DOCUMENT CHARACTERISTICS

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Abstract

The purpose of this document is to frame the support of the flight efficiency within the NMOC such as support to flight plan originator to improve their flight planning, support to major airspace design project etc. This document contains procedures applicable for Flight Efficiency support.

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STATUS AND ACCESSIBILITY

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Edition approved for publication on 19/11/2018.
Edition History

The following table records the complete history of the successive editions of the present document.

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## Edition Change Record

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1 Introduction

1.1 General

The IATA/CANSO/EUROCONTROL Flight Efficiency Plan signed in 2008 was requesting ‘to work in an even closer partnership along with airlines, airports and ANSPs to identify solutions and launch operational actions that will lead to fuel and emissions savings in the short term’

There is now an established requirement for a much closer and more continuous relationship with the AOs and the CFSPs. As such NM has been tasked to work with the AOs and the CFSPs participating in the EUR AOG to execute the following tasks on a consistent basis:

- Monitoring of AO flight planning versus best options offered in the route network;
- Identification of improvements in flight planning for various flows and city pairs taking into account the latest network situation;
- Assessment of individual airline flight plans;
- Identification of airspace design actions or airspace utilization rules leading to improvements in flight planning;
- Making suggestions to AOs and CFSPs on better utilisation of the existing airspace structure.

The NMD Flight Efficiency Work Programme (FEWP) identified actions to fully implement the existing Performance Indicators in NMPP and Strategic Objectives in NSP, as well as to ensure measurement of those objectives and targets.

The FEWP addresses the actions foreseen by the Network Manager to further improve flight efficiency in order to:

- ensure appropriate benefits for the airspace users;
- fulfil the European environment/flight efficiency target requesting the reduction by 0.75 percentage points of the route extension between 2009 and 2014, based on the latest filed flight plan.

It is a support to the flight efficiency plan signed in August 2008 between IATA, CANSO and EUROCONTROL containing 5 Action Points that required immediate attention:

- Enhancing European en-route airspace design;
- Improving airspace utilisation and route network availability;
- Efficient TMA design and utilization;
- Optimizing airport operations;
- Improving awareness of performance.
1.1.1 Performance Scheme - Reference Period 2 (RP2) 2015-2019

In response to the Commission Regulation (EU) No 390/2013 of 3 May 2013 (laying down a performance scheme for air navigation services and network functions), a new set of key performance indicators (KPIs) and associated targets have been set for the 2nd Reference Period (RP2).

It includes two important key performance areas and associated indicators, related to the operational performance of the European ATM network for the period 2015 - 2019.

Average horizontal en-route flight efficiency of the actual trajectory, defined as follows:

- the indicator is the comparison between the length of the en-route part of the actual trajectory derived from surveillance data and the corresponding portion of the great circle distance, summed over all IFR flights within or traversing the European airspace;
- 'en-route' refers to the distance flown outside a circle of 40 NM around the airports;
- where a flight departs from or arrives at a place outside the European airspace, only the part inside the European airspace is considered.

This KPI is applicable at both network and functional airspace block level.

Average horizontal en-route flight efficiency of the last filed flight plan trajectory, defined as follows:

- the difference between the length of the en-route part of the last filed flight plan trajectory and the corresponding portion of the great circle distance, summed over all IFR flights within or traversing the European airspace;
- ‘en-route’ refers to the distance flown outside a circle of 40 NM around the airports;
- where a flight departs from or arrives at a place outside the European airspace, only the part inside the European airspace is considered.

This KPI is only applicable at network level.

Environment target:

- Actual trajectory (KEA) – an average of 2.6% route extension by 2019, decreasing from 3.17% in 2012 (based on PRB measurements);
- Last filed flight plan trajectory (KEP) – an average of 4.1% route extension by 2019, decreasing from 5.15% in 2012 (based on PRB measurements).

The Network Manager also included targets in the Network Performance Plan (NPP) 2015-2019 as described below:

- Route extension - airspace design
  Target: achieve an improvement of the DES indicator by 0.57 percentage points between the baseline year of 2012 and 2019.
Route extension - last filed flight plan
Target: This is a European-wide indicator in RP2 and the NM target for RP2 is to achieve 4.1% value for KEP indicator by 2019 for the entire NM area, fully consistent with the EU-wide target, i.e. a reduction by 1.05 percentage points between the baseline year of 2012 and 2019.

Route extension – actual trajectory
Target: The NM target for RP2 is to achieve 2.6% value for KEA indicator by 2019 for the SES area, fully consistent with the EU-wide target.

NM direct contributions to flight efficiency savings
The NM objective is that these FE direct savings will amount to 5% (2015-2016) and 7% (2017-2019) of the savings required to achieve the annual 0.15 pp reduction (or alternatively 5% of the actual KEP reduction) each year.

Increase the CDR1/2 usage
The NM objective is to increase the CDR availability and CDR usage by 5% between the baseline year 2012 and 2019.

To achieve the required improvement in flight efficiency, Network Manager coordinates European en-route airspace design through annual improvements of European ATS route network, with high priority being given to:

- Implementation of a coherent package of annual improvements and shorter routes;
- Improving efficiency for the most penalised city pairs;
- Implementation of additional Conditional Routes for main traffic flows;
- Supporting initial implementation of free route airspace.

1.2 Purpose

The purpose of this document is to frame the support of the flight efficiency initiative within the NMOC such as support to flight plan originator to improve their flight planning, support to major airspace design project etc.

This document contains also all procedure applicable for Flight Efficiency support. Correct and accurate application of the procedures contained in this document is essential to the achievement of consistent support to the flight plan originators.

1.3 Intended Audience

The provisions of the document apply to all personnel engaged in these processes, namely:

- NM Management
- NM OMs
- NM DOMs
- AOs
The Opportunity Tool (Group rerouting Tool - GRRT)

This is an ETFMS tool capable of recalculating routes based on fixed criteria and ETFMS wind.

The cost of any kind of impact that the rerouting may have on the flight is measured using an artificial measurement unit. The idea is that each elementary cost criteria can be converted to a common unit of measure. The converted values for each criterion can be added together to give a unique value for a flight (or flight alternative) that will be called Total Cost of the flight (or alternative).

Multiple criteria can be taken into account to compute the cost of a route. Cost factors associated allow to tune the ‘balance’ between each criterion (the system proposes default cost values). These criterions are hard-coded in the ETFMS.

The criteria are:
- delay
- flying time
- route length
- suspension
- overload
- fuel cost
- take-off weight factor (route charge)

The objective of improving the route network utilisation may be achieved through the assistance to flight plan filers in making them aware of route opportunities.

A route opportunity is seen as:
- shorter route close to the initial trajectory using missed short cuts;
- shortest route not considering the initial route, can be far away from the filed route;
- better utilisation of free route airspace or night network;
- better utilisation of CDR network.

There are 2 aspects to concentrate on:
- In strategic, by improving their route catalogue.
- In tactical, by informing AO of the latest route opportunities detected by the system.

For both actions, the GRRT plays a major role.

Results of the GRRT calculations are provided as:
• Rerouting opportunities (OPPs) - flights identified as possibly benefiting from an opportunity are marked with a ‘Y’ in the Opp column of NOP / CHMI flight list.

For more details on utilization of rerouting opportunities is available in the Re-Routing Opportunities Information for Airspace Users NOP Version / CHMI Version document.

• Rerouting proposal messages (RRPs) - will be sent only to subscribed AOs.
3 Work on the Valid FPL Database: Use of GRRT

The objective of this work is to ensure a participation of NMD/NMOC staff into the flight efficiency process to ensure the fulfilment of the European Network Operations plan objectives as well as the support of OPL (operations planning) staff around the flight efficiency program.

3.1 Airline Operators subscription

Group re-routing tool will calculate possible route improvements in accordance with AO’s predefined criteria stored in the GRRT template.

AOs interested in definition of their own parameters for generation flight efficiency related RRP's and rerouting opportunities will have to subscribe to this service by submitting an email to NM Flight Efficiency Support (NMD/NOM/OPL): nm.flightefficiencysupport@ops.cfmu.eurocontrol.int.

When subscribing, AOs will have to provide information on various parameters that have to be inserted in the GRRT template:

- AO’s ICAO three letter code(s);
- cost criteria;
- constraints controlling the selection of alternatives;
- selection criteria;
- schedule of runs.

In addition to the list above, AOs will have to indicate if they are interested to receive only OPPs or both OPPs and RRP’s when beneficial routing alternatives are found by GRRT.

Initially, standard GRRT parameters will be offered to AOs (more details in chapter 3.2.1), or they can send their own preferences that are reflecting their business model.

AO have to be advised that RRP’s created by this process are done within the scope of the Flight Efficiency Initiative.

AOS that subscribed to the service should continue to perform qualitative checks of received RRP’s/OPP’s before submitting the amended FPL, in order to ensure that received RRP’s/OPP’s are operationally acceptable for them.

NOTE: AO’s having their custom template shall be excluded from the general OPP’s template (OPS_FE_ALL.NM18).

3.2 GRRT Templates creation

After agreement with AO, parameters have to be inserted into the GRRT template, in ETFMS.

The creation and maintenance of the GRRT templates is done by NM Flight Efficiency Support (NMD/NOM/OPL) with support of Deputy Operations Manager.
How to create GRRT template

(Attributes window)

LOG IN to the ETFMS as Supervisor.

Define valid period.

Open Scenario… and new window will appear.

Select PLAN - New… and then select any date from the list, which will open new tab (named Created from Updates). If the user has no measures selected, then the new plan created will be empty.
If fields of this tab are not empty, delete them (right click on the field and delete).
To rename tab, click Attributes and then change the Title. New title should contain ICAO code of AOs which parameters are created. Under the same sections, schedule of GRRT runs will be created (this will be described later).

Click Measures to create re-routing parameters
Right click on empty space and select NEW - Rerouting.

New window will appear where AO’s parameters have to be inserted (more details will be provided later).
Click OK to save parameters.
Select Plan and SAVE AS and new window will appear (File Manager - save scenario).
Define Template name and location.
Save Template under UNPUBLISHED_TDS/grrt_templates folder.
Close this window by selecting OK.

When file is saved with all parameters inserted, open (Attributes window) and log out from the ETFMS.
3.2.1 GRRT template parameters (Reroute Editor)

When GRRT template is opened as it is described in the previous chapter, it is necessary to define parameters according to the AO’s specification.

Only GRRT pages that will have to be modified when new template is created will be mentioned here. More details about all GRRT template pages are available in TACT / SRD.

**Description page**

**Actions:**
- **Insert Identifier** - AO’s ICAO code;
- **Under Count Location select Aircraft Operator** - enter AO’s ICAO CODE in the Identifier box. If more than one AO code is inserted, then the separation between codes will be made with “space”. By creating this, all flights from specific operator will be selected;
- **As Measure subtype select Ground Horizontal rerouting;**
- **If AO has requested to receive RRP together with OPPs** - select Generate Proposal: RRP. If only OPPs will be generated, then it should be Generate Proposal: NO;
- **Select purpose - Flight efficiency;**
- **Add NOTE if required under Scenario reference - Note;**
- **Select RPL & PFD + FPL flights to look for opportunities;**
- **Select Compute OBT Validity Period - For chosen alternative only;**

![GRRT Template](image)

Click Confirm find flights.

---

1 To open document:
- Right Click in an empty place in the screen -> Open Documentation -> TACT / SRD
or,
- In the reroute editor - put the mouse on a place that has a tool tip (for example, on the tab title ‘Source’). When the tooltip appears, press F1. This will open Firefox in the documentation describing more in details the tooltip place. There are many places where tooltip is available (e.g. for the cost criteria).
Selection page

This page is used to filter flights that will become candidates for rerouting.

By right clicking the column, it is possible to access Wild cards - Configure window where additional filtering might be defined (Include/exclude).

Constraints page

This page allows the user to specify a set of constraints against which the generated flight alternatives will be checked. Depending on the selected “source” from the “Description” page and the type of constraint, some of the constraints will act as instructions during the path generation and vertical profile calculation process of each alternative. In all cases of selected “source” and type of constraint, with the exception of the “opportunity” constraint, the constraints will be used to exclude the generated alternatives that do not comply with these constraints.

Usually, AVOIDANCE criteria will be requested from the user (e.g. ongoing crisis/conflict zone can be avoided). Additionally, AO may request to avoid any other airspace.

To add airspace that will be avoided

Click Plus to ADD criteria;

Select AVOID, select AIRSPACE and type Airspace ID;

When performing calculations, GRRT considers all relevant information available in ETFMS. However, in order to increase effectiveness of the tool and facilitate solution generation, it is necessary to define airspaces through which rerouting will not be offered by GRRT algorithm (supplement to the CACD data available in ETFMS):

- In case of general template (OPS_FE_ALL.NM18) this will be introduced based on the information available on the Crisis Management page at NOP Protected portal (officially closed areas and airspaces for which warning is issued will be introduced as “AVOID AIRSPACE” criteria).
In case of the custom AO templates, this will be done in accordance with AO preferences.

Cost Criteria page

The user can specify costs for the following criteria. Some criteria have a "Limit Deterioration" check box with an associated value. The system will discard, and not consider, any alternative that exceeds the specified limit (in other words, any alternative that exceeds the specified limit for any of the criteria for which a limit is specified is considered "infinitely costly").

The cost criteria are:

"Fixed Cost": Addition of a fixed value to the total cost of the normal profile prior to comparing with the total cost of each generated alternative. A positive cost penalizes the normal profile, making all alternative profiles cheaper in comparison and making it more likely that an alternative will be cheaper than the normal profile. The fixed cost can also be negative; in this case the system selects an alternative only if it improves on the normal profile by at least this many cost units. Thus, a negative fixed cost is the minimal improvement necessary for an alternative to be accepted.

"Delay": Departure delay of the alternative. The user specifies the cost of each minute of delay incurred by the alternative. The user can also specify a limit on the deterioration of the delay.

"Flying Time" (total elapsed time). The user specifies the cost of each minute of flying time via the "cost/minute" field. The user can also specify a limit on the deterioration of the flying time.

"Route Length". The user specifies the cost of each NM of route length via the "cost/NM" field. The user can also specify a limit on the deterioration the route length.

"Suspension". The user specifies a fixed cost to be added to the total cost of the alternative due to flight suspension, via the "cost if suspended" field. The user can also tick the "Forbid Suspension" box to cause any suspended alternative to incur an infinite cost and to be discarded.

"Opportunity". An alternative is an opportunity if it was invalid at some time preceding the corresponding opportunity constraint and is now Valid. This criterion penalizes alternatives that are not opportunities, i.e. alternatives that do not cross a recently released constraint (such as a RAD or closed airspace that became open). With this
criterion, opportunities (i.e. alternatives that became valid only after the start of the AIRAC or the specified point in time) are more interesting than alternatives that were always valid. The alternatives that were always valid incur the cost specified by this criterion. Opportunity Only specifies that this cost is infinite, which marks as uninteresting any alternative that is not an opportunity.

"Overload". The user specifies a cost per minute of overloads caused by the alternative on all other flights. More specifically: for each traffic volume that will be overloaded if the alternative is applied, the system computes the minutes of delay caused by a regulation on this traffic volume that will resolve this overload. Consequently, all delays per overloaded traffic volume are added and then divided by the number of overloaded traffic volumes. The cost of the criterion is this result multiplied by the specified cost of each minute of delay. With "Limit Deterioration", the user can also specify an upper limit on the number of minutes of delay caused by an alternative.

"Fuel cost". The user specifies the estimated price of fuel per ton via the "cost/ton" field. The user can also specify an upper limit to the fuel consumption, in kg. Information on fuel prices is available at IATA website: (http://www.iata.org/publications/economics/fuel-monitor/Pages/index.aspx).

"TOWF" (Take-Off Weight Factor), a way to estimate route charges. When "TOWF" is selected, the user specifies the TOW (take-off weight) of the aircraft as a percentage of the maximum take-off weight of the aircraft type. Thus, a percentage lower than 100% will lower the estimated cost of route charges whereas a percentage higher than 100% will increase the cost. The user can also specify an upper limit for the estimated cost of route charges with "Limit Deterioration".

"Route Deviation". The user specifies a cost for each nautical mile where the alternative profile uses a segment not on the original profile. In other words, this criterion will cause the system to select the alternative that least deviates from the original profile, even if the original profile does not use the shortest possible route. If the Route Deviation cost per nautical mile is nonzero, the system adjusts internal parameters of the path finder to find routes that deviate from the original profile as little as possible. The user can also specify an upper limit on the cost with "Limit Deterioration".

NOTE: Deterioration limitation. Setting one criterion to a very large value means that an improvement in it will allow a huge degradation in other criteria. To avoid this, for each criterion, it is possible to limit the maximum deterioration. Negative value of the "Limit Deterioration" means that this cost criteria must improve for selected value.

Default cost criteria values are:
Saving Parameters:

To save parameters, click OK at the bottom of the Reroute Editor window. Then, in Scenario Display window select PLAN - SAVE/SAVE AS…

### 3.2.2 GRRT schedule

GRRT Schedule is defined through Scenario Display window - Attributes Tab.

Right click at the blank space in table Activation Schedule and select Add Schedule to create new line.

#### Schedule Columns:

- **Global From** - defines start date
- **Global Till** - defines end date
- **Week Days** - defines days of week for which schedule will run
- **Repeat** - select ONCE.
- **Daily From** - select time when GRRT will run
- **Daily Till** - only if under Repeat is selected EVERY
- **Every** - only if under Repeat is selected EVERY - define frequency of runs within Daily From / Till range
- **Rel From** - select CLOCK or MIDNIGHT.
- **On From** - Select time
- **Rel Till** - select CLOCK or MIDNIGHT
- **On Till** - Select time.
Columns On From / Till are used to define a scope of rerouting candidates based on their EOBT time. Depending on the Rel From / Till value this scope can be defined relatively against the CLOCK value or absolutely against MIDNIGHT (time is in UTC).

Example 1:
Daily From = 0500
Rel From = CLOCK
On From = 0700
Rel Till = CLOCK
On Till = 0900
In this case, GRRT will run at 0500, by taking in consideration all flights with EOBT between 0500 + 0700 = 1200 UTC and 0500 + 0900 = 1400 UTC.

Example 2:
Daily From = 0500
Rel From = MIDNIGHT
On From = 0700
Rel Till = MIDNIGHT
On Till = 0900
In this case, GRRT will run at 0500, by taking in consideration all flights with EOBT 0700 UTC and 0900 UTC.

The default values of schedule are:

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When schedule is modified save GRRT template (PLAN - SAVE/SAVE AS..)

3.2.3 GRRT modification/update

To modify existing template, open it from the Scenario Display window (PLAN - OPEN - FILE). Find template and open it by selecting its name and clicking on the OK in Files Manager window.
Select Tab with GRRT template name,
On Measures page click RR*,
Select RR with AO identifier
Right click and select Edit - this will open Reroute Editor
Modification/update of existing template can be used when new template has to be created. In that case, existing template is opened, its parameters are modified where necessary to reflect AO request and then the template is saved under different name.

One AO can have more than one template if different parameters are used for different group of flights (e.g. specific parameters for Boeing and specific parameters for Airbus aircrafts). In this case existing template can be modified and saved under different name.

3.3 Analysing and Using GRRT Results in SIMEX

SIMEX can be used for the GRRT template result analysis. More details on how SIMEX is used can be found in SIMEX manual.

Load the Template
Select Tab with GRRT template name,
On Measures page click RR*,
Select RR with AO identifier.
Right click and select Simulate Selected via Editor.

Reroute editor will be opened in SIMEX environment.
Flights can then be selected and investigated.
Open Selection tab.
Select sub-set of flights and press button KEEP SELECTED (This is not necessary if all flights have to be selected).
Then press Apply or Apply and Trace (this button will visualize flight alternatives) button to reroute selected flights according to the defined criteria.
## Global Result

### Current route:
- Field: ESK 0288F150 DCT CDN 0602 GDAL M725 NONSA/N0266F070 M725 LARES/N0264F210 M725 GOLAR GOLOP
- Total Cost: 1,734
- FIXED COST -20 => Cost: -20
- DEPARTURE_DELAY Not regulated => Cost: 0
- FLYING TIME 0110m27s => Cost: 552
- ROUTE_LENGTH 457
- SUSPENSION FALSE => Cost: 0
- FUEL 1126 kg => Cost: 957
- ROUTE_CHARGES 305 => Cost: 305

### Image Description:
- The image shows a map with routes and various data points indicating flight paths and costs.
- There are markers and lines indicating the flight routes and associated data.
- The map includes various aircraft symbols and markers along the routes.
- Additional data is presented in a table format, detailing flight details, costs, and route-specific information.
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4 Monitoring, Reporting and Post Operations

EUROCONTROL NMD/PFR unit measures, monitors and analyses actual trajectory (KEA) and last filed flight plan trajectory (KEP) KPIs. It also monitors acceptance rate of generated rerouting proposals (RRPs) and re-routing opportunities (OPP).

More information can be found in Network Manager Annual Report and Network Manager Operations Report: http://www.eurocontrol.int/articles/network-operations-monitoring-and-reporting

The unit can be contacted at: nm.ops.perf@eurocontrol.int
## ABBREVIATIONS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADEP</td>
<td>Aerodrome of departure</td>
</tr>
<tr>
<td>AO</td>
<td>Aircraft operator</td>
</tr>
<tr>
<td>AOG</td>
<td>Airline operations group</td>
</tr>
<tr>
<td>ATM</td>
<td>Air Traffic Management</td>
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<tr>
<td>CACD</td>
<td>Central Airspace and Capacity Database</td>
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<tr>
<td>CANSO</td>
<td>Civil Air Navigation Services Organisation</td>
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<tr>
<td>CDR</td>
<td>Conditional Route</td>
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<tr>
<td>CFSP</td>
<td>Computer Flight Planning Service Providers</td>
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<tr>
<td>CHMI</td>
<td>Collaboration Human Machine Interface</td>
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<tr>
<td>DOM</td>
<td>Deputy Operations Manager</td>
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<tr>
<td>ETFMS</td>
<td>Enhanced Tactical Flow Management System</td>
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<td>EU</td>
<td>European union</td>
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<tr>
<td>FDP</td>
<td>Flight Data Processing</td>
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<td>FE</td>
<td>Flight Efficiency</td>
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<tr>
<td>FEWP</td>
<td>Flight Efficiency Work Programme</td>
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<td>FPL</td>
<td>Flight Plan</td>
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<tr>
<td>GRRT</td>
<td>Group rerouting tool</td>
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<tr>
<td>IATA</td>
<td>International Air Transport Association</td>
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<tr>
<td>ICAO</td>
<td>International Civil Aviation Organization</td>
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<tr>
<td>IFPS</td>
<td>Integrated Initial Flight Plan Processing System</td>
</tr>
<tr>
<td>KEA</td>
<td>Average horizontal en route flight efficiency of the actual trajectory</td>
</tr>
<tr>
<td>KEP</td>
<td>Average horizontal en route flight efficiency of the last filed flight plan</td>
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<tr>
<td>KPI</td>
<td>Key Performance Indicator</td>
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<tr>
<td>NM</td>
<td>Network Manager</td>
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<td>Network Management Directorate</td>
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<td>NMIR</td>
<td>Network Manager Interactive Reporting</td>
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<td>Network Manager Operations Centre</td>
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<td>NMPP</td>
<td>Network Manager Performance Plan</td>
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<td>Network Strategic Plan</td>
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<td>OBT</td>
<td>Off-Block Time</td>
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<td>OPP</td>
<td>Rerouting opportunity</td>
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<td>Performance Review Body</td>
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<td>Reference Period</td>
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<td>Rerouting Proposal Message</td>
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<td>SES</td>
<td>Single European Sky</td>
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<tr>
<td>TOW</td>
<td>Take-Off Weight</td>
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<tr>
<td>TOWF</td>
<td>Take-Off Weight Factor</td>
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