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Agenda Item 3: Europe - Southeast / South Asia Contingency planning (scenarios, procedures)

Kabul FIR unavailability - impact on traffic flows Europe - Asia and vice-versa

EUROCONTROL Modelling Tool Evaluations

THE THIRD AD HOC AFGHANISTAN CONTINGENCY GROUP MEETING

11th - 14th May 2015
Muscat, Oman

Presented by: ICAO EUR / NAT Office - EUROCONTROL NM
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Head of Section Airspace Design
Operations Planning
Network Operations Management Division
Network Manager Directorate
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Evaluation Objective

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- To present a modelling tool theoretical findings on potential daily distance and environmental savings/losses on traffic flow Europe - Asia and vice-versa, in case of unavailability of air navigation services within the Kabul FIR.

- To further facilitate proper decisions to be taken by the Organizations and States concerned in order to ensure the least possible disruption of operations affected by such unavailability.

Modelling tool used

SAAM - System for Assignment and Analysis at a Macroscopic level

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Airspace Design and Development Tool
SAAM

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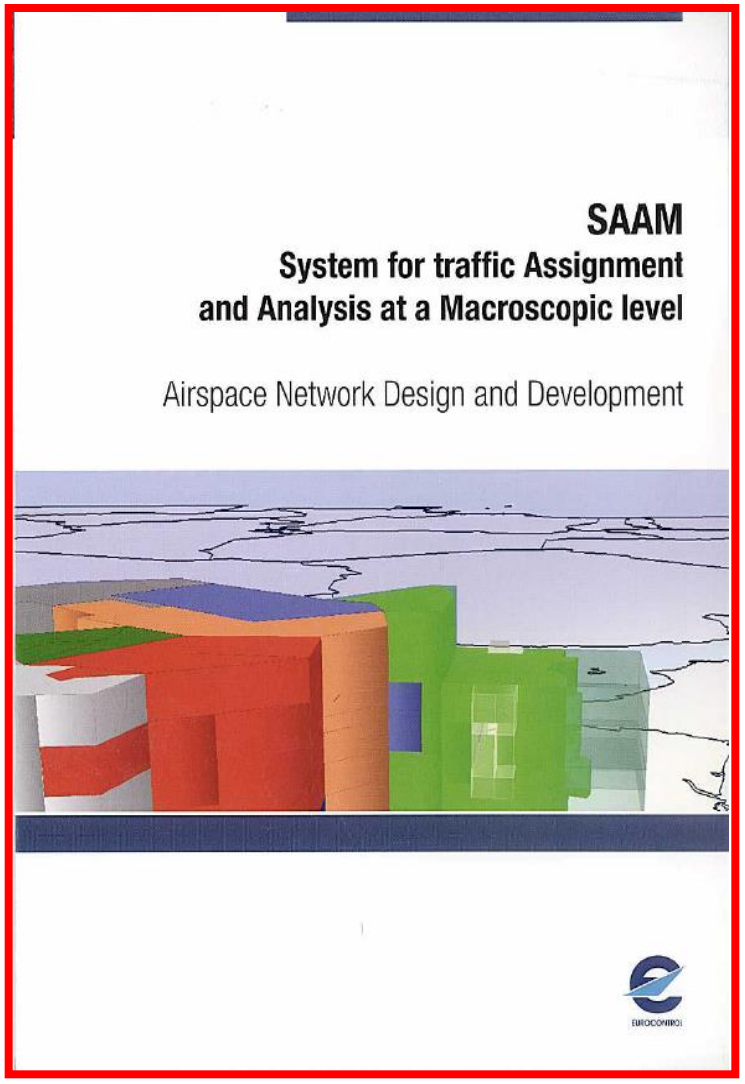

- The System for Assignment and Analysis at a Macroscopic level (SAAM) is an airspace modelling tool designed by EUROCONTROL to assess quantitative information in support of the development of the airspace structure, route network and sectorisation.
- The SAAM tool can assess current and future traffic demand at ECAC, ACC, route segment or sector level. It can evaluate proposals for changes to the route network and sectorisation and support the formulation of new proposals.
- 4D trajectories can be generated (based on traffic demand, route network and aircraft performance) and assessed against traffic volumes. SAAM will by default select the best trajectory option (shortest route, optimum flight profile) but operational rules can be applied such as flight level constraints or restricted route segments.
- In the context of airspace design activities, SAAM is used extensively to perform strategic traffic flow organization, and analyze proposals for route network and airspace optimization.
- Results from SAAM can refine the requirement for fast-time or real-time simulations.

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SAAM - Environmental data

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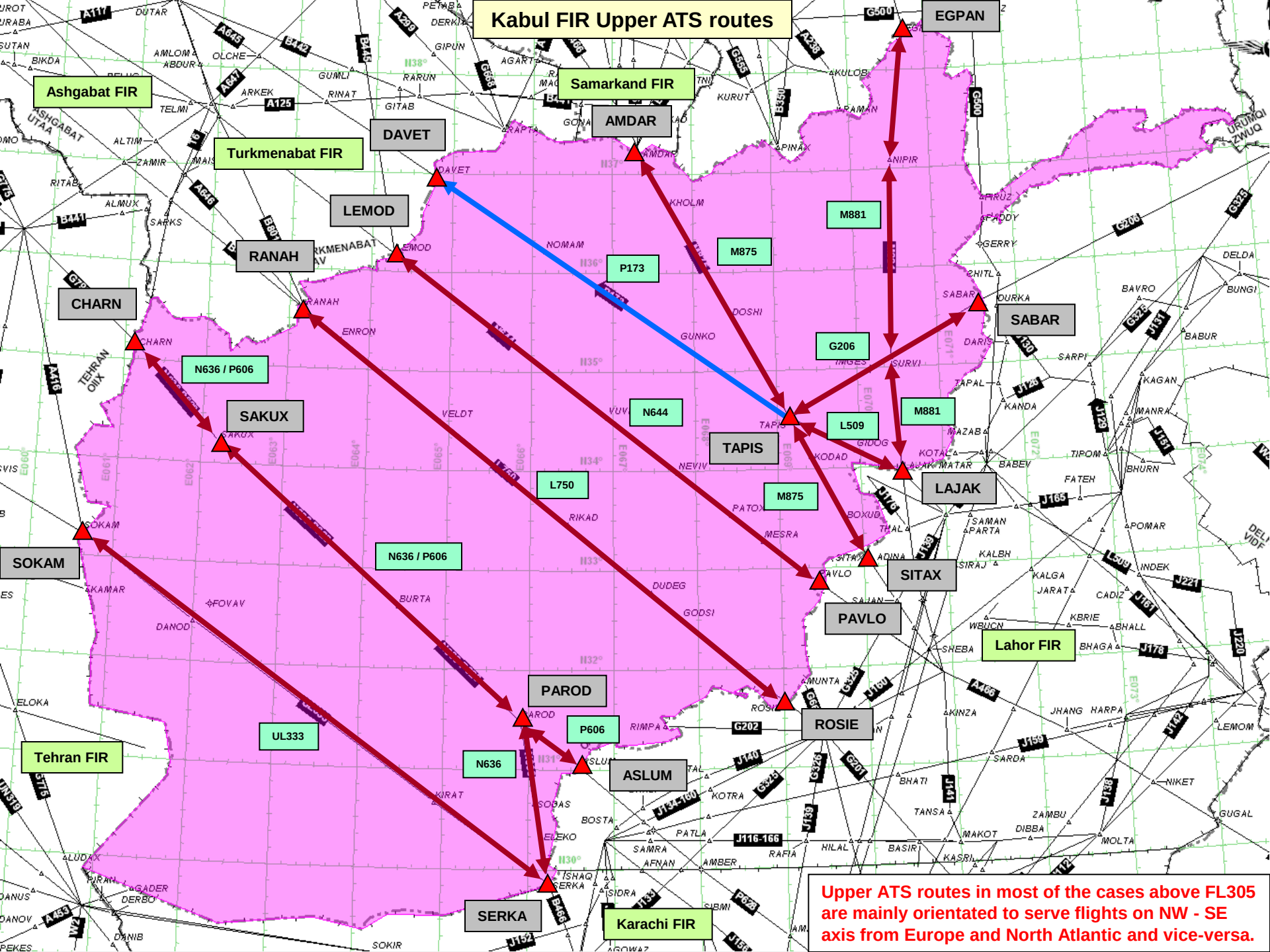
- **Traffic data** - Include all flights through the European airspace for 24 APR 2015, Friday with total 30547 flights. It is the most loaded day for Europe for April 2015. Evaluation includes only those flights via Afghanistan passing by European airspace.
- **ATS route network** - European ATS route network model VST1505. The model includes current ATS route network/sectorisation and all airspace changes confirmed for implementation until 30 APR 2015. The model also includes the majority of ATS route network in Asia including Iranian TOS and GUGAL conditional use.
- **TMA airspace** - Current airspace organisation and changes until 30 APR 2015 are considered (arrival/departure ATS routes).
- **Airspace penalisation** - Part of the airspace over Eastern Ukraine within Dnipropetrovsk FIR and Simferopol FIR is not available. Reduced use of Baghdad FIR and Damascus FIR has no impact on the evaluation.
- **Assignment method** - Aircraft are assigned on the shortest available ATS routes. The existing strategic and structural traffic rules in Europe contained within the Route Availability Document (RAD) are taken into account. The things such as route charges values, meteorological conditions over Europe and the High Seas areas and others are not taken into account.
- **Flight Economy Indicators** - The FEI values - distance (NM), fuel (kg), time (min), CO_2 (carbon dioxide) emissions (kg) and fuel NO_x (mono-nitrogen oxides NO/NO_2) (kg) are calculated by using EUROCONTROL **Advanced Emission Model**.


Kabul FIR Upper ATS routes
Ashgabat FIR
Turkmenabat FIR
Samarkand FIR
Tehran FIR
Lahor FIR
Karachi FIR
EGPAN
AMDAR
DAVET
LEMOD
RANAH
CHARN
SAKUX
SOKAM
TAPIS
SABAR
LAJAK
SITAX
PAVLO
ROSIE
ASLUM
PAROD
SERKA
M881
M875
P173
G206
N644
L509
L750
N636 / P606
UL333
P606
N636
G202
Upper ATS routes in most of the cases above FL305 are mainly orientated to serve flights on NW - SE axis from Europe and North Atlantic and vice-versa.

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SAAM Shortest Route (SR) Assignment
Traffic Load
AFG OPEN
24 APR 2015 FRI

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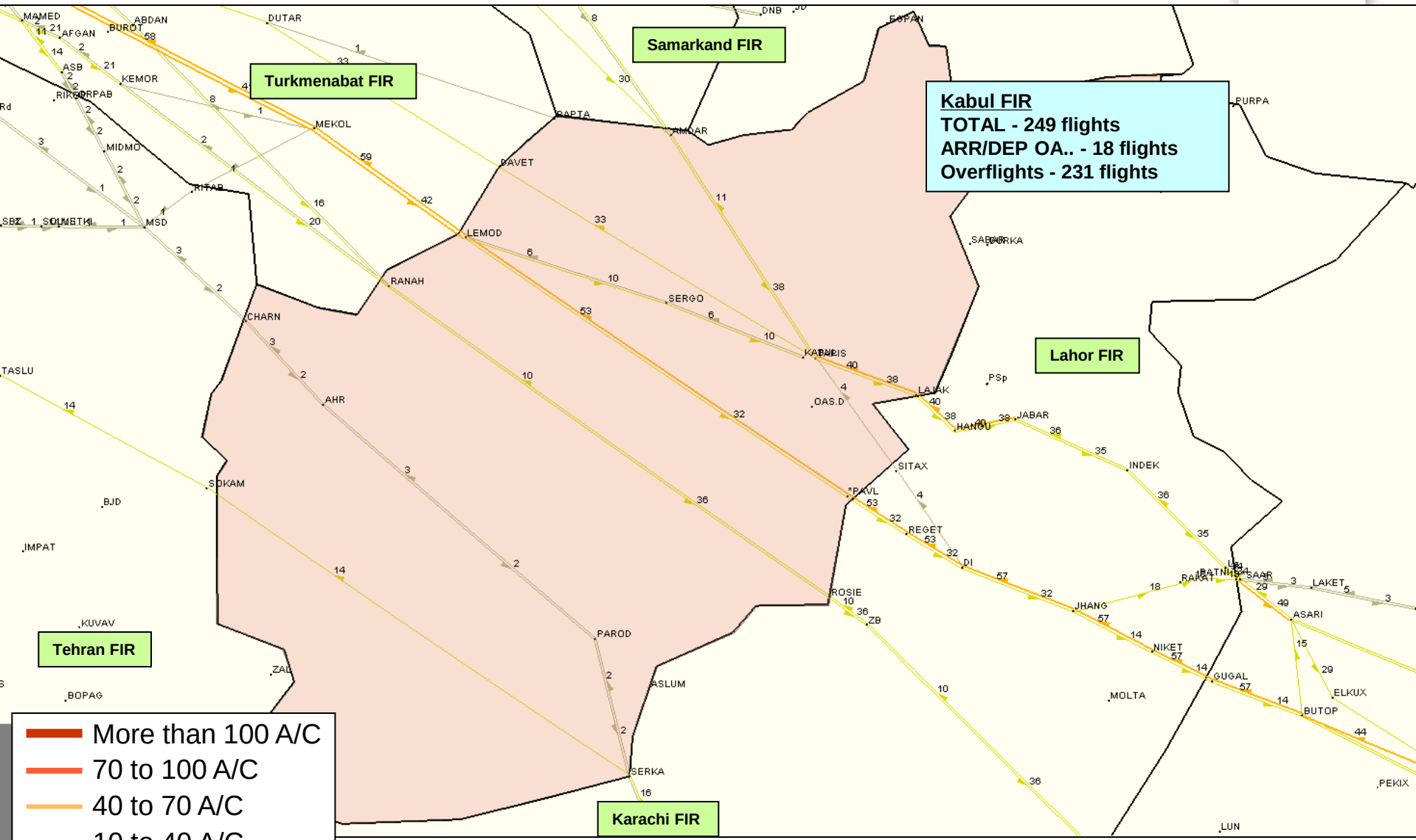

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SAAM SR Assignment
Comparison AFG OPEN / CLOSE
Zoom around Kabul FIR
24 APR 2015 FRI

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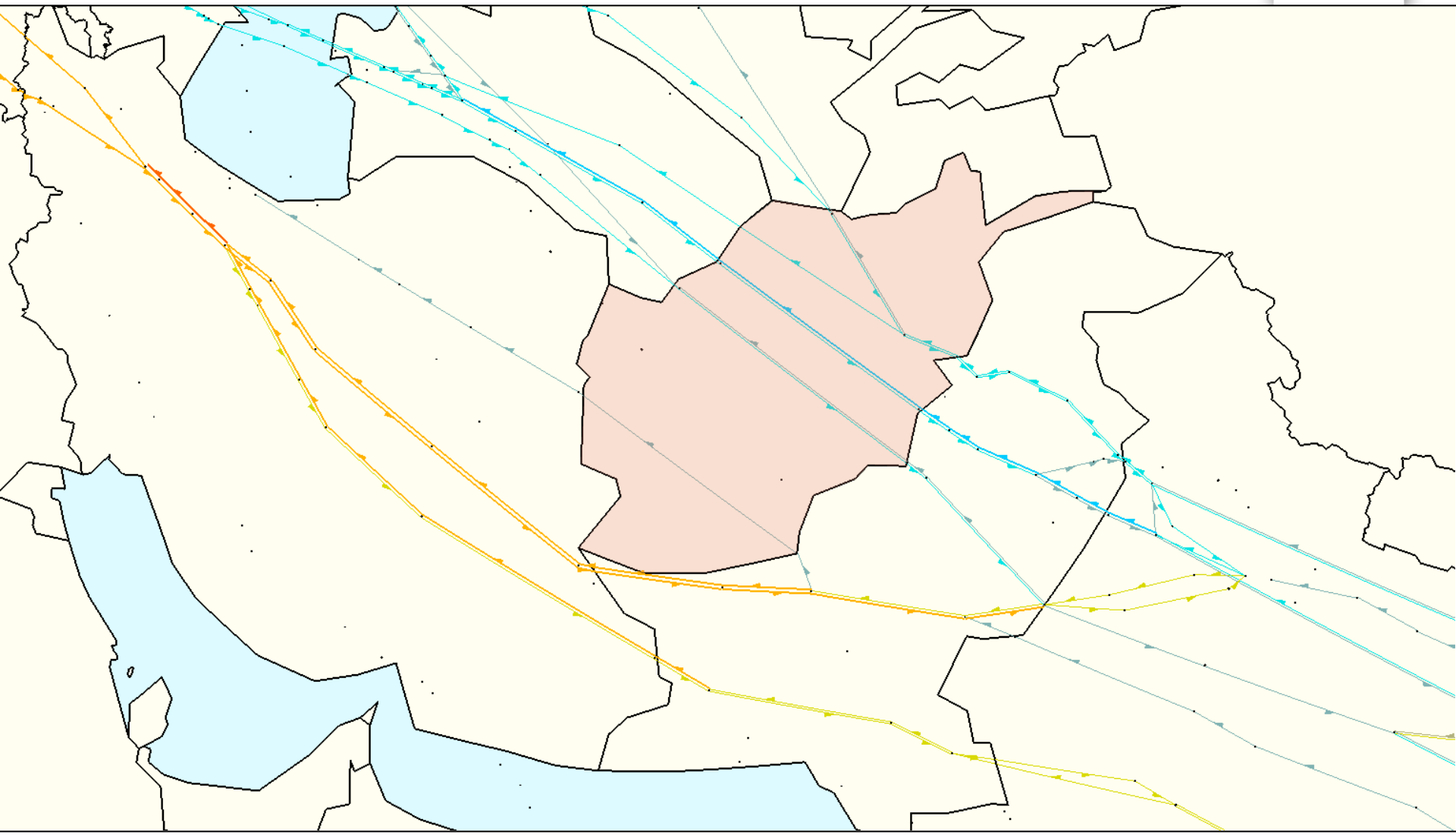

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SAAM SR Assignment
Traffic Load
AFG CLOSE
24 APR 2015 FRI

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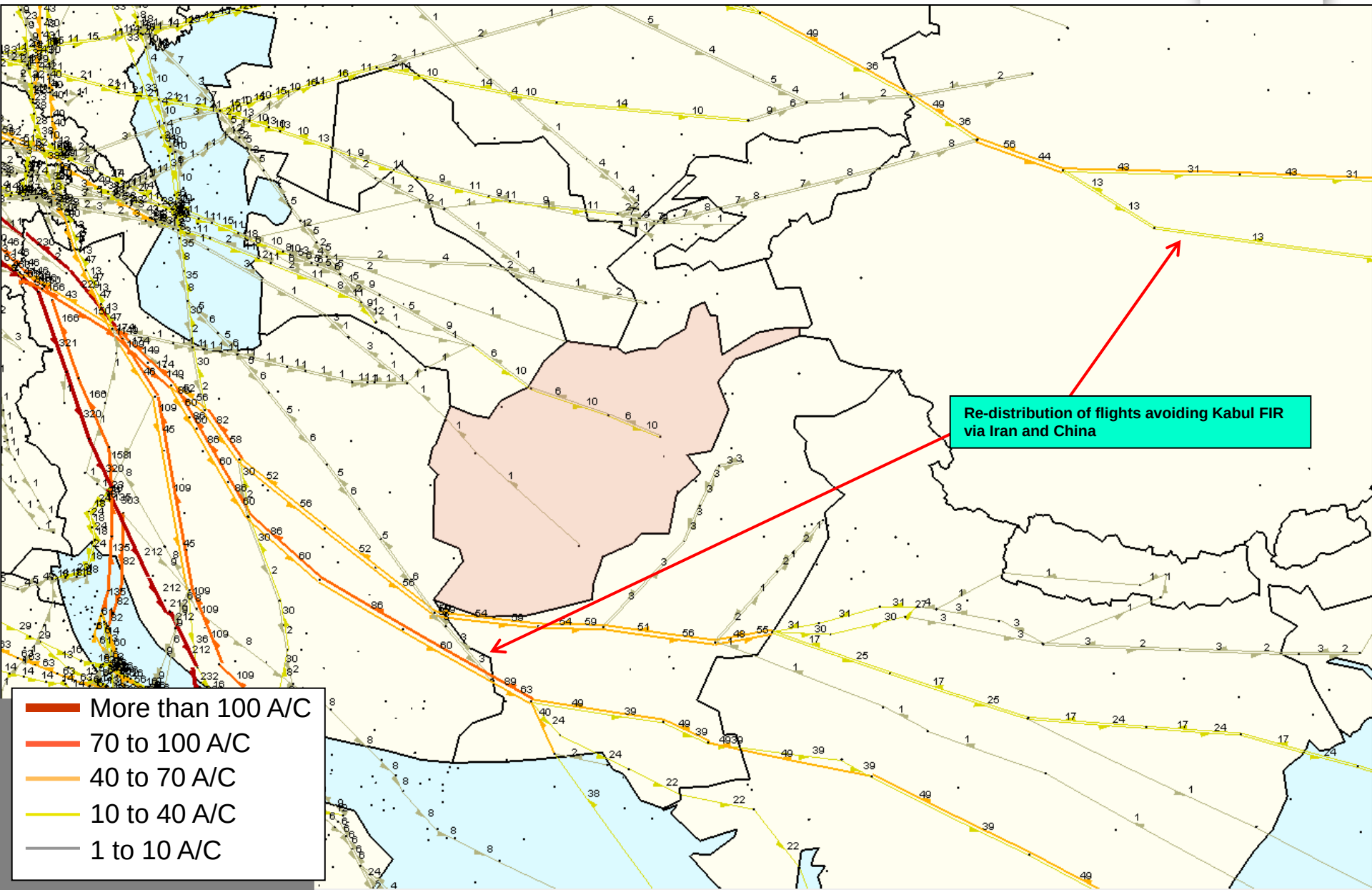

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SAAM SR Assignment
Comparison AFG OPEN / CLOSE
Europe - Asia wide zoom
24 APR 2015 FRI

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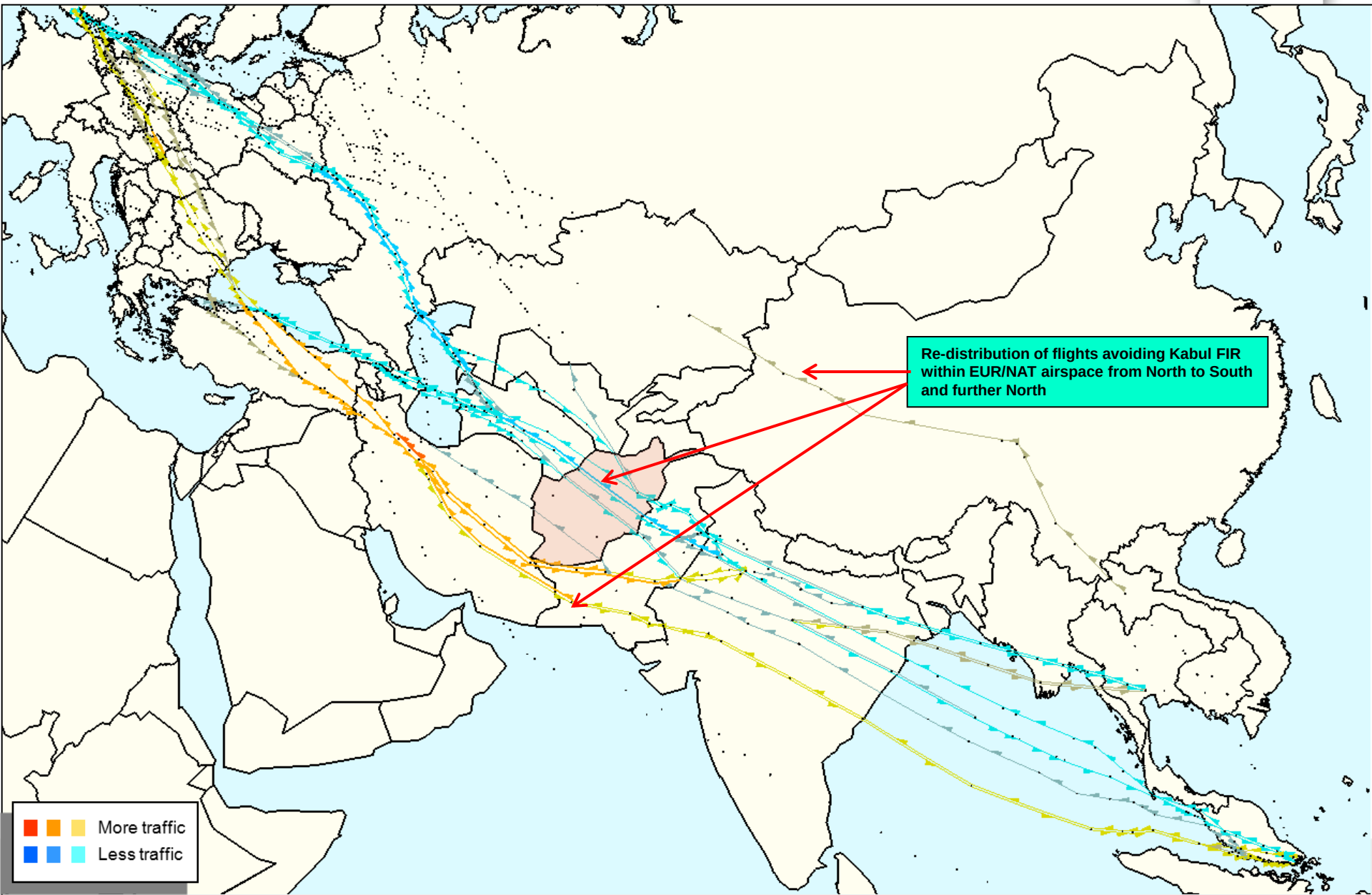

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Flight Economy Indicators calculation

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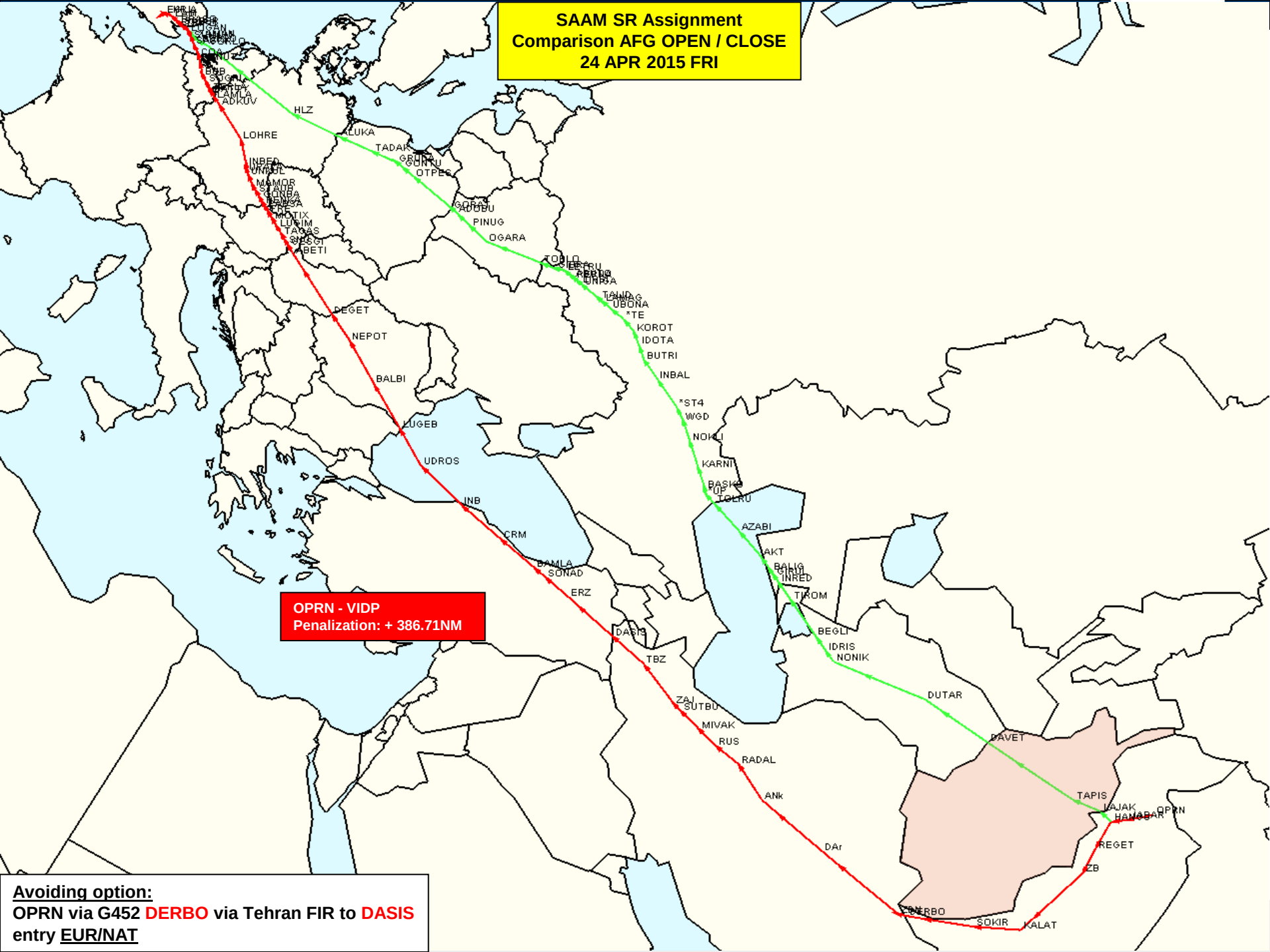
Scenario Economy for … (Potential gains/losses)					
Total impacted flights	Length (NM)	Time (min)	Fuel (kg)	CO2 (kg)	NOx (kg)
225	**22836.100**	**3897.199**	**321864.890**	**1017073.200**	**5836.863**

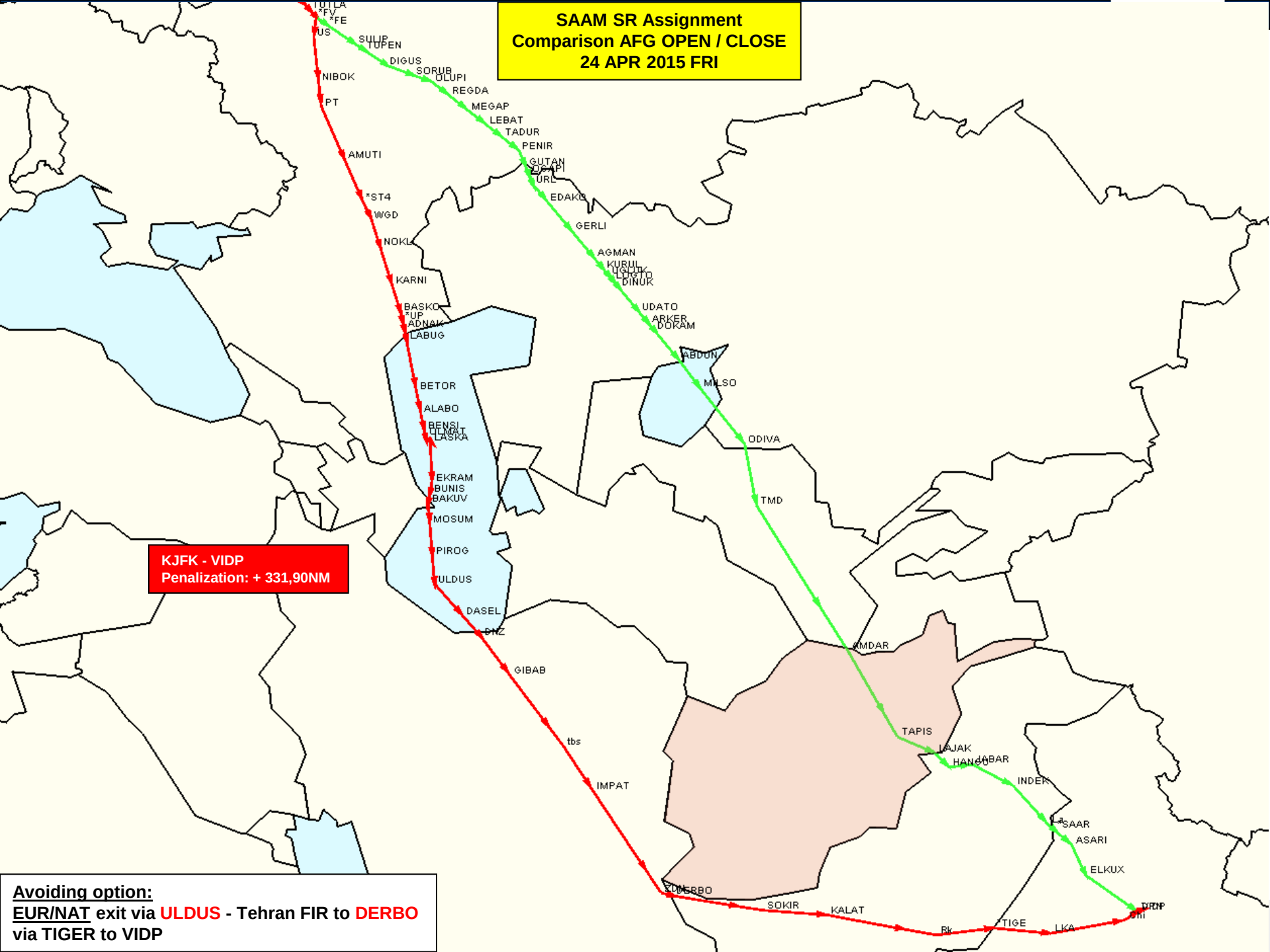
10 most penalized city pairs

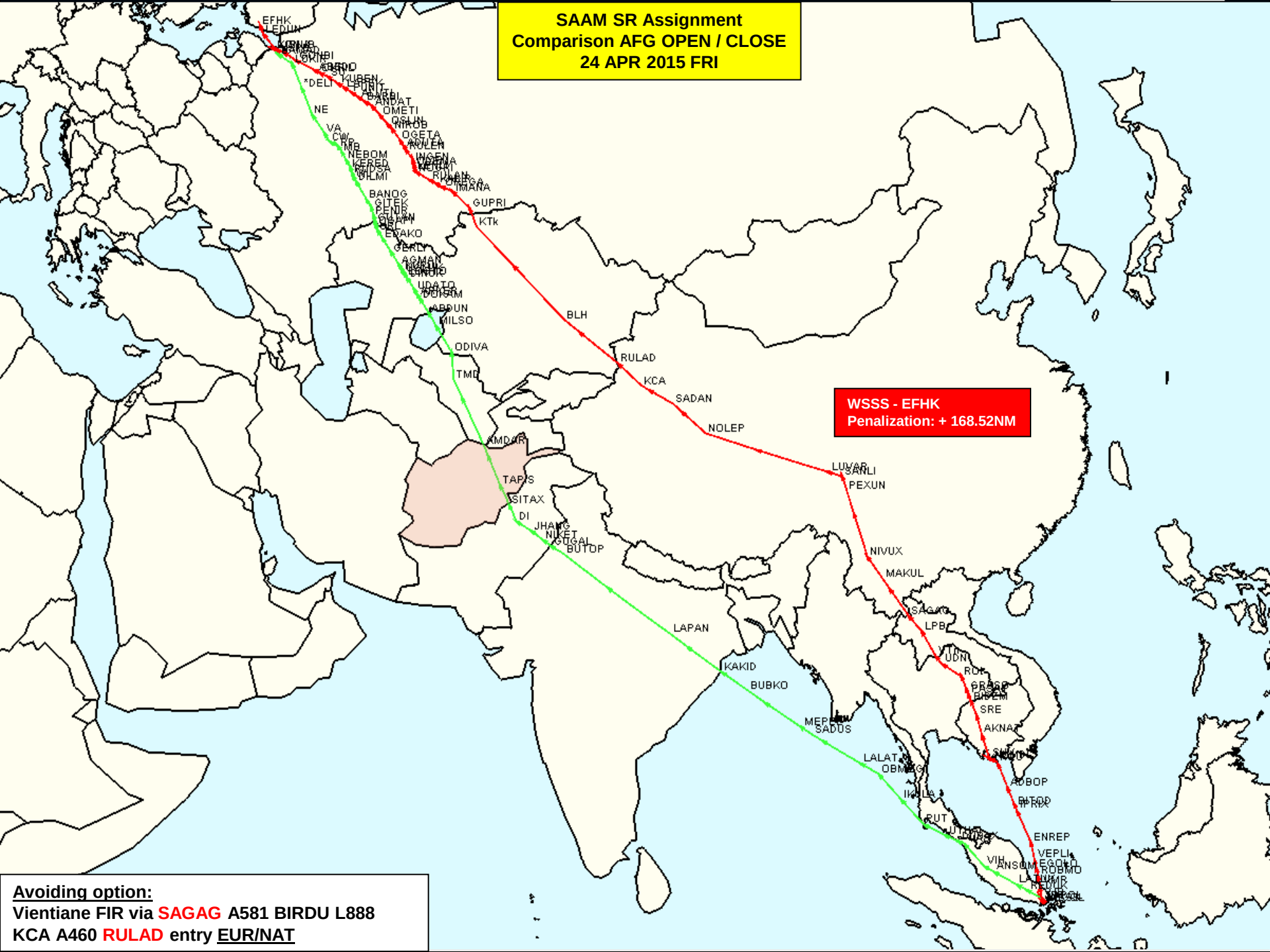
ADEP	ADES	Acft Type	Length (NM)	Time (min)	Fuel (kg)	CO2 (kg)	NOx (kg)
OPRN	EGLL	GLF4	386,710	53,172	446,650	1411,500	3,852
EGCC	OPLA	B772	340,200	42,263	4171,800	13183,000	87,600
VIDP	EFHK	A333	340,180	43,430	3679,700	11628,000	50,287
OPLA	EGCC	B772	333,180	41,175	4090,300	12926,000	85,410
KJFK	VIDP	B77W	331,900	41,321	5400,000	17062,000	104,330
KEWR	VIDP	B772	331,900	41,322	4128,900	13047,000	87,000
KJFK	VIDP	B77W	331,900	41,321	5400,000	17062,000	104,330
OPRN	LBSF	A332	330,330	42,172	3620,500	11441,000	45,634
OPRN	LIMC	B772	330,330	41,126	4147,600	13106,000	87,352
LFPG	OPRN	B772	313,410	39,151	3918,800	12383,000	82,942

10 less penalized city pairs

ADEP	ADES	Acft Type	Length (NM)	Time (min)	Fuel (kg)	CO2 (kg)	NOx (kg)
LIRF	WSSS	B772	22,400	2,789	271,300	858,000	5,760
LEBL	WSSS	B77W	22,400	2,789	363,600	1150,000	7,030
WSSS	LTBA	A333	18,100	2,308	185,700	587,000	2,467
WSSS	LTBA	B772	18,100	2,253	216,800	685,000	4,660
WSSS	LIRF	B772	18,100	2,254	216,800	685,000	4,660
WSSS	LTBA	A333	18,100	2,308	185,700	587,000	2,467
WMKK	LTBA	B772	14,490	1,804	173,600	549,000	3,740
WMKK	LTBA	A333	14,480	1,847	148,500	469,000	1,974
WMKK	LTBA	A332	14,480	1,849	158,700	502,000	2,001
LTBA	WMKK	A333	10,640	1,358	107,300	339,000	1,412


SAAM SR Assignment
Comparison AFG OPEN / CLOSE
24 APR 2015 FRI
OPRN - VIDP
Penalization: + 386.71NM
Avoiding option:
OPRN via G452 DERBO via Tehran FIR to DASIS
entry EUR/NAT
HLZ
LOHRE
ALUKA
TADAK
OTPES
PINUG
OGARA
DEGET
NEPOT
BALBI
LUGEB
UDROS
INB
CRM
BAMLA
SONAD
ERZ
DASIS
TBZ
ZAJ
SUTBU
MIVAK
RUS
RADAL
ANk
DAr
UBONA
KOROT
IDOTA
BUTRI
INBAL
WGD
KARNI
AZABI
AKT
INRED
TIROM
BEGLI
IDRIS
NONIK
DUTAR
DAVET
TAPIS
REGET
ZB
DERBO
SOKIR
KALAT


SAAM SR Assignment
Comparison AFG OPEN / CLOSE
24 APR 2015 FRI
KJFK - VIDP
Penalization: + 331,90NM
Avoiding option:
EUR/NAT exit via ULDUS - Tehran FIR to DERBO
via TIGER to VIDP
TUTLA
*FV
*FE
US
SULIP
TUPEN
DIGUS
SORUB
OLUPI
REGDA
MEGAP
LEBAT
TADUR
PENIR
GUTAN
URL
EDAKO
GERLI
AGMAN
KURUL
DINUK
UDATO
ARKER
DOKAM
ABDUN
MILSO
ODIVA
TMD
NIBOK
PT
AMUTI
*ST4
WGD
NOKLI
KARNI
BASKO
TUP
ADNAK
LABUG
BETOR
ALABO
BENSI
LASKA
EKRAM
BUNIS
BAKUV
MOSUM
PIROG
ULDUS
DASEL
GIBAB
tbs
IMPAT
OMDAR
TAPIS
LAJAK
HANGO
JABAR
INDEK
SAAR
ASARI
ELKUX
DERBO
SOKIR
KALAT
TIGE
LKA


SAAM SR Assignment
Comparison AFG OPEN / CLOSE
24 APR 2015 FRI
WSSS - EFHK
Penalization: + 168.52NM
Avoiding option:
Vientiane FIR via SAGAG A581 BIRDU L888
KCA A460 RULAD entry EUR/NAT
EFHK
LEDUN
*DELI
NE
VA
CW
NEBOM
KERED
BILMI
BANOG
GITEK
ELAKO
AGMAN
UDATO
ABDUN
MILSO
ODIVA
TMD
AMDAR
TAPIS
SITAX
DI
JHANG
NIKET
GUGAI
BUTOP
LAPAN
KAKID
BUBKO
MEPEN
SADDS
LALAT
OBMAG
ADBOP
RUT
ENREP
VEPLI
VIH
ANSUM
EGOLI
ROBMO
LATNA
GUPRI
KTk
BLH
RULAD
KCA
SADAN
NOLEP
LUVAR
SANLI
PEXUN
NIVUX
MAKUL
SAGAG
LPB
UDN
ROP
SRE
AKNAS
IPRIX

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Possible Avoiding Options for Europe - Asia Axis

South of the Himalayas

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Avoidance via Iran

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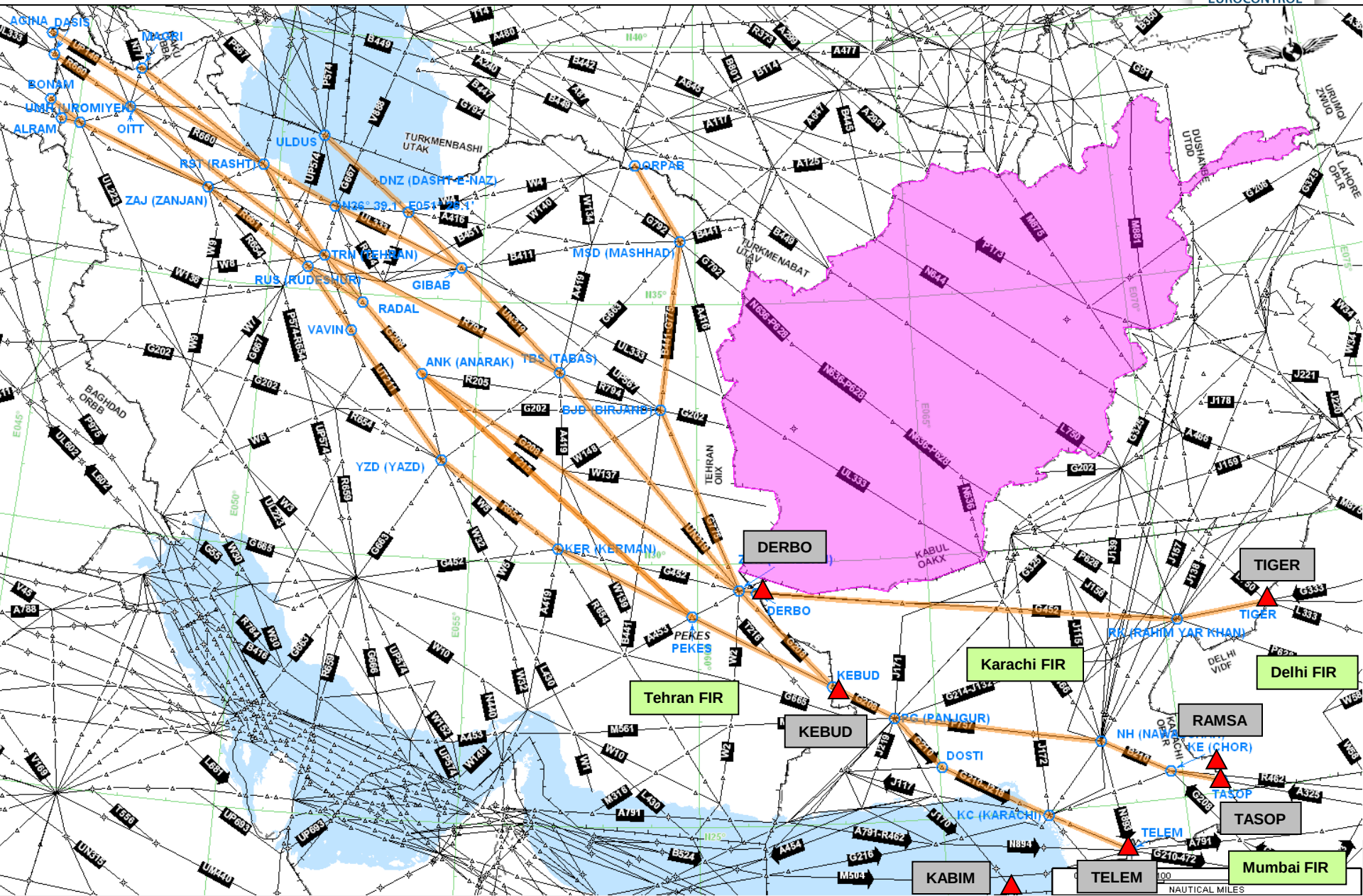

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Avoidance via Iran

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- ATS route options avoiding Kabul FIR are available on axis Delhi FIR / Mumbai FIR - Karachi FIR - Tehran FIR and vice-versa.

- To / From EUR/NAT Region airspace via Tehran FIR ATS route options are available via Ankara FIR, Yerevan FIR, Baku FIR and Ashgabat FIR.

- The most loaded TCPs are as follows:
  - ✓ TELEM / KABIM between Mumbai FIR and Karachi FIR;
  - ✓ TIGER / RAMSA / TASOP between Delhi FIR and Karachi FIR;
  - ✓ DERBO / KEBUD between Karachi FIR and Tehran FIR;
  - ✓ ALRAM / BONAM / DASIS between Tehran FIR and Ankara FIR.

- The general traffic distribution via the TCPs is as follows:
  - ✓ “V” area - TELEM, TIGER, KABIM and VIKIT;
  - ✓ “W” area - KABIM, TASOP and RAMSA;
  - ✓ “OP” area - DERBO and KEBUD.

- Possible shortest option ATS routes at interface Karachi FIR / Tehran FIR to accommodate re-routed traffic flows are:
  - ✓ G208, G452, G775;
  - ✓ L/UL124, UL125, UN319, UT211, UT215.

  The shortest option G208 / UL125 is merging with G208 over ZDN inside Tehran FIR immediately after the FIR boundary near DERBO but Iranian TOS prevents possible additional ATC workload. G208 / UL125 is limited only for flights to / from Ashgabat FIR.

North of the Himalayas

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Avoidance via China

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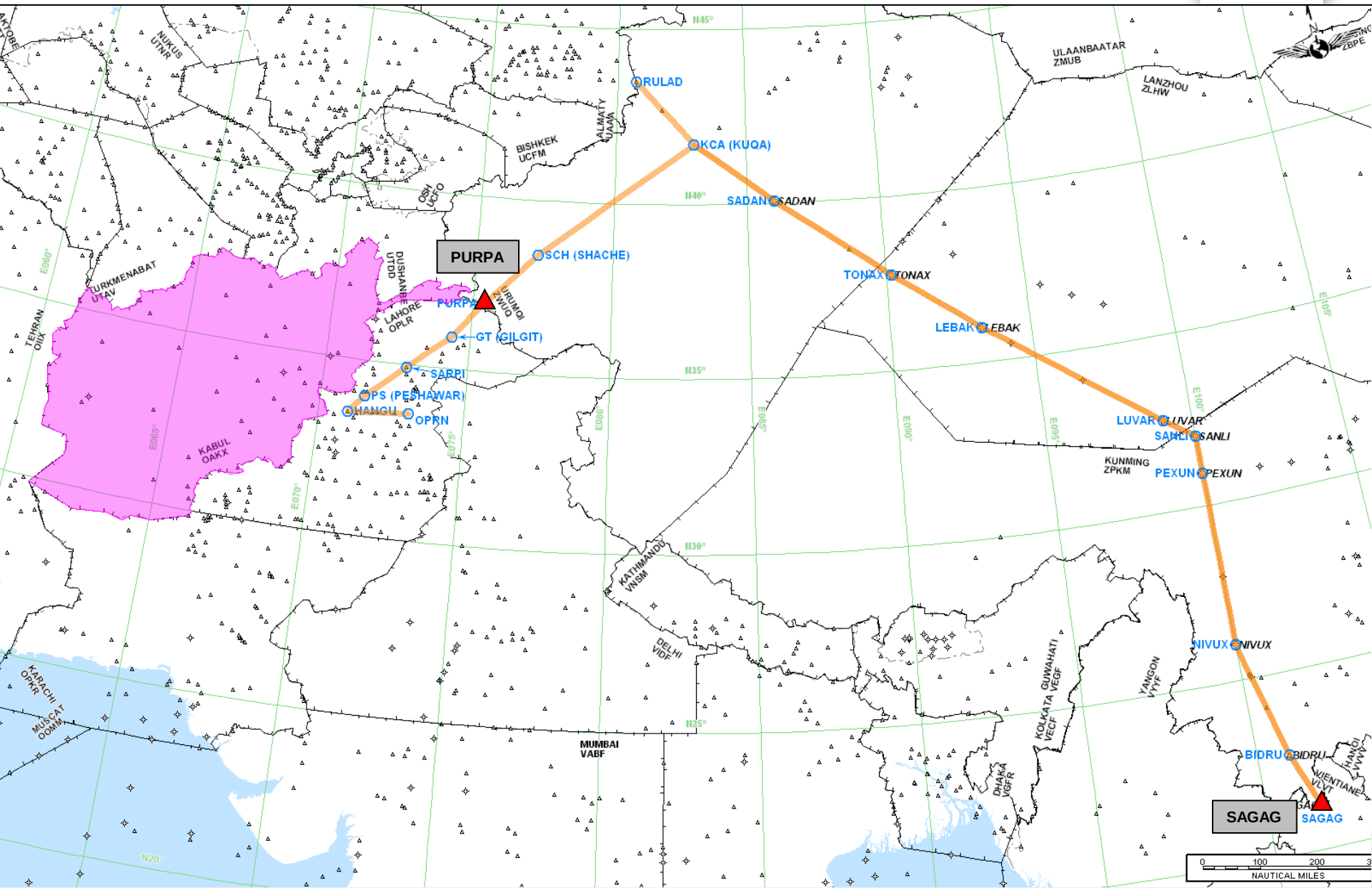

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Avoidance via China

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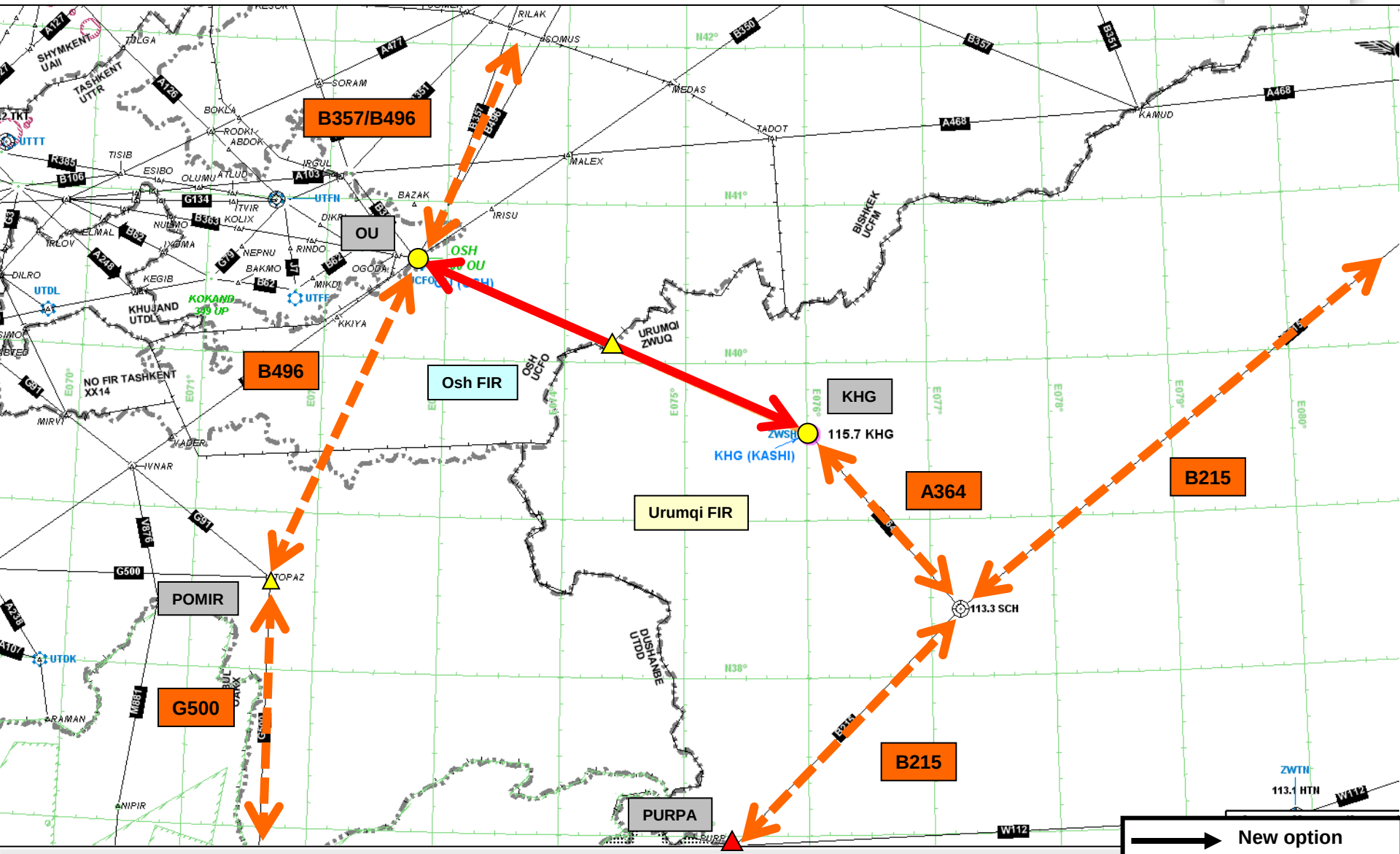
- ATS route options avoiding Kabul FIR are available on axis Karachi FIR - Urumqi FIR and Vientiane FIR - Kunming FIR and vice-versa.

- To / From EUR/NAT Region airspace via China the shortest ATS route option out of Kabul FIR airspace is available via Almaty FIR. Bi-directional option P500 / G500 FARUZ - PADDY delegated from Kabul ACC to Dushanbe ACC is also possible following the extension of B496 between Tajikistan and Kyrgyzstan.

- The most loaded TCPs are as follows :
  - ✓ PURPA between Karachi FIR and Urumqi FIR, in case P500 not available:
    - Mainly for DEP OP to North Atlantic Area (“C” and “K” areas);
  - ✓ SAGAG between Vientiane FIR and Kunming FIR:
    - Mainly for flights between VTBS, VVTS, WSSS and Europe (EF, ES, EN, ED, LF…) and vice-versa.

- Possible shortest option ATS routes via China to accommodate re-routed traffic flows are:
  - ✓ B215;
  - ✓ A581 / L888.

Possible improvement China / Kyrgyzstan
Presented at EAT SCM/2 (22 - 23 SEP 2014, Beijing, China)



Note: Option might be also feasible today with initial potential load of 16 flights per week

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Avoidance via South

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- Upper ATS routes inside Kabul FIR in most of the cases available above FL305 are mainly orientated to serve flights on NW - SE axis from Europe and North Atlantic to Asia and vice-versa.

- Flights to Africa and Gulf area and beyond normally are not routed via Kabul FIR.

- In case of such flights re-routing is possible either via Tehran FIR for North African States or Tehran FIR / Muscat FIR for the rest of African States and beyond.

- In all cases closures or warnings for North African FIRs shall be considered.

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Possible Impact of Kabul FIR unavailability

Possible Impact on common interfaces

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SAAM SR Assignment
Comparison AFG OPEN / CLOSE
Interface Iran / Pakistan
24 APR 2015 FRI

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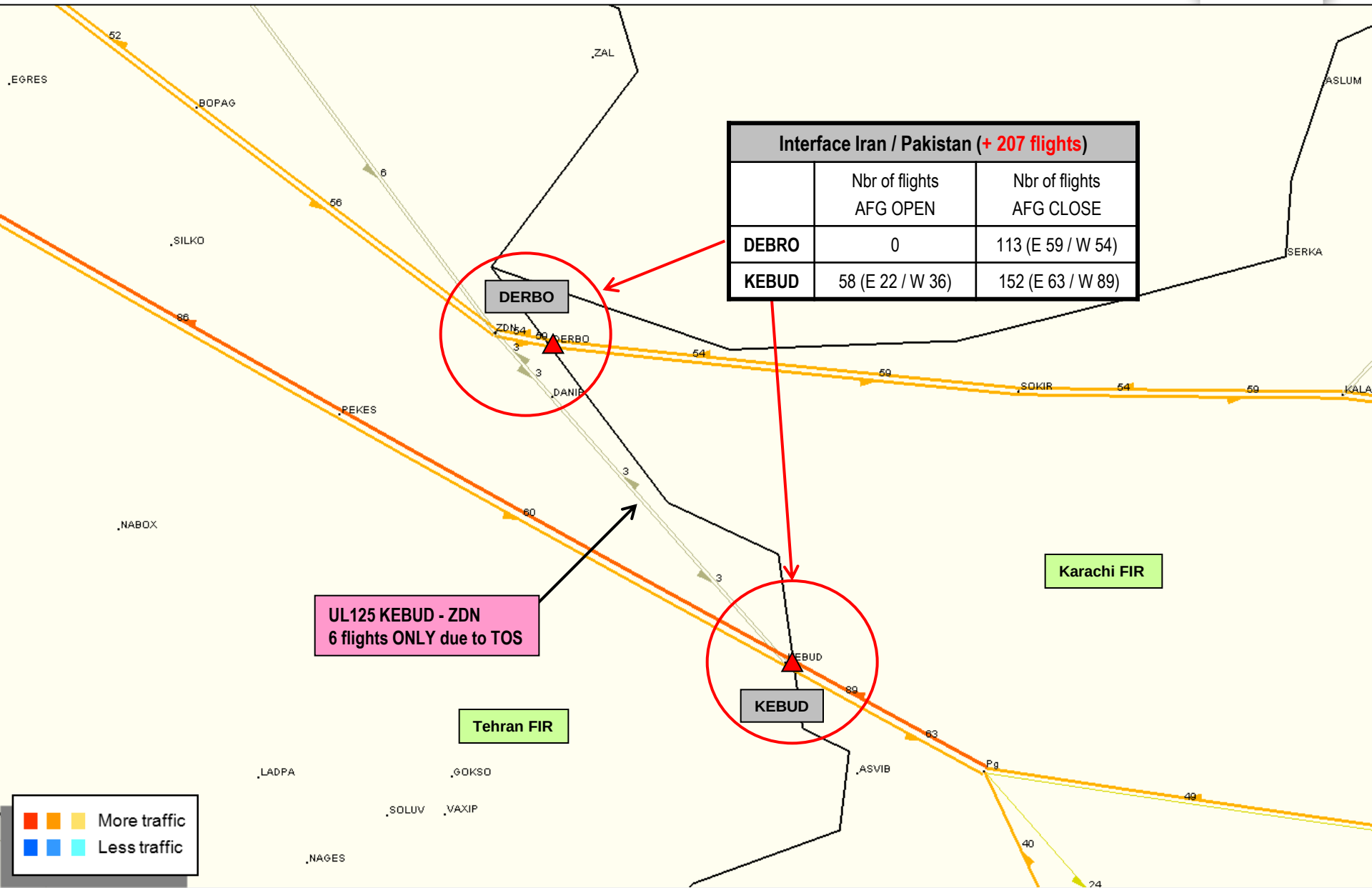

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SAAM SR Assignment
Comparison AFG OPEN / CLOSE
Interface Pakistan / India
24 APR 2015 FRI

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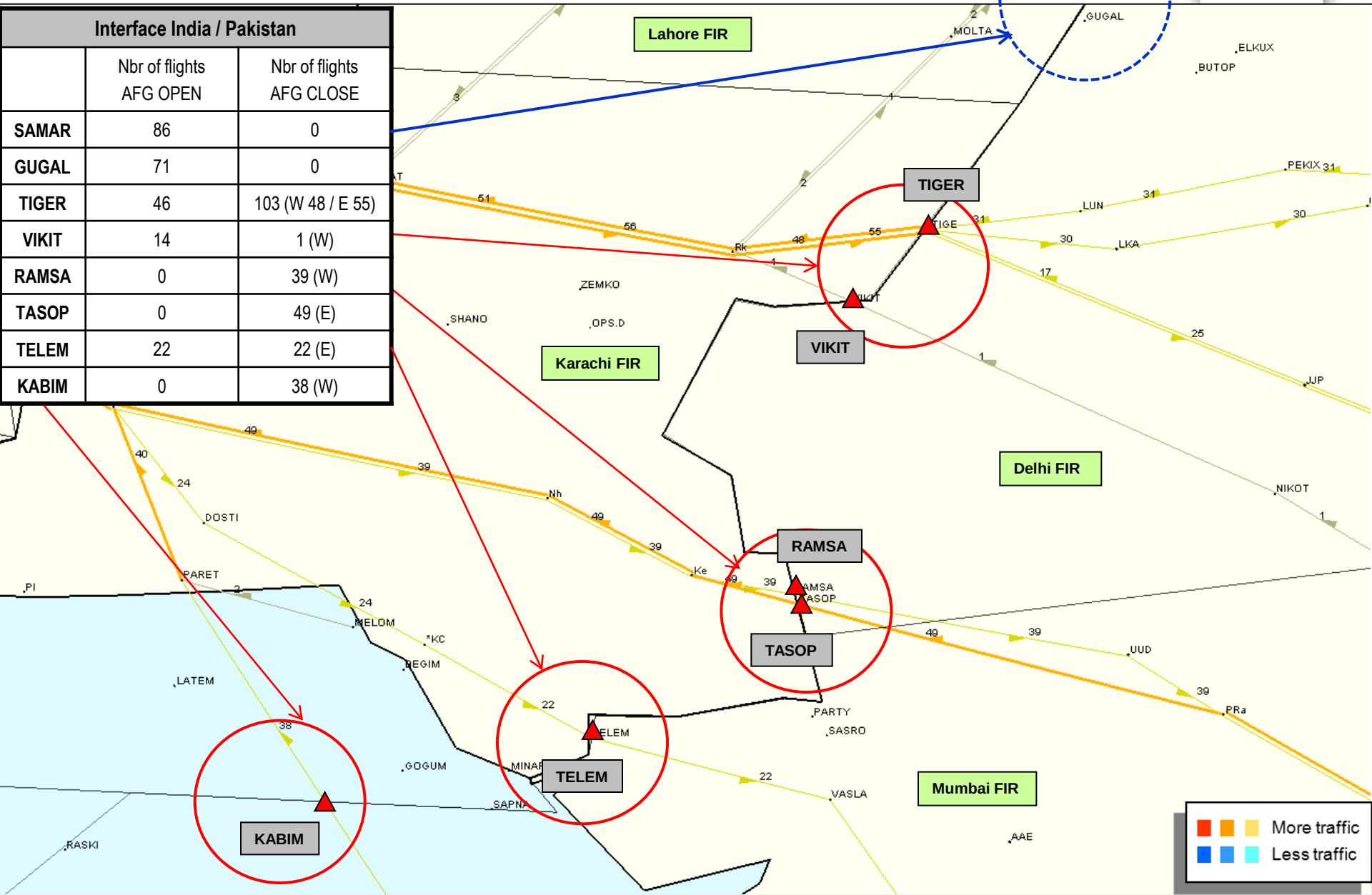
Interface India / Pakistan		
	Nbr of flights AFG OPEN	Nbr of flights AFG CLOSE
SAMAR	86	0
GUGAL	71	0
TIGER	46	103 (W 48 / E 55)
VIKIT	14	1 (W)
RAMSA	0	39 (W)
TASOP	0	49 (E)
TELEM	22	22 (E)
KABIM	0	38 (W)



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SAAM SR Assignment
Comparison AFG OPEN / CLOSE
Interface with China / Laos
24 APR 2015 FRI

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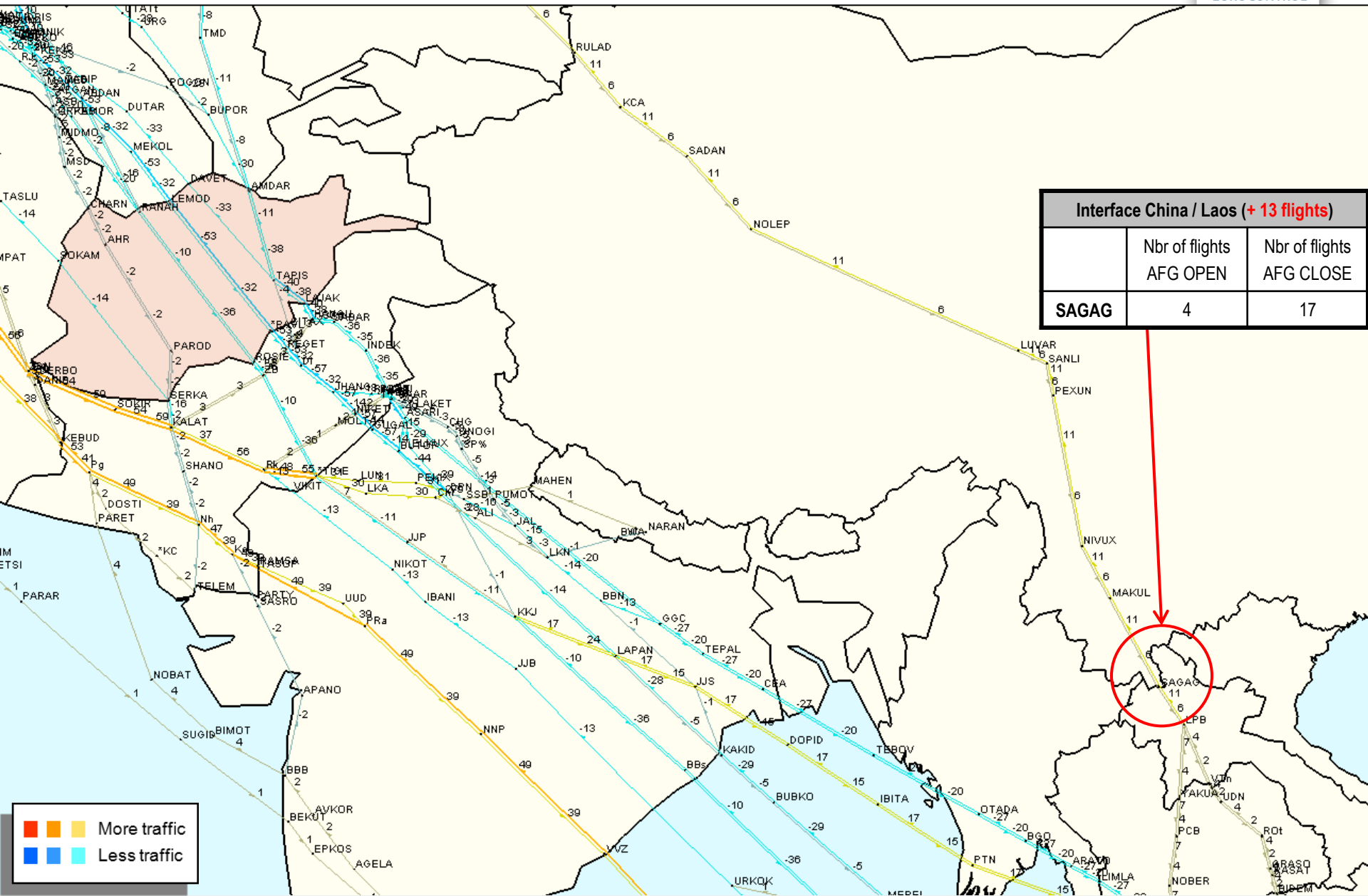

Interface China / Laos (+ 13 flights)		
	Nbr of flights AFG OPEN	Nbr of flights AFG CLOSE
SAGAG	4	17

Possible Impact on States (ACC / Sectors)*

**** FIR, ACC or ATC Sector boundaries are as per State AIPs***

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SAAM - Abbreviations Explanation

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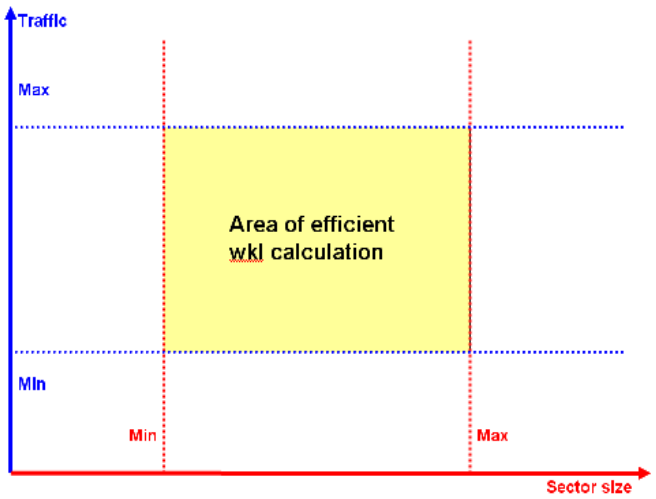
- **SHER** (Sliding Hourly Entry Rate) represents the Hourly Entry rate expressed in number of aircraft entering the sector per hour. This figure is calculated every minute. The maximum of 15 min time-frame is displayed.
- **AVG TIME** (Average Time) represents the average number of minutes spends in the sector for all aircraft crossing that sector for that hour.
- **Conf** (conflict) represents the number of potential conflicts found in the sector during an hour (a conflict is a pair of flights for which a loss of vertical or horizontal separation is detected).
- **wkl** (workload) represents the effective workload curve. The unit is expressed in percentage. It is commonly accepted that the maximum continuous work for a controller is around 42 minutes per hour, so 70%. The calculation is based on AVG TIME, SHER and Conf. In theory if the wkl is above 70% for more than 2 hours the opening of an additional sector is required.
- **70%** represent the commonly accepted limit for a **controller workload (70%)**.
- **90%** should represent the absolute limits to not overpass the workload of a controller (90% so 54 minutes of continuous work).
- **Maximum Occupancy Count** - Instantaneous number of aircraft, which gives the number of aircraft that are observed within the sector at any minute during the interval. An aircraft is counted during the time it actually flew in the sector.



Iran - Tehran ACC

Tehran ACC Sectorisation and Traffic Load
AFG CLOSE

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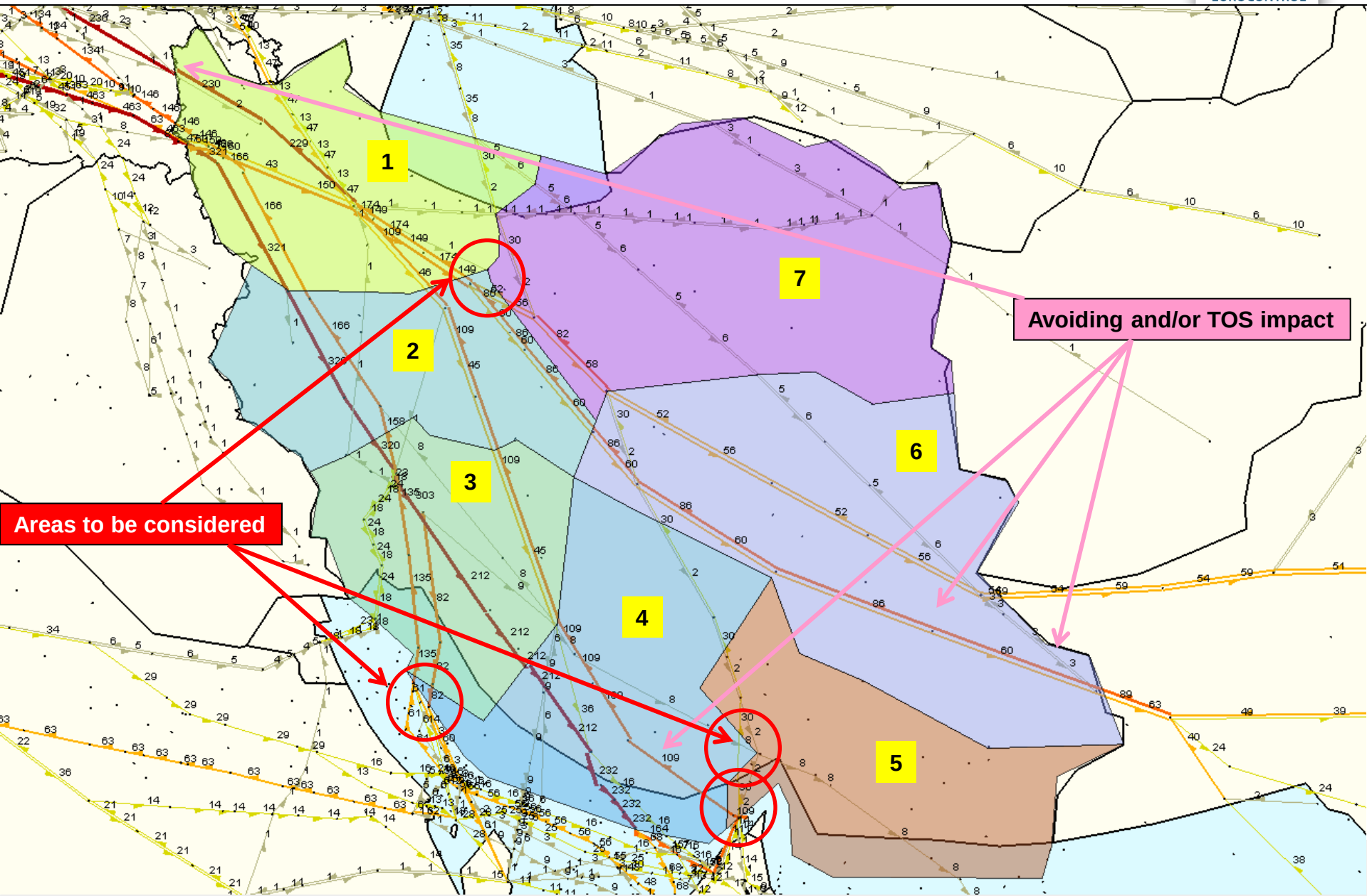

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Tehran ACC Total Traffic Load
Comparison AFG OPEN / CLOSE
24 APR 2015 FRI

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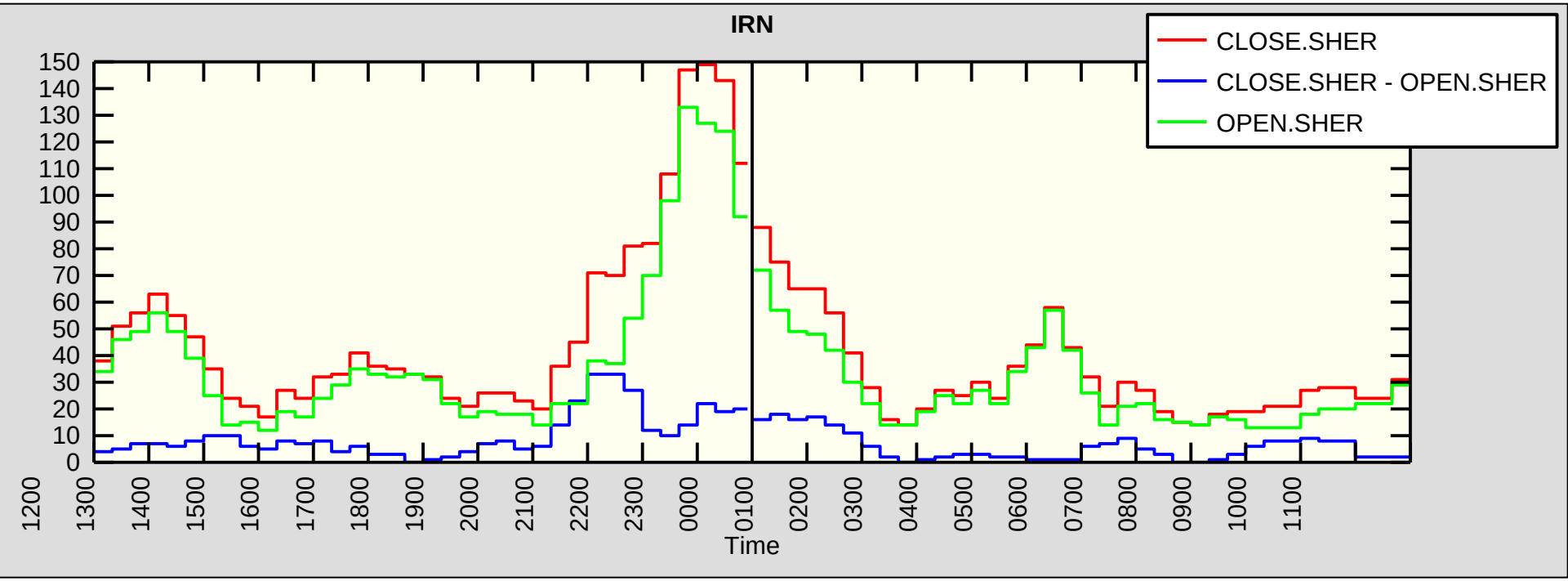

	AFG OPEN				AFG CLOSE			
Sector	Number of flights	Average distance (NM)	Average time (min)	Maximum occupancy Count	Number of flights	Average distance (NM)	Average time (min)	Maximum occupancy Count
Tehran ACC	829	776.9	99.4	198	1029	834.5	106.2	237

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Tehran ACC Sector Load
Comparison AFG OPEN / CLOSE
24 APR 2015 FRI

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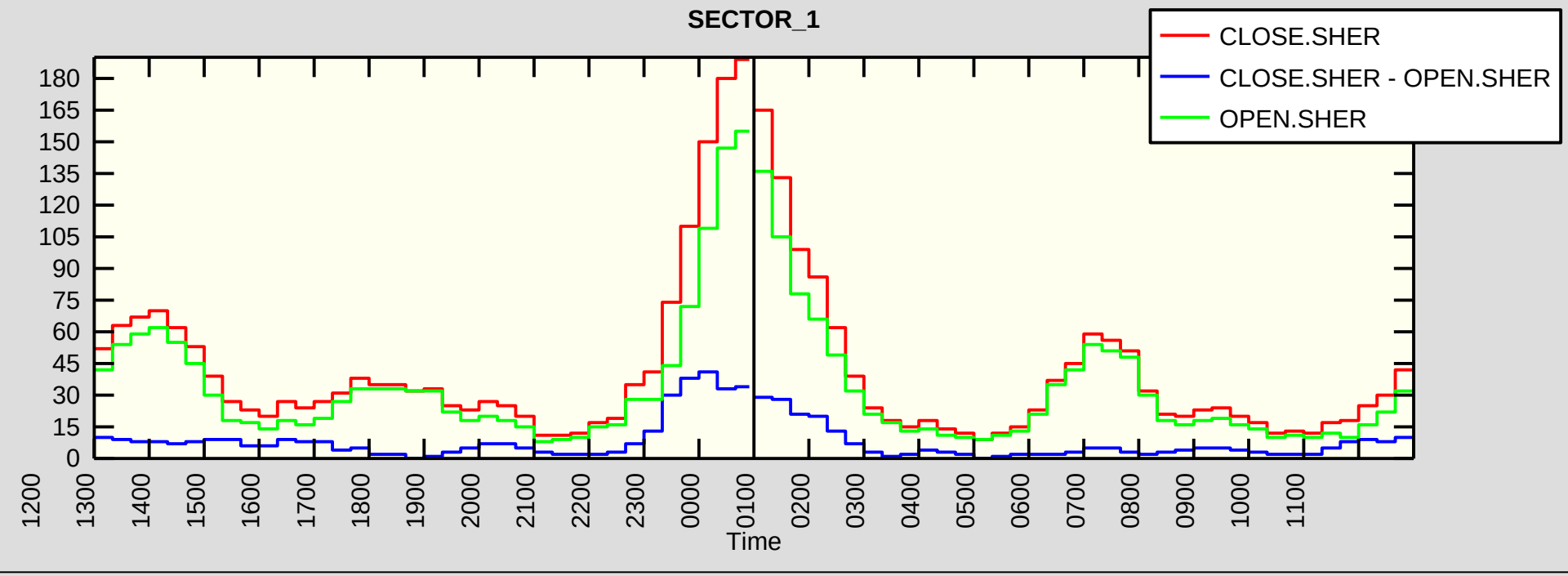
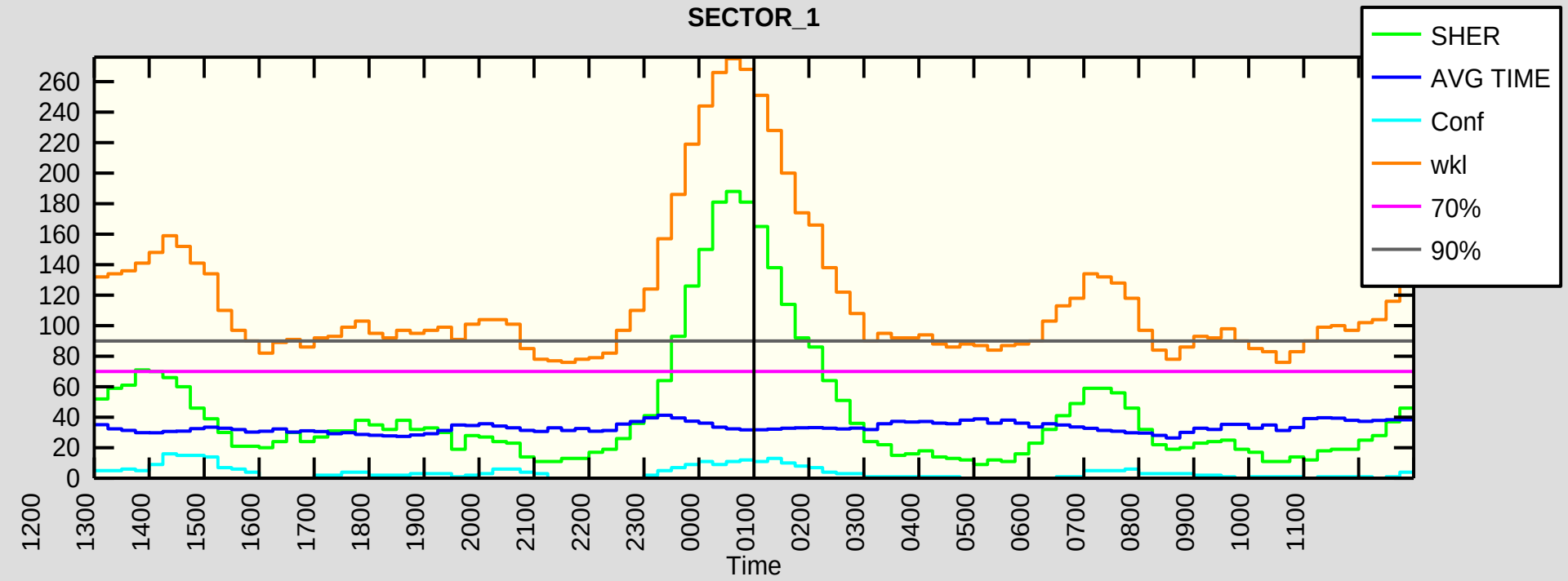
	AFG OPEN				AFG CLOSE			
Sector	Number of flights	Average distance (NM)	Average time (min)	Maximum occupancy Count	Number of flights	Average distance (NM)	Average time (min)	Maximum occupancy Count
Sector 1	821	244.0	31.3	97	**1015**	260.1	33.2	121
Sector 2	769	167.9	21.6	62	**966**	159.2	20.4	70
Sector 3	641	246.0	31.3	52	642	246.1	31.4	52
Sector 4	628	148.1	18.8	32	629	148.3	18.8	32
Sector 5	148	152.1	6.8	8	149	153.3	6.9	8
Sector 6	90	436.2	55.2	13	**297**	491,2	61,8	52
Sector 7	57	296.0	37.9	14	**158**	174.2	22.2	11


SECTOR_1
CLOSE.SHER
CLOSE.SHER - OPEN.SHER
OPEN.SHER
180
165
150
135
120
105
90
75
60
45
30
15
0
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200
2300
0000
0100
0200
0300
0400
0500
0600
0700
0800
0900
1000
1100
Time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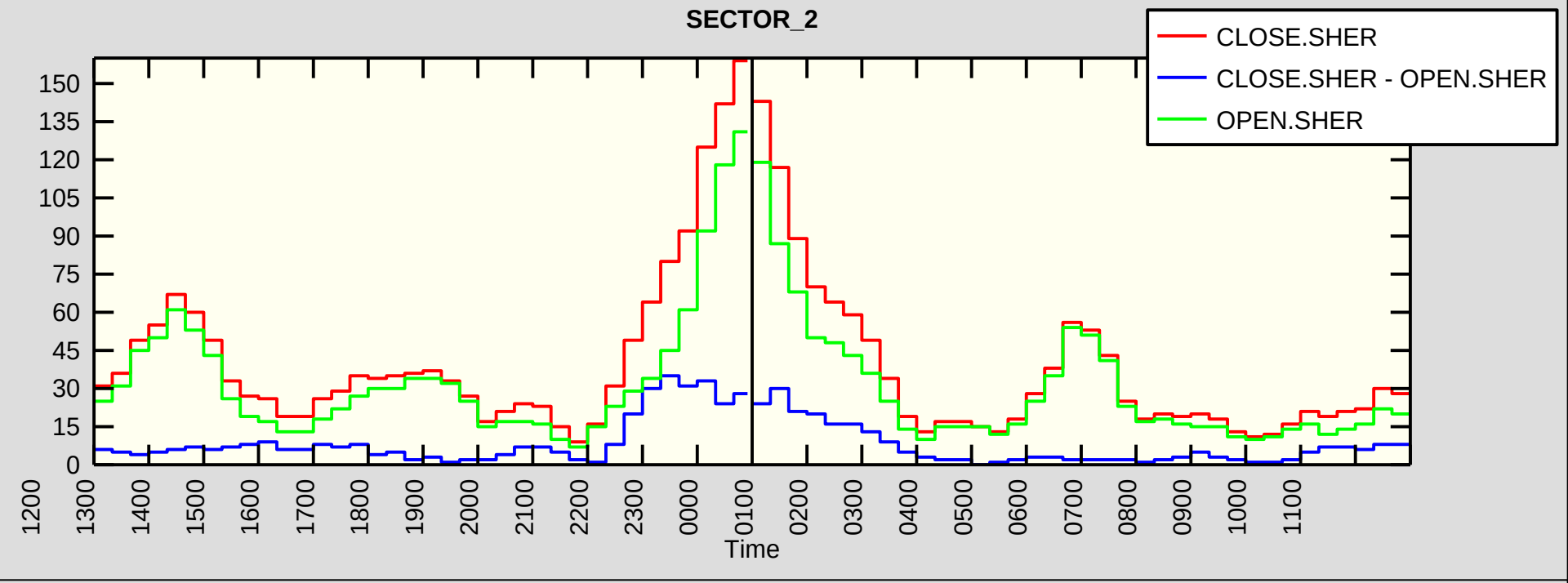
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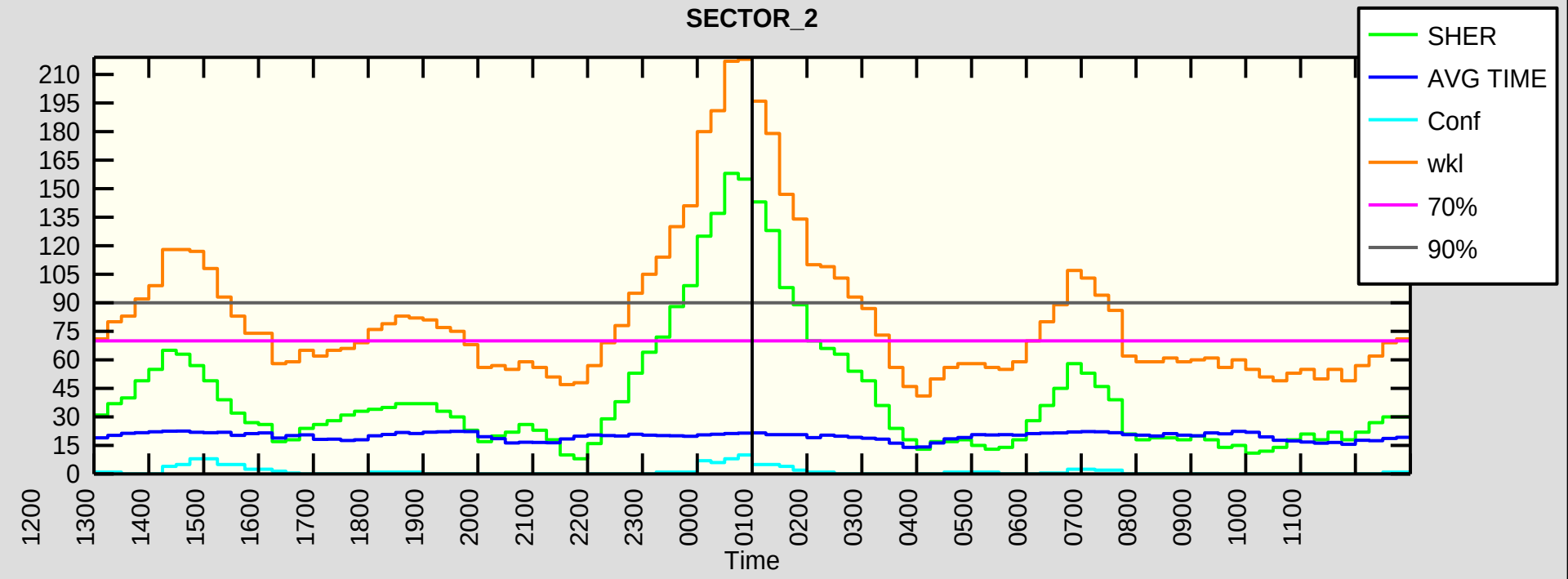
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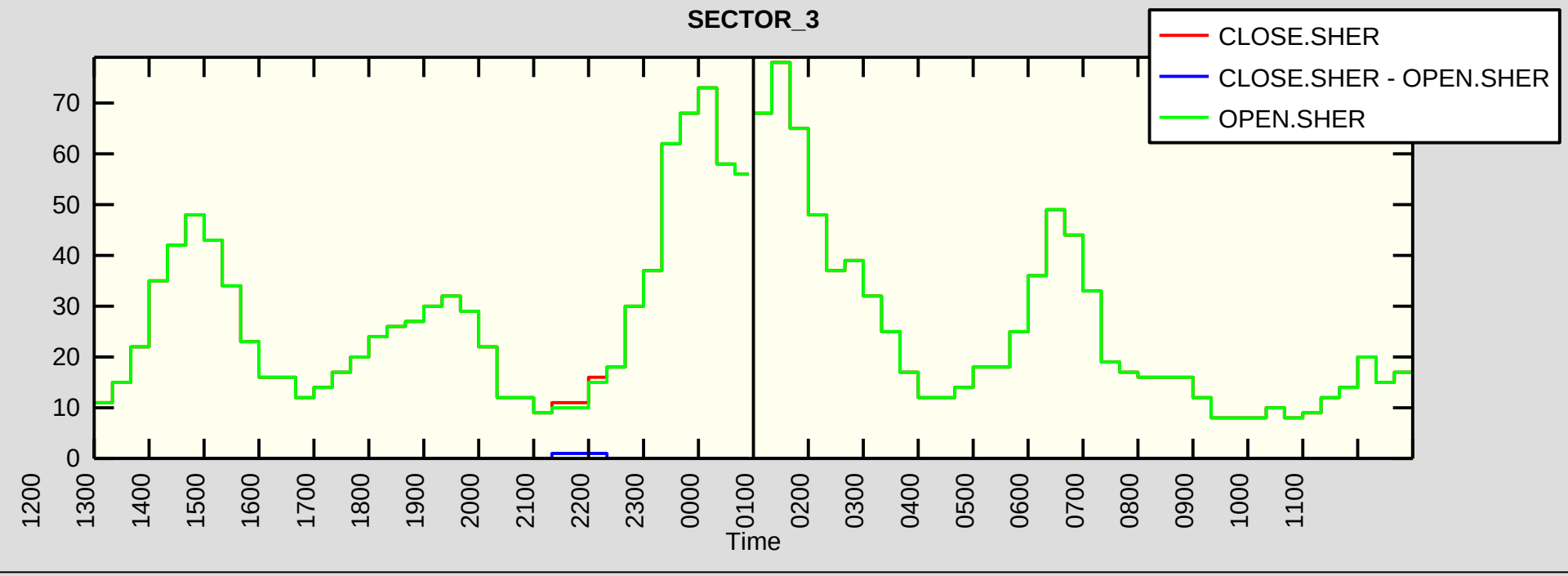
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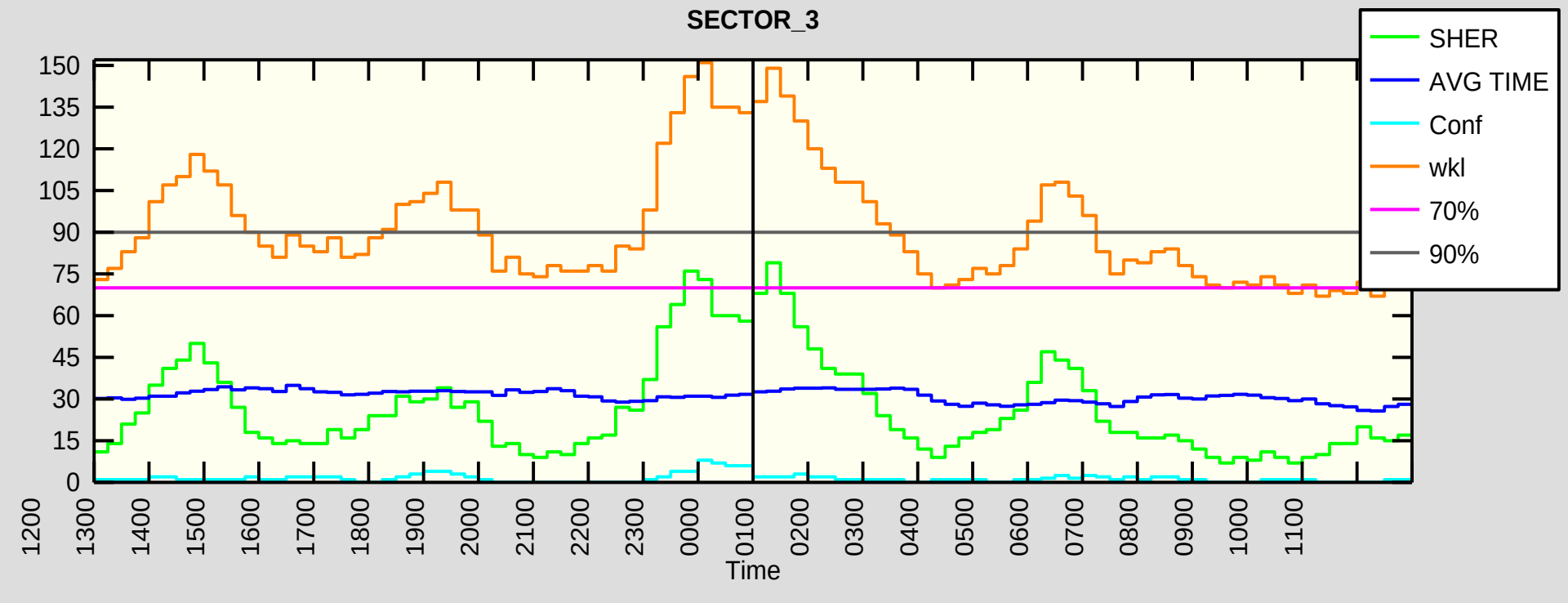
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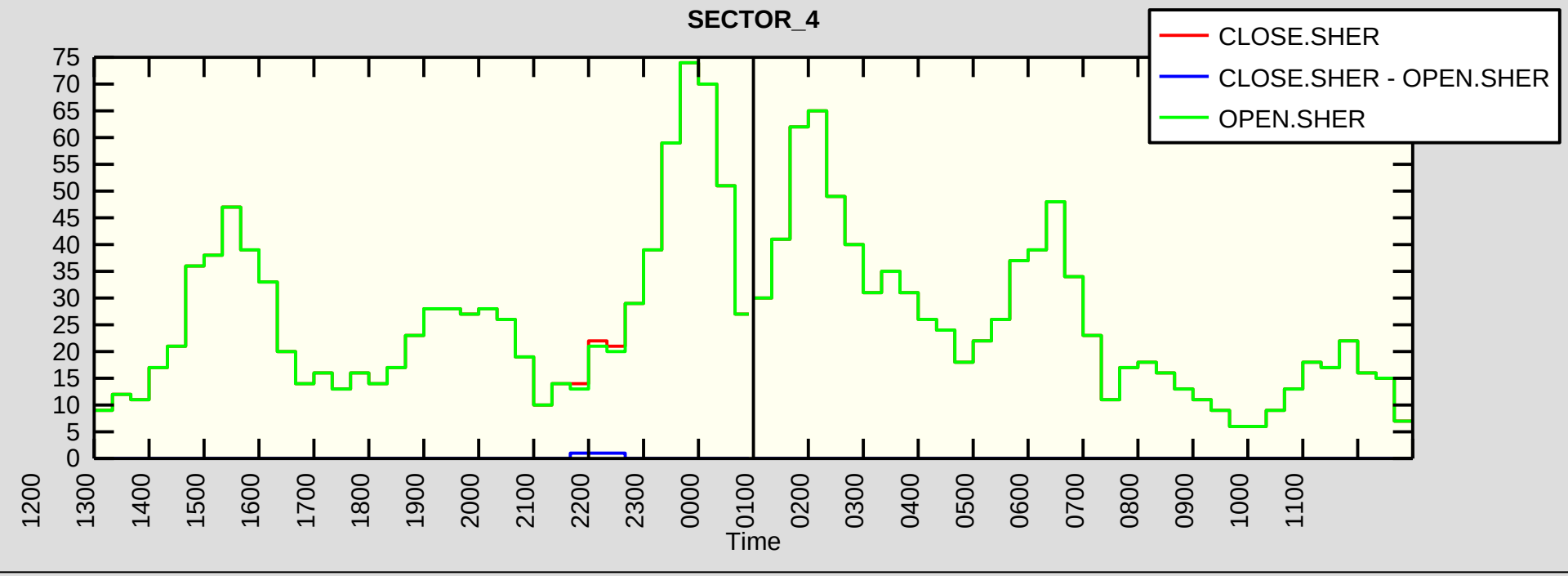
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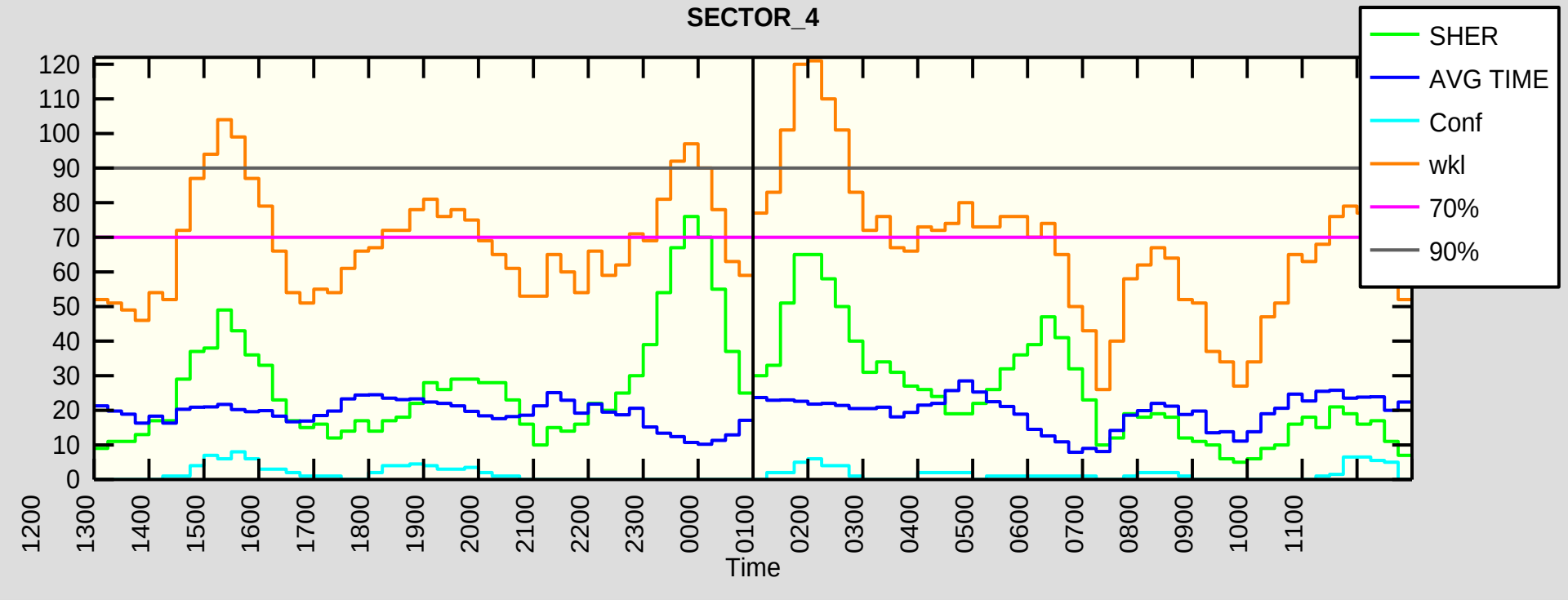
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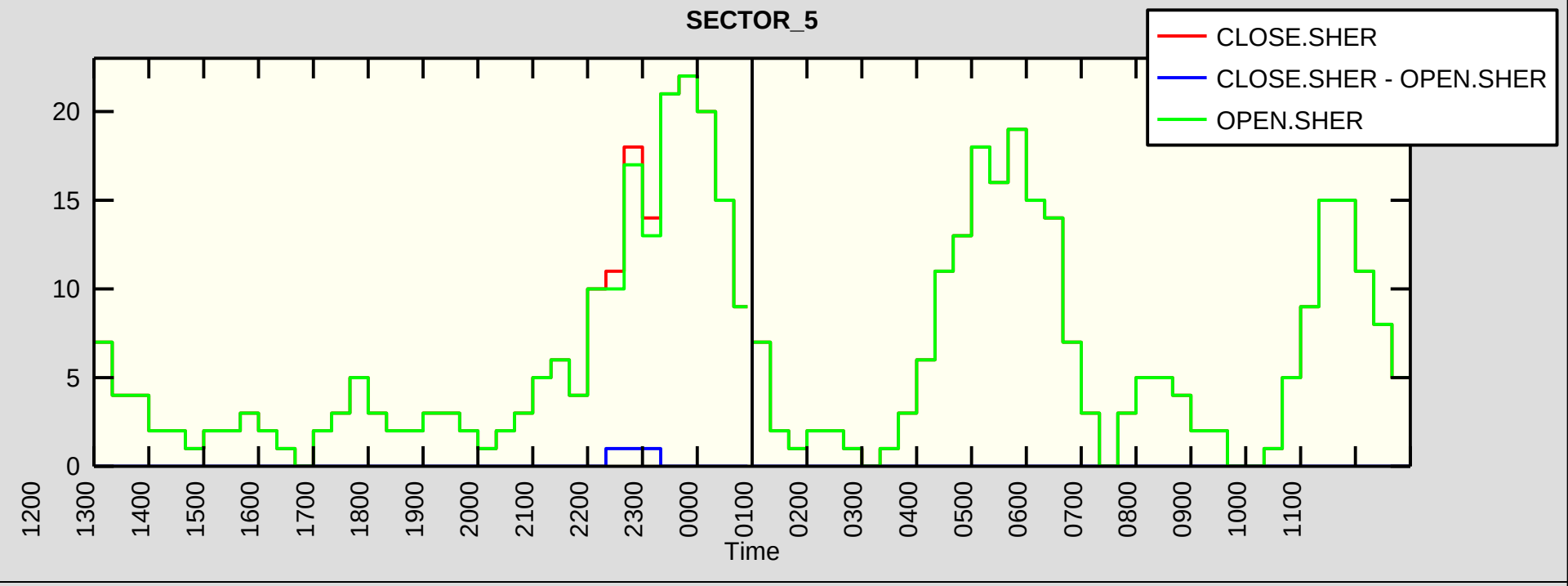
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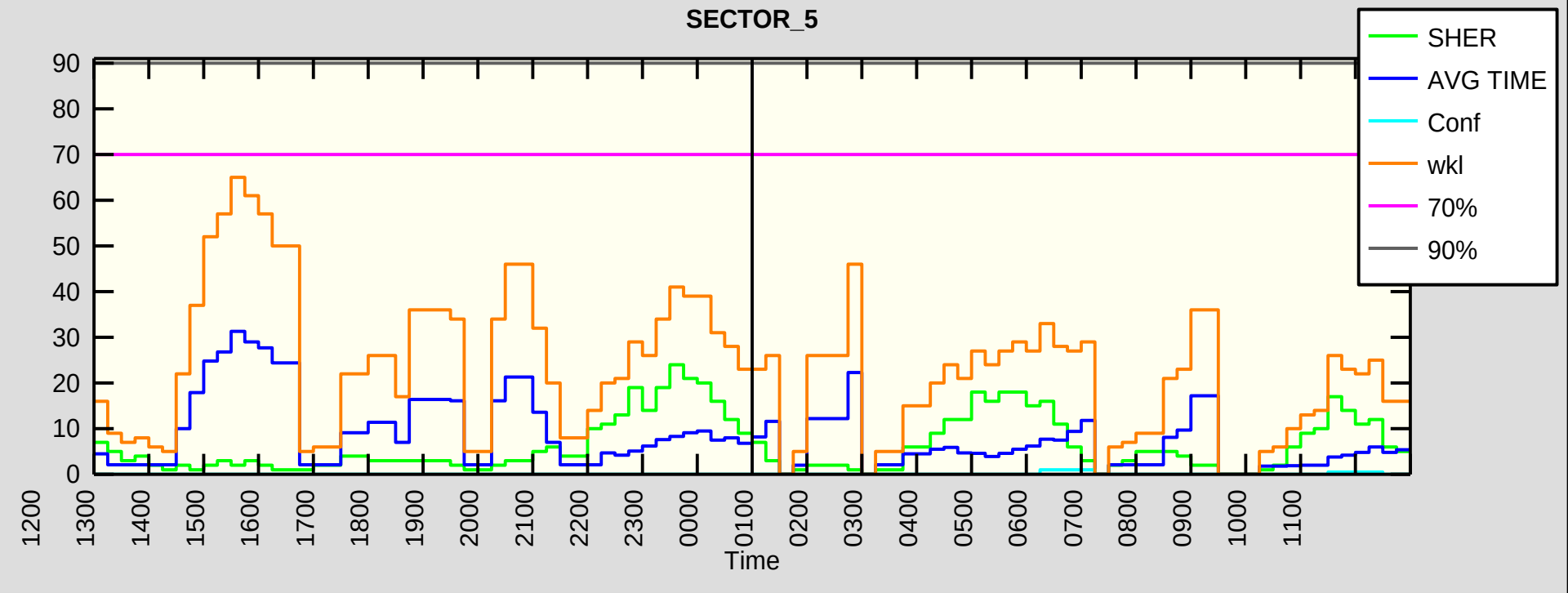
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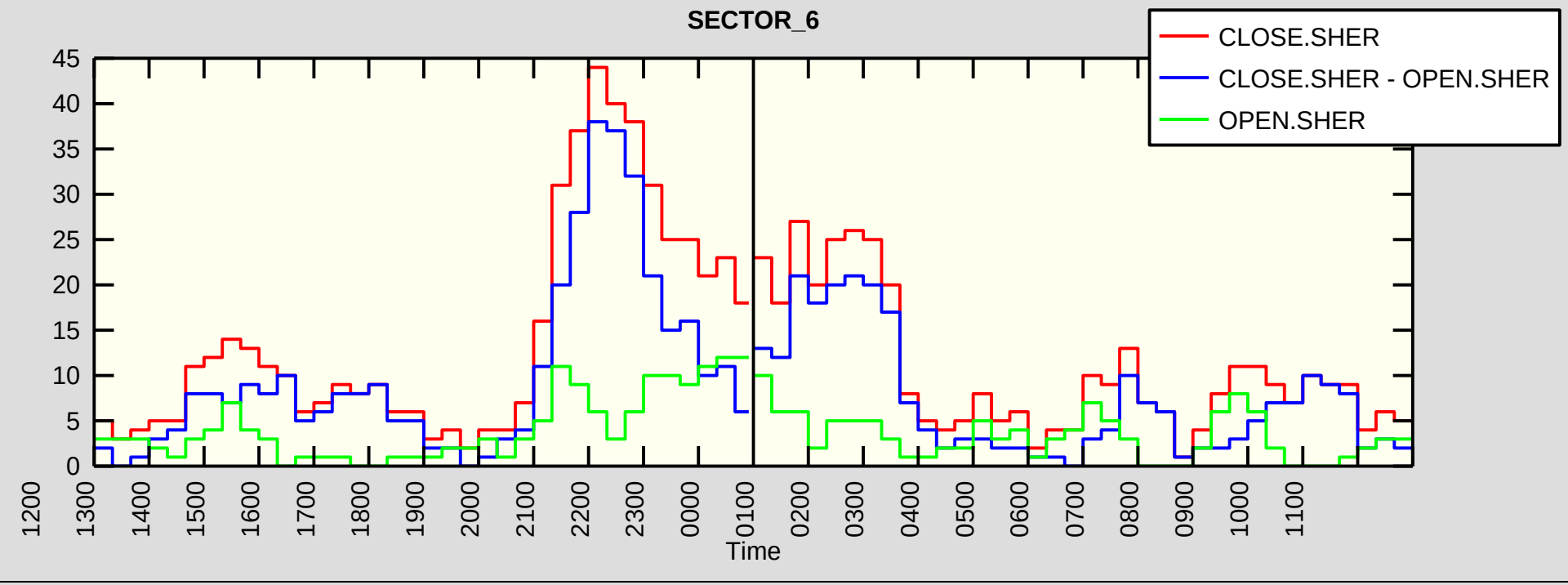
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CLOSE.SHER - OPEN.SHER
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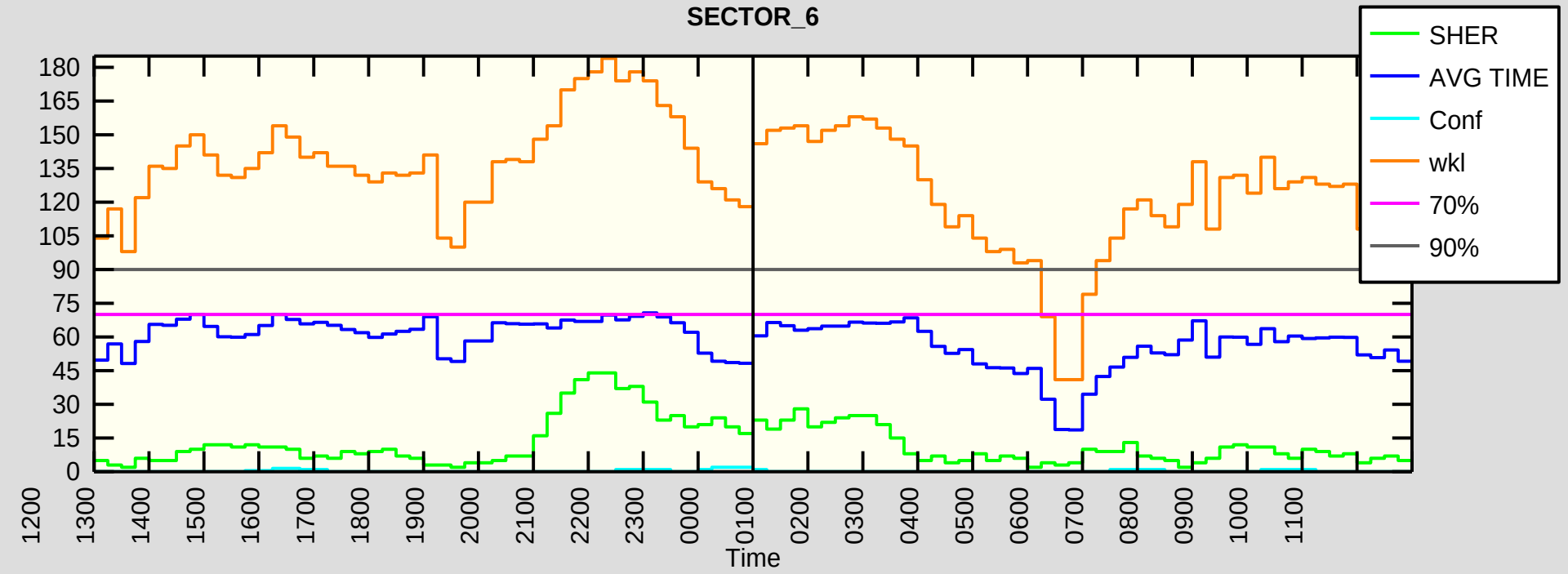
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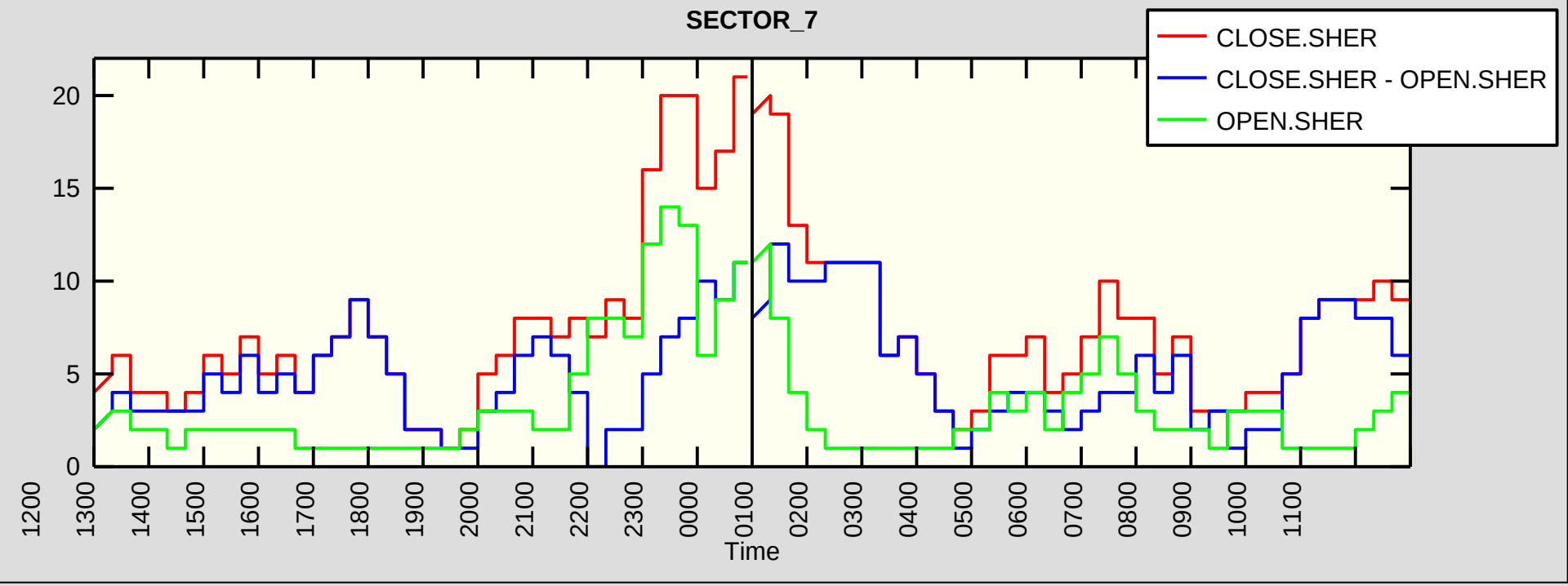
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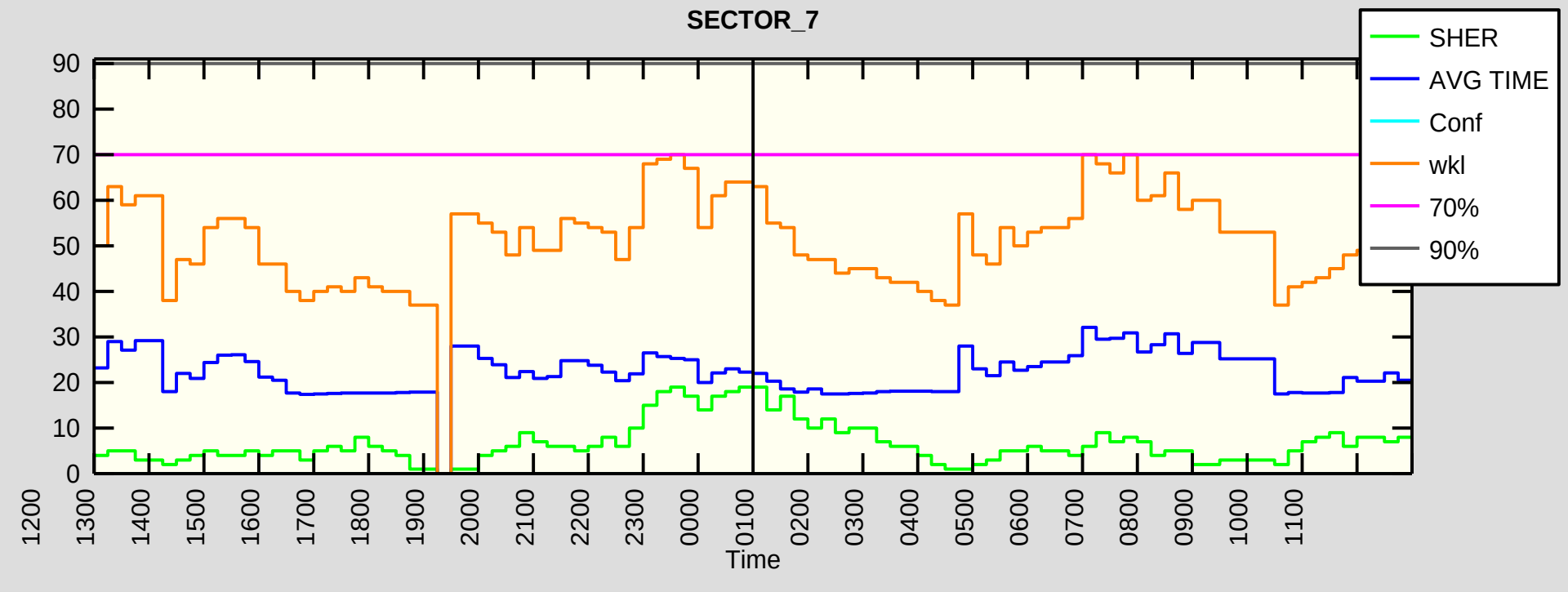
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Pakistan - Karachi ACC / Lahore ACC

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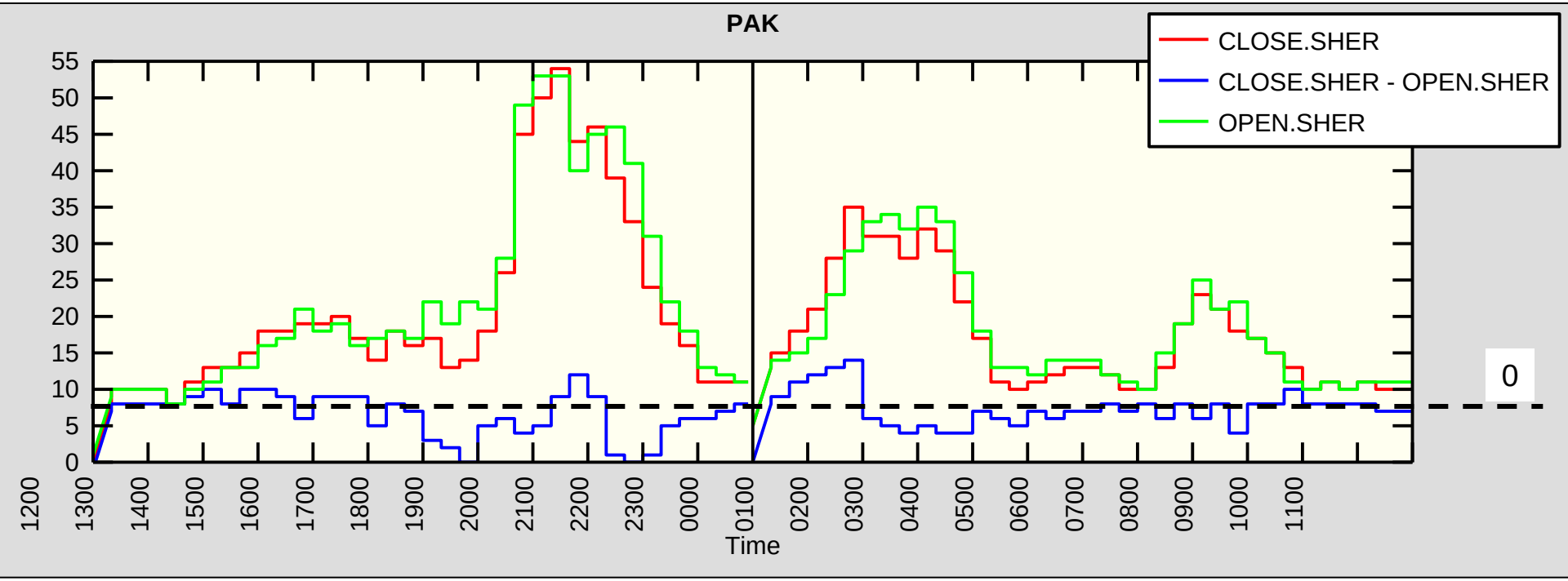
nominated by
the European Commission

Pakistan Total Traffic Load
Comparison AFG OPEN / CLOSE
24 APR 2015 FRI

EUROCONTROL



	AFG OPEN				AFG CLOSE			
Sector	Number of flights	Average distance (NM)	Average time (min)	Maximum occupancy Count	Number of flights	Average distance (NM)	Average time (min)	Maximum occupancy Count
Pakistan	289	281.7	35.6	35	265	481.3	60.8	45

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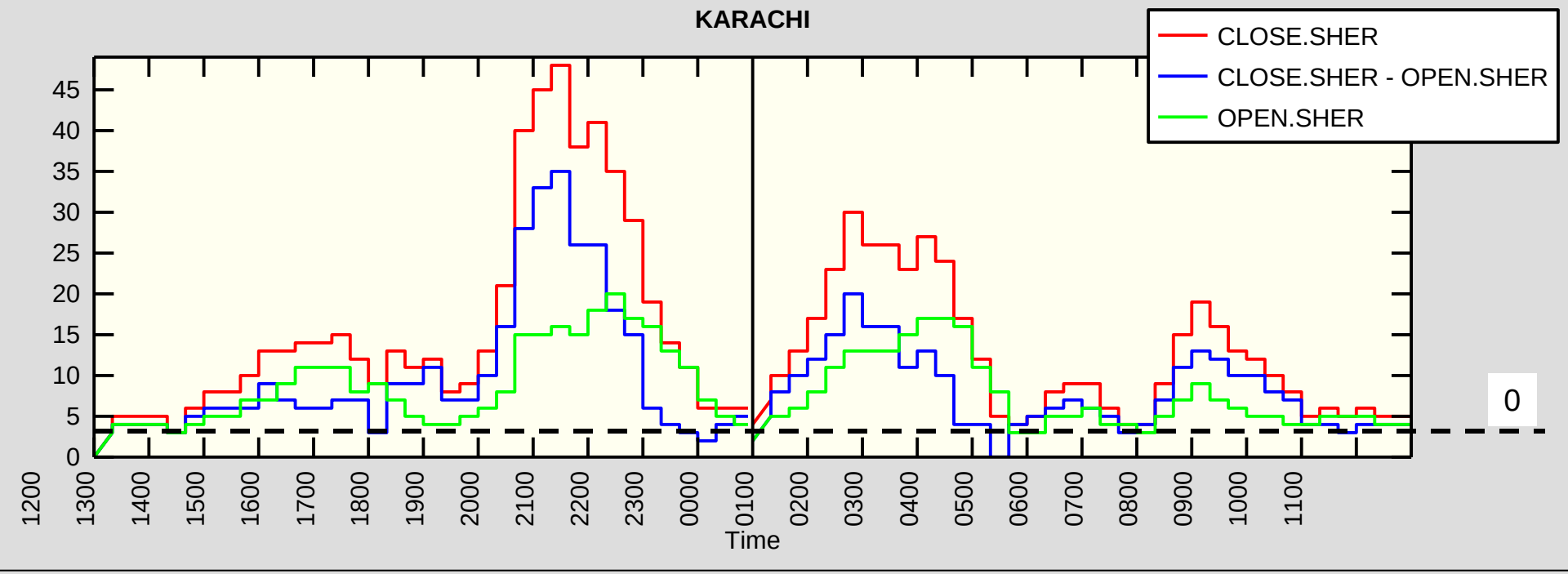
the European Commission

Karachi ACC / Lahore ACC Load Comparison AFG OPEN / CLOSE 24 APR 2015 FRI

EUROCONTROL

	AFG OPEN				AFG CLOSE			
Sector	Number of flights	Average distance (NM)	Average time (min)	Maximum occupancy Count	Number of flights	Average distance (NM)	Average time (min)	Maximum occupancy Count
Karachi ACC	122	243.5	30.8	13	265	470.8	59.3	44
Lahore ACC	213	242.7	30.7	25	9	308.8	43.8	2


KARACHI
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CLOSE.SHER - OPEN.SHER
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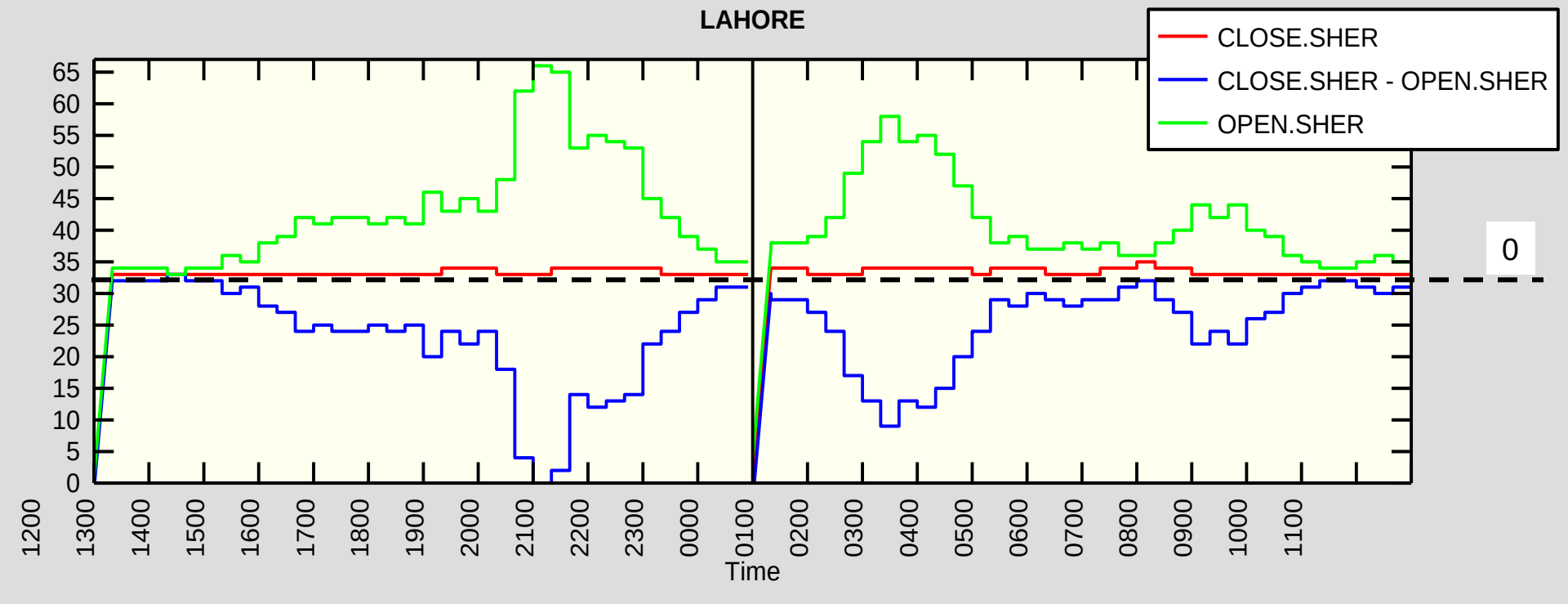
LAHORE
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CLOSE.SHER - OPEN.SHER
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India - Delhi ACC / Mumbai ACC

Network Manager
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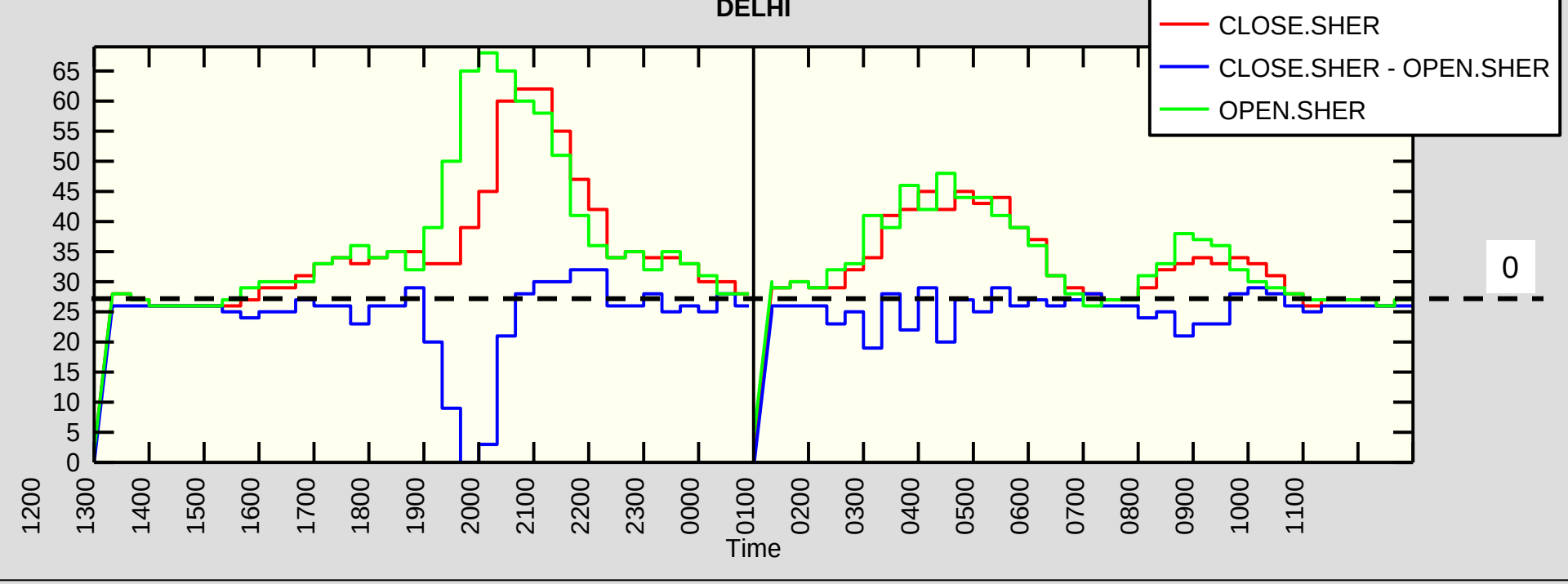
the European Commission

Delhi ACC / Mumbai ACC Load Comparison AFG OPEN / CLOSE 24 APR 2015 FRI

EUROCONTROL

	AFG OPEN				AFG CLOSE			
Sector	Number of flights	Average distance (NM)	Average time (min)	Maximum occupancy Count	Number of flights	Average distance (NM)	Average time (min)	Maximum occupancy Count
Delhi ACC	217	418.2	53.7	45	192	222.5	29.2	25
Mumbai ACC	180	338.5	43.8	23	211	547.8	69.7	50


DELHI
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CLOSE.SHER - OPEN.SHER
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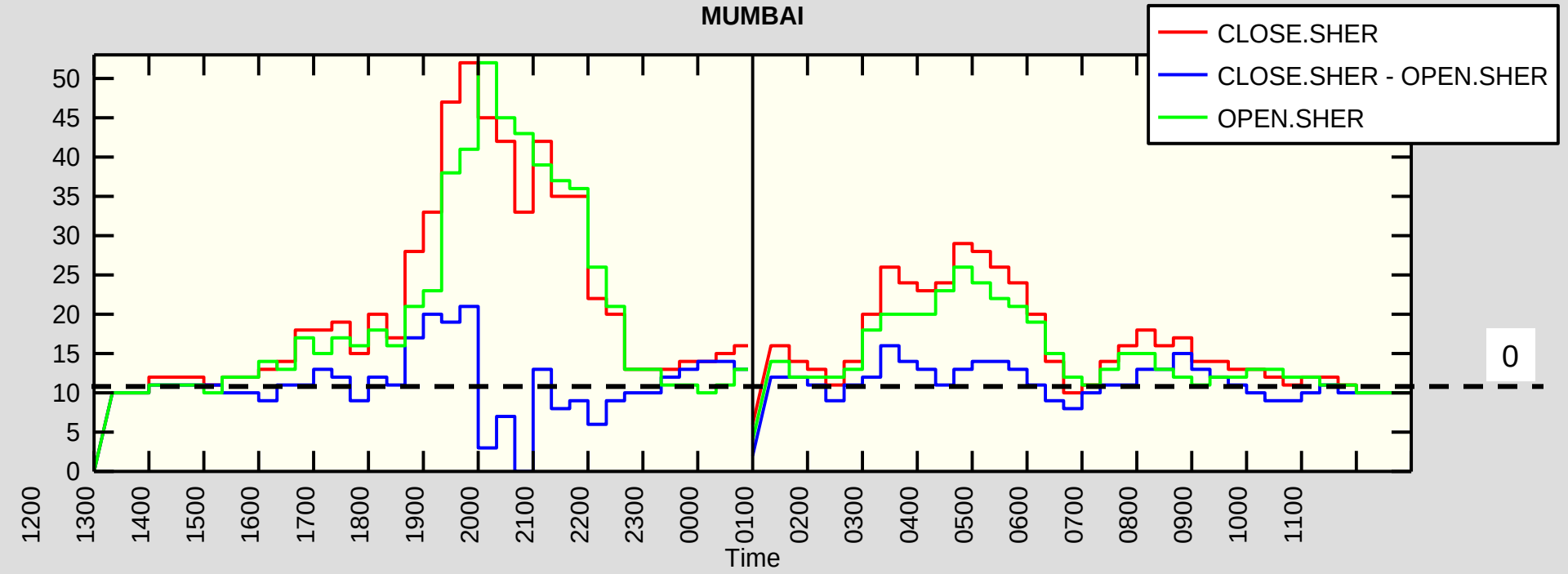
MUMBAI
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CLOSE.SHER - OPEN.SHER
OPEN.SHER
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Impact on on-loading areas - Findings

EUROCONTROL

Findings are based on EUROCONTROL Evaluation including ONLY flights operating via European (ECAC) Airspace. Other local area flights shall be also considered in final conclusions and decisions.

- Tehran FIR:
  - ✓ Might be concluded that established TOS works at sufficient level, redistributes traffic inside Tehran ACC and resolves congested area over ZDN.
  - ✓ Existing, as published, 7 ACC Sectors theoretically are not able to fulfil its purpose even in current circumstances as most of them are overloaded.
  - ✓ Opening of more ACC Sectors or re-shape of existing ones shall be considered.
  - ✓ Additional load of currently off-loaded Eastern ACC Sectors are expected due to Kabul FIR unavailability.
- Interface Karachi FIR - Tehran FIR:
  - ✓ Significant increase of additional 207 flights compare to normal situation.
  - ✓ TCPs are loaded instantaneously during the night period.
  - ✓ ZDN merge inside Tehran FIR is resolved by existing TOS.
- Interface Delhi FIR / Mumbai FIR - Karachi FIR / Lahore FIR:
  - ✓ Similar number of flights but re-distribution from Lahore FIR to Karachi FIR is evident.
  - ✓ Re-distribution inside Indian FIRs is not significant except the swap of VIDP flights from GUGAL to TIGER.
- Interface Vientiane FIR - Kunming FIR:
  - ✓ Increase of 17 flight per day encountered with increase of around 3 flights per hour.

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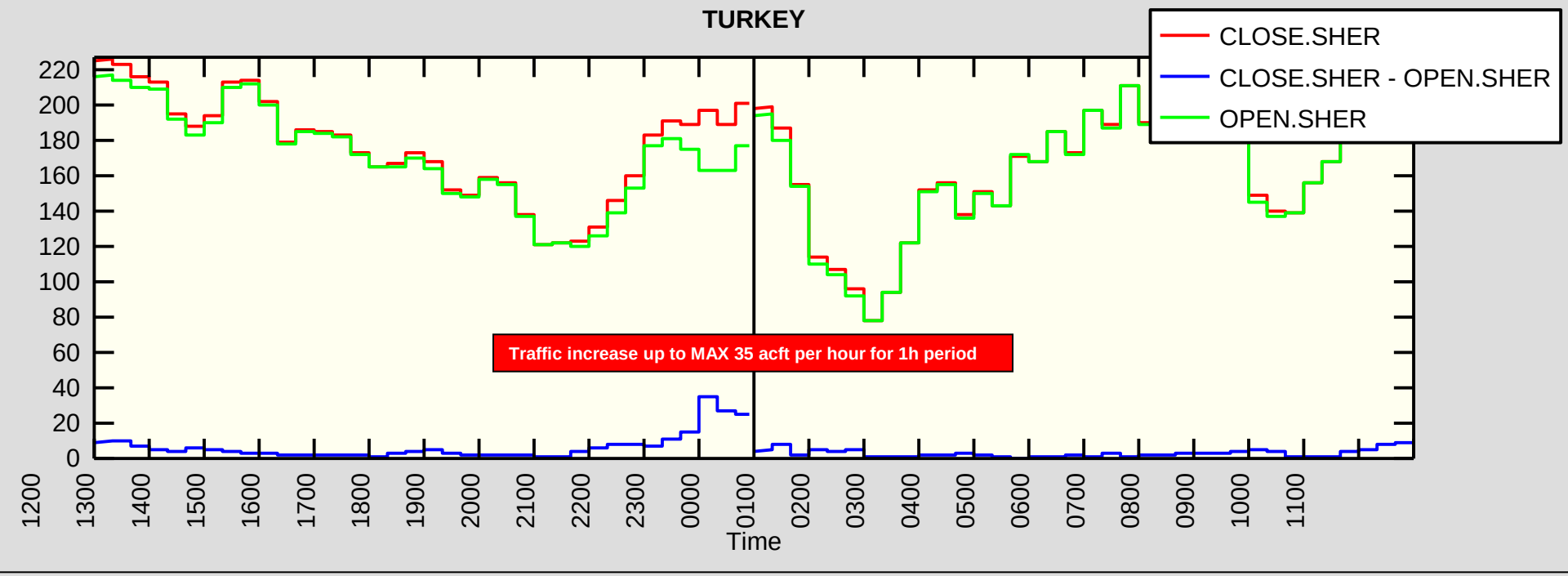
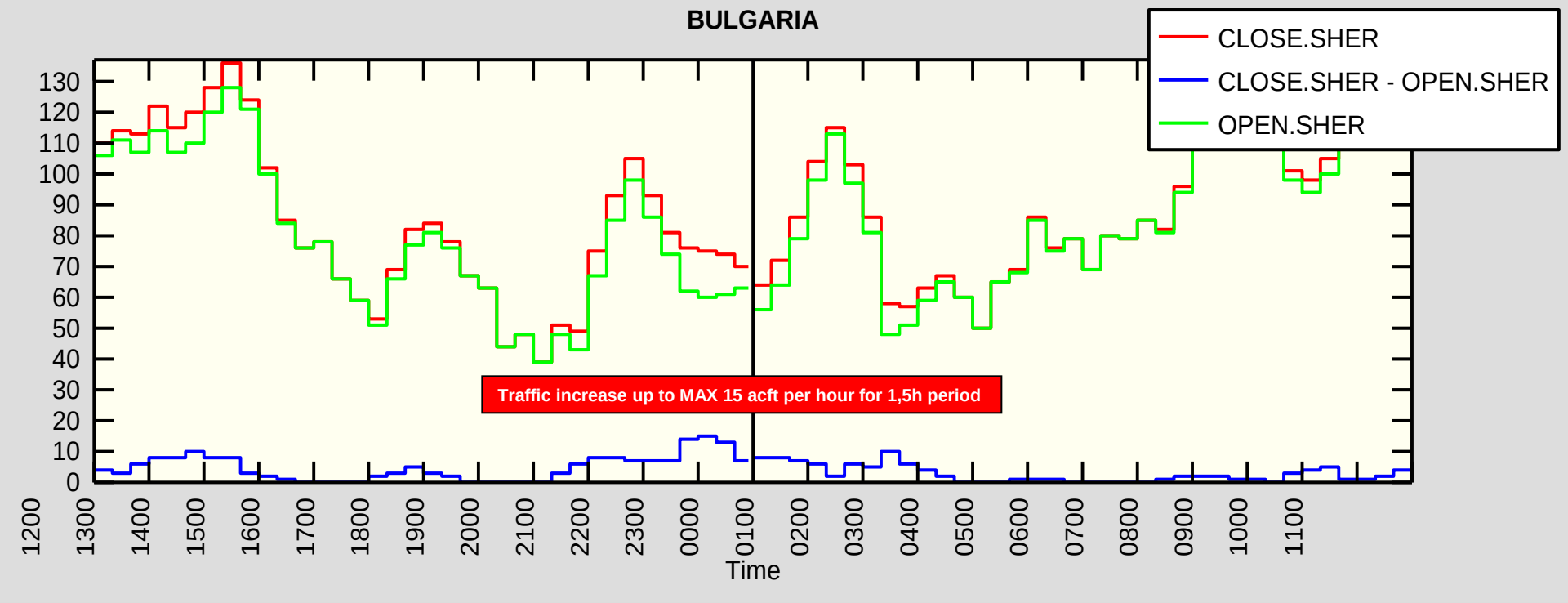
EUROCONTROL

ICAO EUR/NAT ACCs


TURKEY
CLOSE.SHER
CLOSE.SHER - OPEN.SHER
OPEN.SHER
Traffic increase up to MAX 35 acft per hour for 1h period
Time


BULGARIA
CLOSE.SHER
CLOSE.SHER - OPEN.SHER
OPEN.SHER
Traffic increase up to MAX 15 acft per hour for 1,5h period
Time

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Impact on EUR/NAT Region - Findings

EUROCONTROL

- In general no traffic increase inside EUR/NAT Region airspace except encountered re-distribution of more than 200 flights from North to South and further North.

- The main traffic concentration is on axis Ankara FIR - Sofia FIR - Bucuresti FIR and beyond where for all FIRs except Ankara FIR traffic increase might be expected.

- Reduction of flights via Caucasus Area (Yerevan FIR, Tbilisi FIR and Baku FIR).

- The most loaded TCPs are ALRAM / DASIS and ODERO / UDROS between Ankara FIR and respectively Tehran FIR and Sofia FIR. Airspace design discussion is still in progress to further improvement interface Ankara FIR / Sofia FIR / Bucuresti FIR.

- Prior information in case of unavailability of air navigation services within the Kabul FIR and traffic re-distribution inside EUR/NAT Region shall be properly communicated in order to assure necessary coordination inside the Region.

END