - Config
 - MET
 - FIR: EGGX
 - FIR: BIRD
 - FIR: ENOR
 - Config
 - MET
 - FIR: ESAA
 - Config
 - MET
- Settings
- Flight Plans



Disable FIR

110W PIE-120SSE ILM WST ISSUANCES POSS. REFER TO MOST RECENT ACUS01 KWNS FROM STORM PREDICTION CENTER FOR SYNOPSIS AND METEOROLOGICAL DETAILS. AREA 2...FROM EKN-40SW CSN-50SW CRG-80SW CTY-CEW-SONNE MSL-VXX-EKN WST ISSUANCES POSS. REFER TO MOST RECENT ACUS01 KWNS FROM STORM PREDICTION CENTER FOR SYNOPSIS AND METEOROLOGICAL DETAILS.

SIGMET: WAUS41 KKCI 290245 MIAT WA 290245 AIRMET TANGO FOR TURB VALID UNTIL 290900 AIRMET TURB...NC ME NH VT MA RI CT NY LO NJ PA WV MD DC DE VA AND CSTL WTRS FROM YSC TO BGR TO 110SE BGR TO 200SE ACK TO 160SE SIE TO 190ESE ECG TO 20NE ILM TO 20S JST TO 70NE YYZ TO YOW TO YSC MOD TURB BTN FL270 AND FL400. CONDS CONTG BYD 09Z ENDG 09-12Z.

SIGMET: WAUS41 KKCI 290245 BOST WA 290245 AIRMET TANGO FOR TURB VALID UNTIL 290900 AIRMET TURB...ME NH VT MA RI CT NY LO NJ PA WV MD DC DE VA NC AND CSTL WTRS FROM YSC TO BGR TO 110SE BGR TO 200SE ACK TO 160SE SIE TO 190ESE ECG TO 20NE ILM TO 20S JST TO 70NE YYZ TO YOW TO YSC MOD TURB BTN FL270 AND FL400. CONDS CONTG BYD 09Z ENDG 09-12Z.

SIGMET: WAUS41 KKCI 290245 BOSS WA 290245 AIRMET SIERRA FOR IFR AND MTN OBSCN VALID UNTIL 290900 AIRMET IFR...NH VT MA NY FROM 30SE YSC TO 30W BOS TO 40WSW ALB TO 30E MSS TO 30SE YSC CIG BLW 010/VIS BLW 3SM BR/FG. CONDS DVLPG 06-09Z. CONDS CONTG BYD 09Z ENDG 12-15Z.

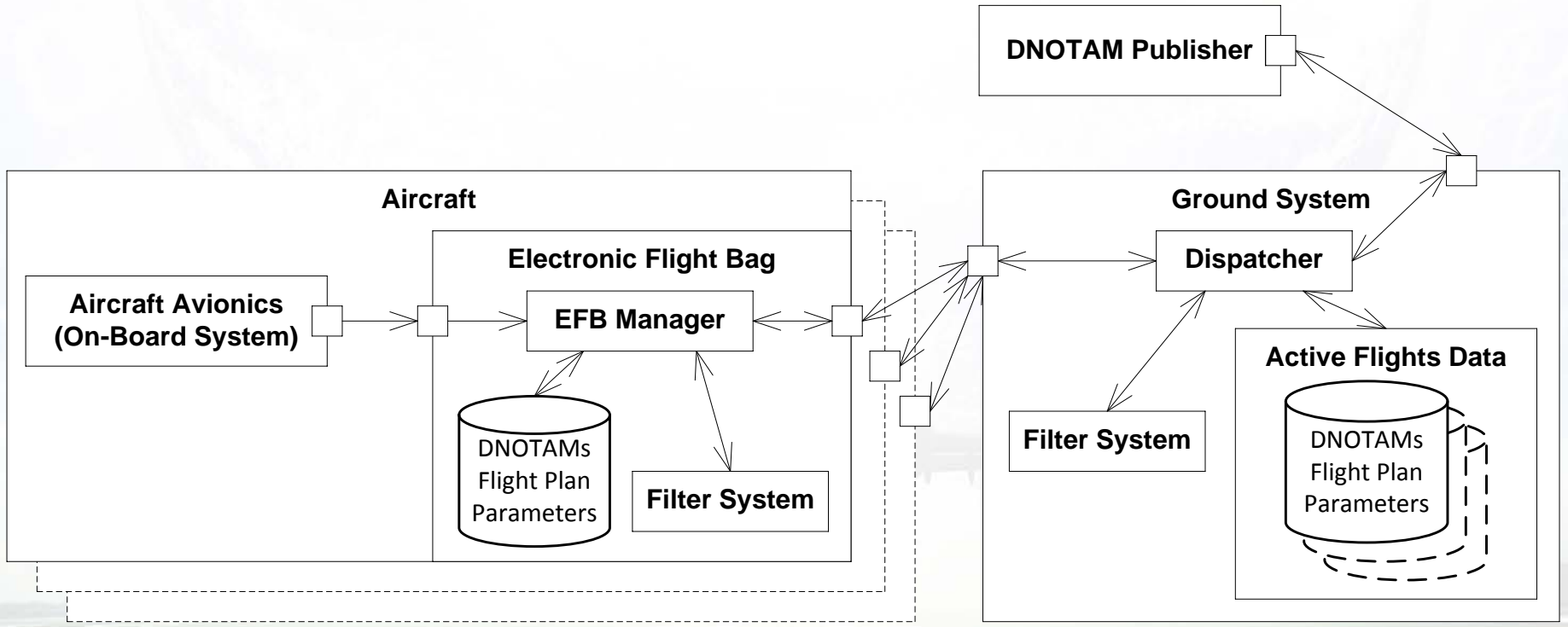
SIGMET: WAUS41 KKCI 290245 BOSS WA 290245 AIRMET SIERRA FOR IFR AND MTN OBSCN VALID UNTIL 290900 AIRMET IFR...ME NH MA RI AND CSTL WTRS FROM 30ESE HUL TO 140E ACK TO 60ESE ACK TO 50SSE PVD TO 20WSW BGR TO 30ESE HUL CIG BLW 010/VIS BLW 3SM BR/FG. CONDS CONTG BYD 09Z THRU 15Z.

SIGMET: WAUS41 KKCI 290845 BOSS WA 290845 AIRMET SIERRA UPDT 1 FOR IFR AND MTN OBSCN VALID UNTIL 291500 AIRMET IFR...ME NH VT MA RI CT NY AND CSTL WTRS FROM 50SE HUL TO 160ESE ACK TO 70S ACK TO 30W BDL TO 50S PLB TO YSC TO 20W BGR TO 50SE HUL CIG BLW 010/VIS BLW 3SM BR/FG. CONDS CONTG BYD 15Z THRU 21Z.

SIGMET: WAUS41 KKCI 290845 BOST WA 290845 AIRMET TANGO UPDT 1 FOR TURB VALID UNTIL 291500 AIRMET TURB...ME NH MA RI CT NY NJ MD DE VA AND CSTL WTRS FROM 70NW PQJ TO 60NE PQJ TO 200SE ACK TO 160SE SIE TO 70E ORF TO 30SW PVD TO 40SE YQB TO 70NW PQJ MOD TURB BTN FL280 AND FL420. CONDS CONTG BYD 15Z ENDG 15-18Z. OTLK VALID 1500-2100Z...TURB OH LE BOUNDED BY 20WNW YYZ-40WNW AIR-CVG-FWA-30SE ECK-20WNW YYZ MOD TURB BTN FL340 AND FL400. CONDS ENDG 18-21Z.

SIGMET: WAUS41 KKCI 290845 BOSS WA 290845 AIRMET SIERRA UPDT 1 FOR IFR AND MTN OBSCN VALID UNTIL 291500 AIRMET MTN OBSCN...ME NH VT NY FROM 50E YQB TO 20WNW BGR TO 20S MPV TO 30ENE MSS TO YSC TO 50E YQB MTNS OBSC BY CLDS/BR. CONDS ENDG 12-15Z.

In-Flight Prototype



Summary

- Introduced SemNOTAM enabling fine-grained semantic filtering and prioritization of NOTAMs
- Flexible and adaptable architecture
- Integrated DBriefing & In-Flight scenario

**Get the right information at the right time
to reduce costs!**

Outlook

- Flight relevant Information on an Electronic Flight Bag
- Weather Information prioritized according to the situation awareness and needs of the pilot
- SemNOTAM methods can used with other XMs/AIRM:
 - Weather Information Exchange Model
 - Aviation Information Data Exchange
 - Flight Information Exchange Model

Contact Information

Air Transportation Information
Exchange Conference -
Global Information Management

dke

Data & Knowledge Engineering

FREQUENTIS



FFG

TAKE OFF

semNOTAM

Intelligent NOTAM Prioritization

eduard.gringinger@frequentis.com

semNOTAM.frequentis.com

References

- [1] EUROCONTROL, Federal Aviation Administration, 2011, AIXM Digital NOTAM Event Specification, Available:
http://www.aixm.aero/gallery/content/public/digital_notam/Specifications/Digital%20NOTAM%20Event%20Specification%201.0.doc.
- [2] Hoeft, Raegan M., Florian Jentsch, Janeen A. Kochan, 2004, Freeing NOTAMs From Teletype Technology, Flight Safety Digest. Vol. 23., No. 4, pp. 1-35.
- [3] Wilson, Scott, Robert, Suzic, Sam, Van der Stricht, 2014, The SESAR ATM Information Reference Model Within the New ATM System, ICNS 2014.
- [4] Gringinger, Eduard, Wilson, Scott, Van der Stricht, 2015, AIRM-based, Fine-grained Semantic Filtering Of Notices To AirMen, ICNS 2015.
- [5] Porosnicu, Eduard, Donald, Hughes, Asa, Standar, 2013, Operational Service and Environment Definition (OSED) Step 2, Edition 00.07.00, Single European Sky ATM Research Program, pp. 44 - 52.
- [6] NOTAM Task Group, 2014, NOTAM Search and Filter Options, Available:
<http://www.rtca.org/Files/Miscellaneous%20Files/NOTAM%20Search%20and%20Filter%20Options%20May%202014%20TOC%20final.pdf>.