

# Meteorology in the Next GANP/ASBU Update

CAeM-16 Side event - 26 July 2018

*University of Exeter,  
Exeter, United Kingdom*



**WMO OMM**

World Meteorological Organization

Organisation météorologique mondiale

What is the GANP ?

What does ASBU mean ?

Any meteorology in there ?

# The Global Air Navigation Plan

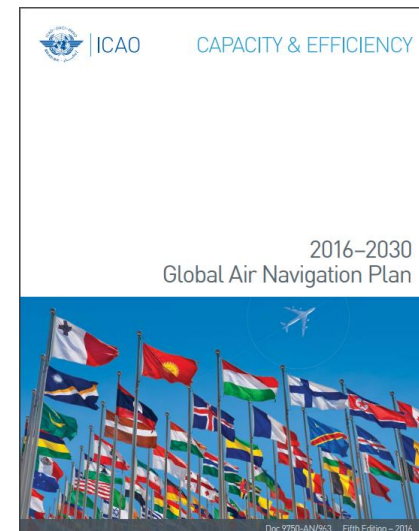
## ICAO's 15-year Plan Addressing Global Air Navigation

- The Global Air Navigation Plan (GANP) is a means to help achieve a global interoperable air navigation system for all users for all phases of flight, which meets agreed safety levels, provides optimum economic operations, is environmentally sustainable and meets national security requirements.
- A reference for ICAO, States, manufacturers and other organizations to develop the necessary technology, standards and procedures.
- A rolling, 15-year strategic methodology which leverages existing technologies and anticipates future developments based on State/industry agreed operational objectives.

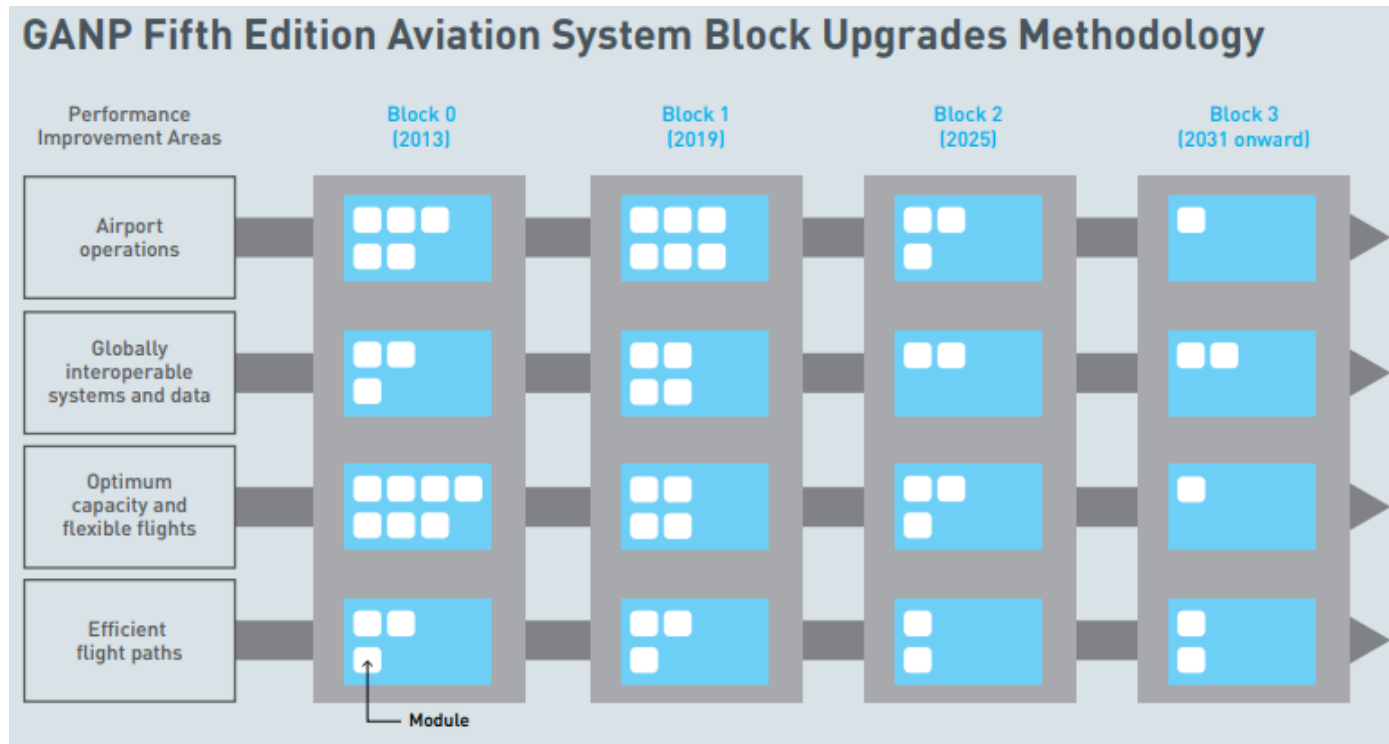


# The Global Air Navigation Plan

- Long-term vision to ensure continuity and harmonization with ICAO, States and industry modernization programs.
- Objective is to increase capacity and improve efficiency of the global civil aviation system whilst improving or at least maintaining safety
- Methodology based on **Block Upgrades**, organized in non-overlapping six-year time increments starting in 2013 and continuing through 2035 and beyond.
- Triannual revision cycle, with major updates every six years, One major in 2019



# Aviation System Block Upgrades (ASBU)



Refer to the target availability timelines for a group of operational improvements i.e. technologies and procedures organized into unique **Modules**

This block upgrade and module-based methodology would allow Member States to only consider and adopt the Modules appropriate to their operational needs.



# Aviation System Block Upgrades (ASBU)

Key concepts in developing the draft 2019 version of the GANP :

**ASBU Block:** a six year timeframe whose starting date defines a deadline for an element to be available for implementation.

**ASBU Thread:** key feature area of the air navigation system that needs improvement in order to achieve the vision outlined in the Global ATM Operational Concept (GATMOC).

**ASBU Element:** a specific change in operations designed to improve the performance of the air navigation system under specified operational conditions.

**ASBU Module:** a group of elements from a thread that, according to the enablers' roadmap, will be available for implementation within the defined deadline established by the ASBU Block.

**ASBU Enabler:** component (standards, procedures, training, technology, etc) required to implement an element.

=> **Operational** threads, **Enabler** threads and **Network/Infrastructure** threads



# Aviation System Block Upgrades (ASBU)

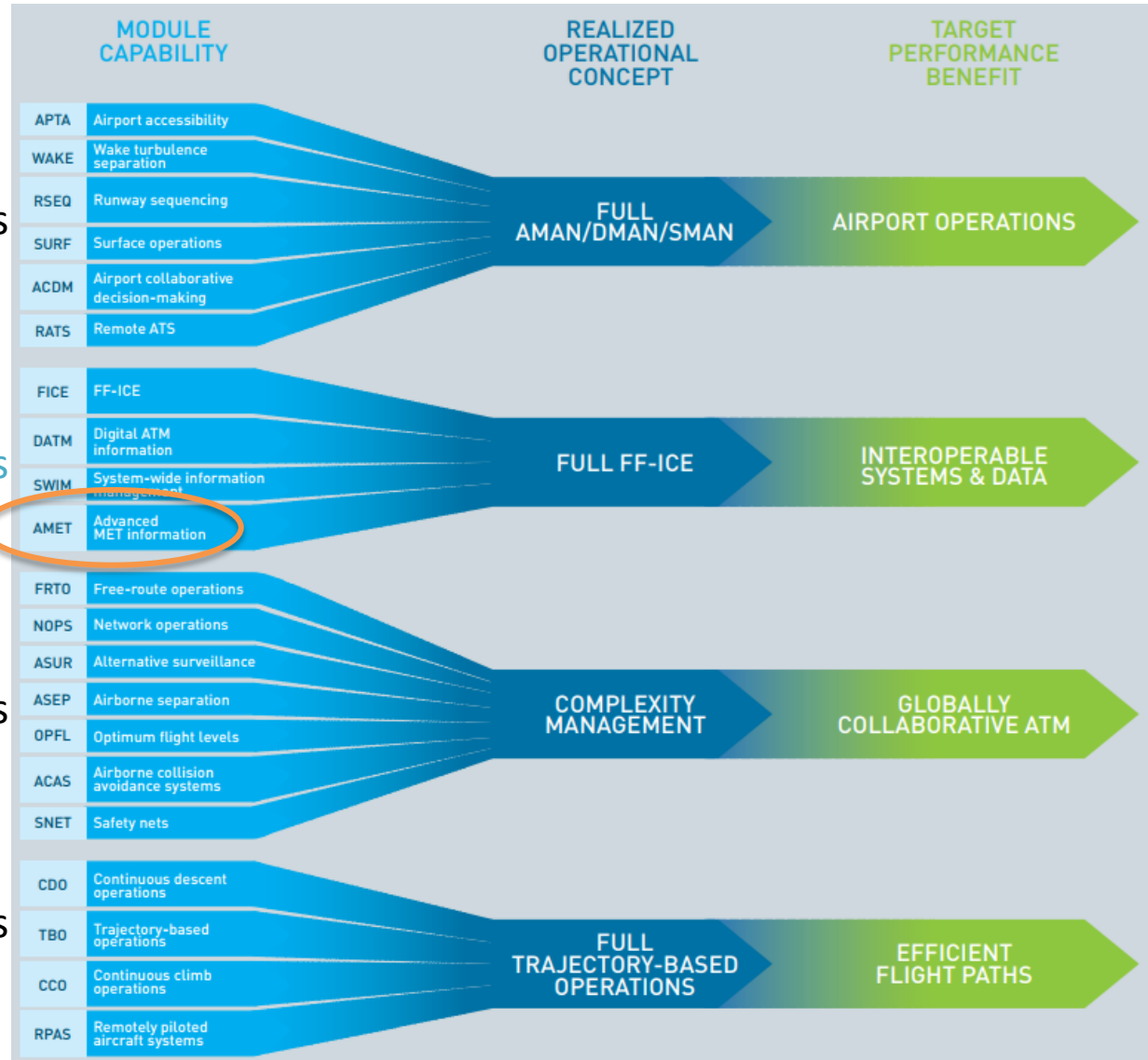
GANP Thread modules

Operational threads

Enabler threads

Operational threads

Operational threads



# Meteorology in 2019 GANP/ASBU

From the ICAO ASBU Panel Project Team work:

- Meteorology is an **Enabler** for the majority of the other Threads.
- Challenge is to ensure that **all the other ASBU threads** and related modules are able to fully articulate the requirements they have for MET information in the future.
- This means looking at the **MET information required**, rather than existing products.
- Information includes phenomenon/parameter and data characteristics such as severity, accumulation, intensity, probability of occurrence, confidence/uncertainty of forecasts and reliability, etc.
- Evolution of AMET thread and modules is driven by the transition to the **SWIM environment** and by the need for **more interoperability allowing integration of MET information** in ATM systems



# Meteorology in 2019 GANP/ASBU

## AMET Block 0:

Global, regional and local meteorological information to support flexible airspace management, improved situational awareness, collaborative decision-making and dynamically optimized flight trajectory planning.

## AMET Block 1:

Meteorological information supporting automated decision process or aids, involving meteorological information, **meteorological information translation**, **ATM impact conversion** and ATM decision support.



# Meteorology in 2019 GANP/ASBU

## AMET Block 2:

**Integrated meteorological information** in support of enhanced operational ground and air decision-making processes, particularly **in the planning phase and near-term.**

## AMET Block 3:

**Integrated meteorological information** in support of enhanced operational ground and air decision-making processes, **for all flight phases and corresponding air traffic management operations.**

## AMET Block 4:

**Integrated meteorological information** supporting both air and ground decision making for all phases of flight and ATM operation, especially **for implementing immediate weather mitigation strategies.**



# AMET – METEOROLOGICAL INFORMATION

TEMPLATE TABLE 1: Thread overview

# Meteorology in 2019 GANP/ASBU

AMET	METEOROLOGICAL INFORMATION		
<b>CONCEPT OF OPERATIONS OF THE THREAD BY BLOCK</b>			
BBB	Meteorological information provided to support operational efficiency and safety.		
<b>PART 1</b>	Block 0	Global, regional and local meteorological information to support flexible airspace management, improved situational awareness, collaborative decision-making and dynamically optimized flight trajectory planning.	
	Block 1	Meteorological information supporting automated decision process or aids, involving meteorological information, meteorological information translation, ATM impact conversion and ATM decision support.	
	Block 2	Integrated meteorological information in support of enhanced operational ground and air decision-making processes, particularly in the planning phase and near-term.	
	Block 3	Integrated meteorological information in support of enhanced operational ground and air decision-making processes, for all flight phases and corresponding air traffic management operations.	
	Block 4	Integrated meteorological information supporting both air and ground decision making for all phases of flight and ATM operations, especially for implementing immediate weather mitigation strategies.	
	<b>Block</b>	<b>Element ID</b>	<b>Title</b>
	<b>PART 2</b>	Block 0	AMET-B0/1
Block 0		AMET-B0/2	Meteorological forecast and warning products
Block 0		AMET-B0/3	Climatological and historical meteorological products
Block 0		AMET-B0/4	Dissemination of meteorological products
Block 1		AMET-B1/1	Meteorological observations information
Block 1		AMET-B1/2	Meteorological forecast and warning information
Block 1		AMET-B1/3	Climatological and historical meteorological information
Block 1		AMET-B1/4	Dissemination of meteorological information
Block 2		AMET-B2/1	Meteorological observations information
Block 2		AMET-B2/2	Meteorological forecast and warning information
Block 2		AMET-B2/3	Climatological and historical meteorological information
Block 2		AMET-B2/4	Meteorological information service in SWIM
Block 3		AMET-B3/1	Meteorological observations information
Block 3		AMET-B3/2	Meteorological forecast and warning information
Block 3		AMET-B3/3	Climatological and historical meteorological information
Block 3		AMET-B3/4	Meteorological information service in SWIM
Block 4		AMET-B4/1	Meteorological observations information
Block 4		AMET-B4/2	Meteorological forecast and warning information
Block 4		AMET-B4/3	Climatological and historical meteorological information
Block 4		AMET-B4/4	Meteorological information service in SWIM

## AMET-B1/2 METEOROLOGICAL FORECAST AND WARNING INFORMATION

Main purpose Meteorological forecast and warning information in support of automated decision processes or aids and performance based requirements, involving meteorological information, meteorological information translation, ATM impact conversion and ATM decision support.

New capabilities Commencement of change from product-centric to data-centric information. Commencement of space weather and sulphur dioxide (SO<sub>2</sub>) services. Enhanced hazardous weather services. First steps in the provision of probabilistic information derived from ensemble prediction systems.

Meteorological forecasts and warnings will begin to transition from traditional alphanumeric codes (TAC) form to data-centric information to better support the common understanding on the various operational constraints, capabilities and needs. The following SWIM-compliant forecast parameters and phenomena will begin to be made available to users and will include:

- Wind speed and direction (aerodrome) including gusts and operationally significant wind shifts
- Air temperature and dew point temperature (aerodrome)
- Upper level:
  - Wind (speed and direction), including departure to Top of Climb (TOC) and then Top of Descent (TOD) to landing
  - Air temperature and dew point temperature or equivalent (i.e. humidity), including height of freezing level and lower tropospheric temperature inversions
- Flight level and temperature of tropopause
- Geopotential altitude for flight levels
- Pressure (aerodrome) (i.e. QNH, QFE)
- Visibility (aerodrome), Runway visual range (RVR)
- Cloud type (of operational significance)
- Cloud coverage, bases, tops and layers
- Thunderstorms, Lightning, Convection (TCU & CB)
- Precipitation (ie. drizzle, rain, freezing rain, snow, hail)
- Weather (ie. dust storm, sand storm, funnel cloud, squall, smoke, haze, mist, fog)
- Icing (airframe and engine),
- Liquid Water Content, Iced Water Content
- Turbulence, Mountain waves, Wind shear
- Fronts
- Radioactive clouds, Toxic chemicals
- Tropical cyclones
- Volcanic ash
- Sulphur dioxide (SO<sub>2</sub>) and other hazardous gases
- Sea temperature, state and wave height (seaports)
- Space weather events
- Tsunami, Flood

Characteristics of the meteorological information include:

- Time (ie. issue time, validity, commencement/cessation, lead time)
- Units of measurement
- Resolution (temporal & spatial)
- Geo Location (2D/3D/4D context, point, line or polyhedron)
- Movement
- Severity, Accumulation, Intensity
- Range (Max. – Min.)
- Variations
- Probability of occurrence
- Confidence/Uncertainty of forecast
- Reliability
- Data sample period
- Auto
- Change indicator/period
- Amendment / Correction
- Operational Status
- Source

- Thresholds
- Format (TAC, Gridded, Graphical, IWXXM)
- Data quality flag
- Runway identification or location identifier
- Effects/impact on aviation systems (i.e. communications, navigation & surveillance systems)
- Radiation (exposure)

Human-readable meteorological advisory and warning products start to be derived from the meteorological information/data to better suit user needs and can be based on user defined thresholds. Meteorological information to be used to assess impact.

Verification of quality (accuracy) of forecast parameters. An increased use performance measures (via compliance, availability and regularity indices) of forecast parameters.

Human Factors	Change in task by user?	Yes				
	Processing of new information by user?	Yes				
Dependencies and relations	Use of new equipment?	Yes				
	Change in level of automation?	Yes				
Operations	Type of dependencies	ASBU element				
	Evolution	Relation	ID	Title		
Planning layers	X		AMET-B0/2	Meteorological forecast and warning products		
		X	AMET-B1/1	Meteorological observations information (operational requirement)		
Enablers	Flight phases					
	Taxi-out	Departure	En-route	Arrival	Taxi-in	Turn-around
Operational Procedures	X	X	X	X	X	X
	ATM planning	Strategical	Pre-tactical	Tactical		Post operations
Pre ops				During ops		
Enablers	X	X	X	X	X	

Category	Type	Description/Examples	Stakeholder(s)
Regulatory Provisions	Annex	Annex 3 - Meteorological Service for International Air Navigation	
	Technical Regulation	WMO No.49 Vol II - Technical Regulations - Basic Documents No. 2, Volume II - Meteorological Service for International Air Navigation	
	Technical Regulation	WMO No.49 Vol IV - Technical Regulations - Basic Documents No. 2, Volume IV - Quality Management	
	PANS	Procedures for Air Navigation Services - Meteorology (PANS-MET) - being developed	
	PANS	Doc. 4444 - Procedures for Air Navigation Services - Air Traffic Management (PANS-ATM)	
Operational Procedures	Manual	WMO No.306 - Manual on Codes - International Codes	
	Guidance	WMO No.732 - Guide to Practices for Meteorological Offices Serving Aviation	
	Handbook	WMO No.782 - Aerodrome Reports and Forecasts	
	Guidance	WMO No.1001 - Guide to the Quality Management System for the Provision of Meteorological Service for International Air Navigation	
	Guidance	WMO No.1100 - Guide to the Implementation of a Quality Management System for National Meteorological and Hydrological Services	
	Manual	Doc. 7488 - Manual of the ICAO Standard Atmosphere	
	Manual	Doc. 8896 - Manual of Aeronautical Meteorological Practice	
	Manual	Doc. 9691 - Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds	
	Manual		

PART 3	AMET-B1/4	DISSEMINATION OF METEOROLOGICAL INFORMATION					
	Main purpose	Dissemination of meteorological information in support of automated decision process or aids, involving meteorological information, meteorological information translation, ATM impact conversion and ATM decision support					
	New capabilities	Meteorological information in ICAO Meteorological Information Exchange Model (IWXXM) form starts to replace traditional alphanumeric code (TAC) products. Human-readable products will start to be derived from the IWXXM information (rather than the other way around). The introduction of web services allows for progressive replacement of fixed line dissemination systems.					
	Description	<p>This element represents the dissemination of meteorological products using a variety of formats, including:</p> <ul style="list-style-type: none"> <li>Tailored products (human-readable)</li> <li>Impact-related products</li> <li>Gridded</li> <li>Graphical (PNG and BUFR to be phased out)</li> <li>ICAO Meteorological Information Exchange Model (IWXXM) format</li> <li>Traditional alphanumeric code (TAC) – being phased out</li> </ul> <p>Dissemination means include aeronautical fixed service (ie. AMHS) and via secure internet services (ie. WIFS/SADIS). Commencement of SWIM-compliant web service capability to access the exact meteorological information required by users (in terms of geographical coverage, resolution etc).</p>					
	Human Factors	Change in task by user?	Yes	Processing of new information by user?	Yes	Use of new equipment?	Yes
	Dependencies and relations	Type of dependencies		ASBU element			
		Evolution	Relation	ID	Title		
		X		AMET-B0/4	Dissemination of meteorological products		
			X	AMET-B1/1	Meteorological observations information (operational requirement)		
			X	AMET-B1/2	Meteorological forecast and warning information (operational requirement)		
		X	COMS-B1/1	PBSC approved CPDLC (FANS 1/A+) for domestic and procedural airspace			
		X	COMS-B1/2	PBSC approved ADS-C (FANS 1/A+) for procedural airspace			
		X	COMS-B1/3	SATVOICE (incl. routine communications) for procedural airspace			
		X	COMI-B1/1	VHF Data Link (VDL) Mode 2 Mult-Frequency			
		X	COMI-B1/2	SATCOM Class B (SB-S) Voice and Data			
Operations	Flight phases					Turn-around	
	Taxi-out	Departure	En-route	Arrival	Taxi-in		
	X	X	X	X	X	X	
Planning layers	ATM planning	Strategical	Pre-tactical	Tactical		Post operations	
				Pre ops	During ops		
X	X	X	X	X	X	X	
PART 4	Enablers						
	Category	Type	Description/Examples			Stakeholder(s)	
	Regulatory Provisions	Annex	Annex 3 - Meteorological Service for International Air Navigation				
Technical Regulation		WMO No.49 Vol II - Technical Regulations Basic Documents No. 2, Volume II – Meteorological Service for					

	Technical Regulation	International Air Navigation	
		WMO No.49 Vol IV - Technical Regulations - Basic Documents No. 2, Volume IV – Quality Management	
		PANS	Procedures for Air Navigation Services – Meteorology (PANS-MET) – being developed
		Annex	Annex 10 – Aeronautical Telecommunications
Operational Procedures	Annex	Annex 15 - Aeronautical Information Services	
	Manual	Doc. 8896 - Manual of Aeronautical Meteorological Practice	
	Manual	Doc. 9377 – Manual on the Coordination between Air Traffic Services, Aeronautical Information Services and Aeronautical Meteorological Services	
	Guidance	Doc. 9855 - Guidelines on the use of the Public Internet for Aeronautical Applications	
	Manual	Doc. 9880 - Manual on Detailed Technical Specifications for the Aeronautical Telecommunication Network (ATN) using ISO/OSI Standards and Protocols	
	Manual	Doc. 9896 – Manual on the Aeronautical Telecommunication Network (ATN) using Internet Protocol Suite (IPS) Standards and Protocol	
	Manual	Doc. 10003 - Manual on the Digital Exchange of Aeronautical Meteorological Information	
	Manual	Doc. 10039 - Manual on System Wide Information Management (SWIM) Concept	
	Guidance	WMO No.731 – Guide to Meteorological Observing and Information Distribution Systems for Aviation Weather Services	
	Guidance	ICAO Guidelines for the Implementation of OPMET Data Exchange using IWXXM	
	Guidance	Regional OPMET Interface Control Documents	
	Guidance	Regional OPMET Bulletin Exchange Handbooks	
	Airborne System capability		
	Ground system infrastructure		
	Training		
	Information Exchange Model	ICAO Meteorological Information Exchange Model (IWXXM)	
	Other		

SWIM and IWXXM ... don't be afraid to dive into IWXXM! With good advice from WMO and ICAO experts.

IWXXM = model ; built on XML schemes  
WMO CBS TT-AvXML

# Meteorology in 2019 GANP/ASBU

From the ICAO ASBU Panel Project Team work:

- Meteorology is an **Enabler** for the majority of the other Threads.

⇒ Dependencies between threads and/or elements:

- *what relations AMET has with other threads,*
- *what are the elements in other threads the AMET modules depend on, and*
- *what are the AMET elements that modules in other threads depend on.*



<b>PART 3</b>	<b>AMET-B1/4</b>	<b>DISSEMINATION OF METEOROLOGICAL INFORMATION</b>					
	Main purpose	Dissemination of meteorological information in support of automated decision process or aids, involving meteorological information, meteorological information translation, ATM impact conversion and ATM decision support.					
	New capabilities	Meteorological information in ICAO Meteorological Information Exchange Model (IWXXM) form starts to replace traditional alphanumeric code (TAC) products. Human-readable products will start to be derived from the IWXXM information (rather than the other way around). The introduction of web services allows for progressive replacement of fixed line dissemination systems.					
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		Processing of new information by user?	Yes				
		Use of new equipment?	Yes				
		Change in level of automation?	Yes				
	Dependencies and relations	Type of dependencies		ASDU element			
		Evolution	Relation	ID	Title		
		X		AMET-B0/4	Dissemination of meteorological products		
			X	AMET-B1/1	Meteorological observations information (operational requirement)		
			X	AMET-B1/2	Meteorological forecast and warning information (operational requirement)		
			X	COMS-B1/1	PBCS approved CPDLC (FANS 1/A+) for domestic and procedural airspace		
			X	COMS-B1/2	PBCS approved ADS-C (FANS 1/A+) for procedural airspace		
			X	COMS-B1/3	SATVOICE (incl. routine communications) for procedural airspace		
			X	COMI-B1/1	VHF Data Link (VDL) Mode 2 Multi-Frequency		
			X	COMI-B1/2	SATCOM Class B (SB-S) Voice and Data		
		X	COMI-B1/3	Commercial links for non-safety critical			
		X	DAIM-B1/1	Provision of quality-assured aeronautical data and information			
		X	DAIM-B1/2	Provision of digital Aeronautical Information Publication (AIP) data sets			
	Operations	Flight phases					Turn-around
		Taxi-out	Departure	En-route	Arrival	Taxi-in	
		X	X	X	X	X	X
	Planning layers	ATM planning	Strategical	Pre-tactical	Tactical		Post operations
					Pre ops	During ops	
		X	X	X	X	X	X
<b>PART 4</b>	<b>Enablers</b>						
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		Technical Regulation	WMO No. 49 Vol II - Technical Regulations Basic Documents No. 2, Volume II – Meteorological Service for				

		International Air Navigation	
	Technical Regulation	WMO No. 49 Vol IV - Technical Regulations - Basic Documents No. 2, Volume IV – Quality Management	
	PANS	Procedures for Air Navigation Services – Meteorology (PANS-MET) – being developed	
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Operational Procedures	Manual	Doc. 8896 - Manual of Aeronautical Meteorological Practice	
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	Manual	Doc. 10003 - Manual on the Digital Exchange of Aeronautical Meteorological Information	
	Manual	Doc. 10039 - Manual on System Wide Information Management (SWIM) Concept	
	Guidance	WMO No. 731 – Guide to Meteorological Observing and Information Distribution Systems for Aviation Weather Services	
	Guidance	ICAO Guidelines for the Implementation of OPMET Data Exchange using IWXXM	
	Guidance	Regional OPMET Interface Control Documents	
	Guidance	Regional OPMET Bulletin Exchange Handbooks	
	Airborne System capability		
	Ground system infrastructure		
	Training		
	Information Exchange Model	ICAO Meteorological Information Exchange Model (IWXXM)	
	Other		

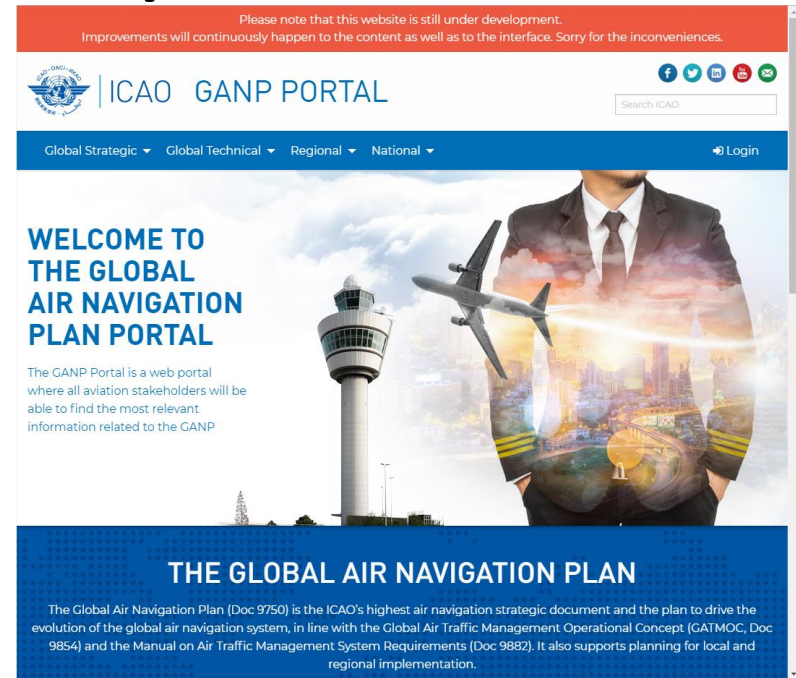
# ICAO GANP web portal

<https://www4.icao.int/ganpportal/>

- Where to find the most relevant information related to the GANP;
- It provides **elements and threads overview** including AMET elements:

<https://www4.icao.int/ganpportal/ASBU>


- And a **graphics of dependencies**.





# ICAO GANP web portal

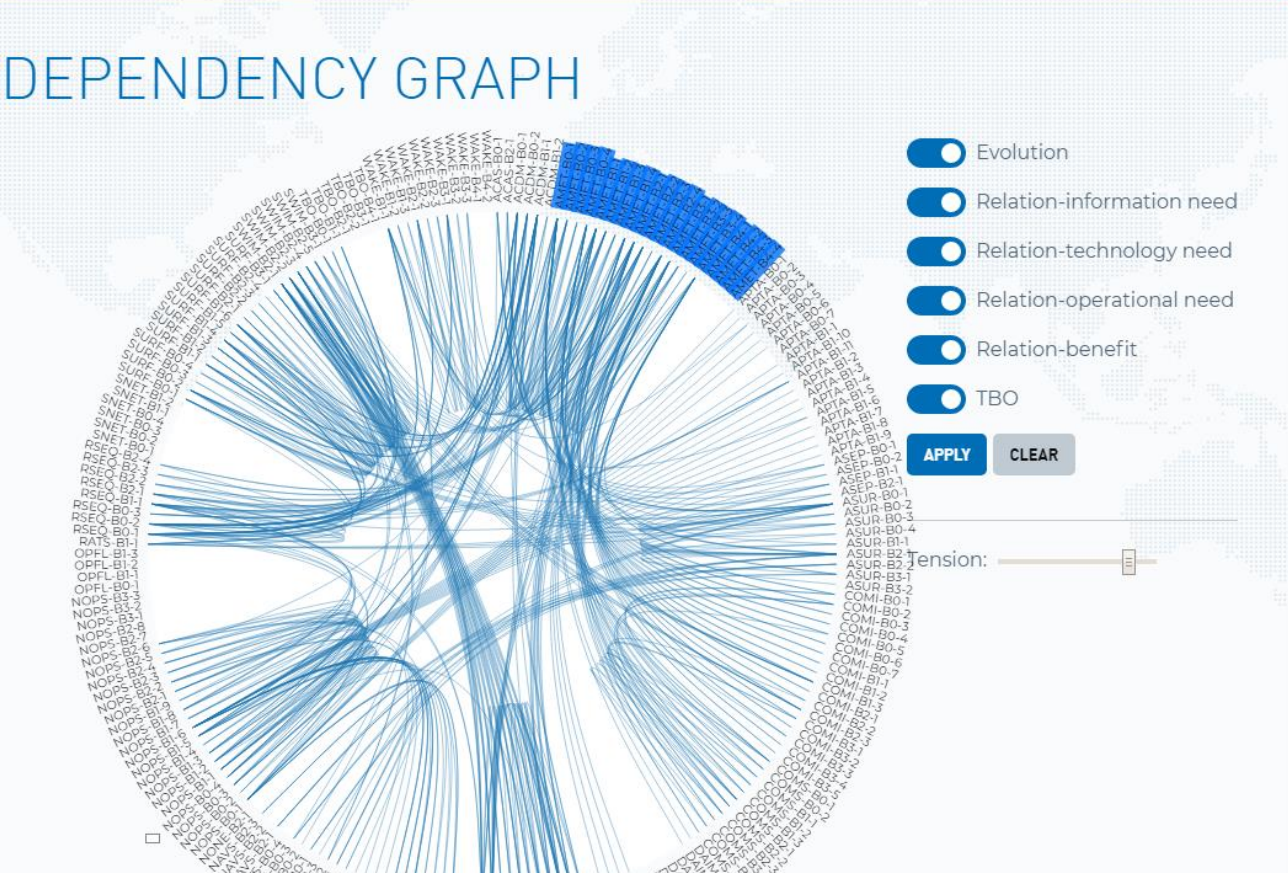
Please note that this website is still under development.  
Improvements will continuously happen to the content as well as to the interface. Sorry for the inconveniences.

 | ICAO GANP PORTAL

Search ICAO


Back to Portal | Element Overview | Thread Overview | Performance Objectives | Dependencies | Login

## DEPENDENCY GRAPH



- Evolution
- Relation-information need
- Relation-technology need
- Relation-operational need
- Relation-benefit
- TBO

APPLY CLEAR

Dimension: 



# ICAO GANP/ASBU more information

Also presented at WMO Aeronautical Meteorology Scientific Conference, in Toulouse, France in November 2017:

- AeM Series, 02. Proceedings of the 2017 WMO Aeronautical Meteorology Scientific Conference
- [https://library.wmo.int/doc\\_num.php?explnum\\_id=4339](https://library.wmo.int/doc_num.php?explnum_id=4339)

# Thank you Merci



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World Meteorological Organization

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