

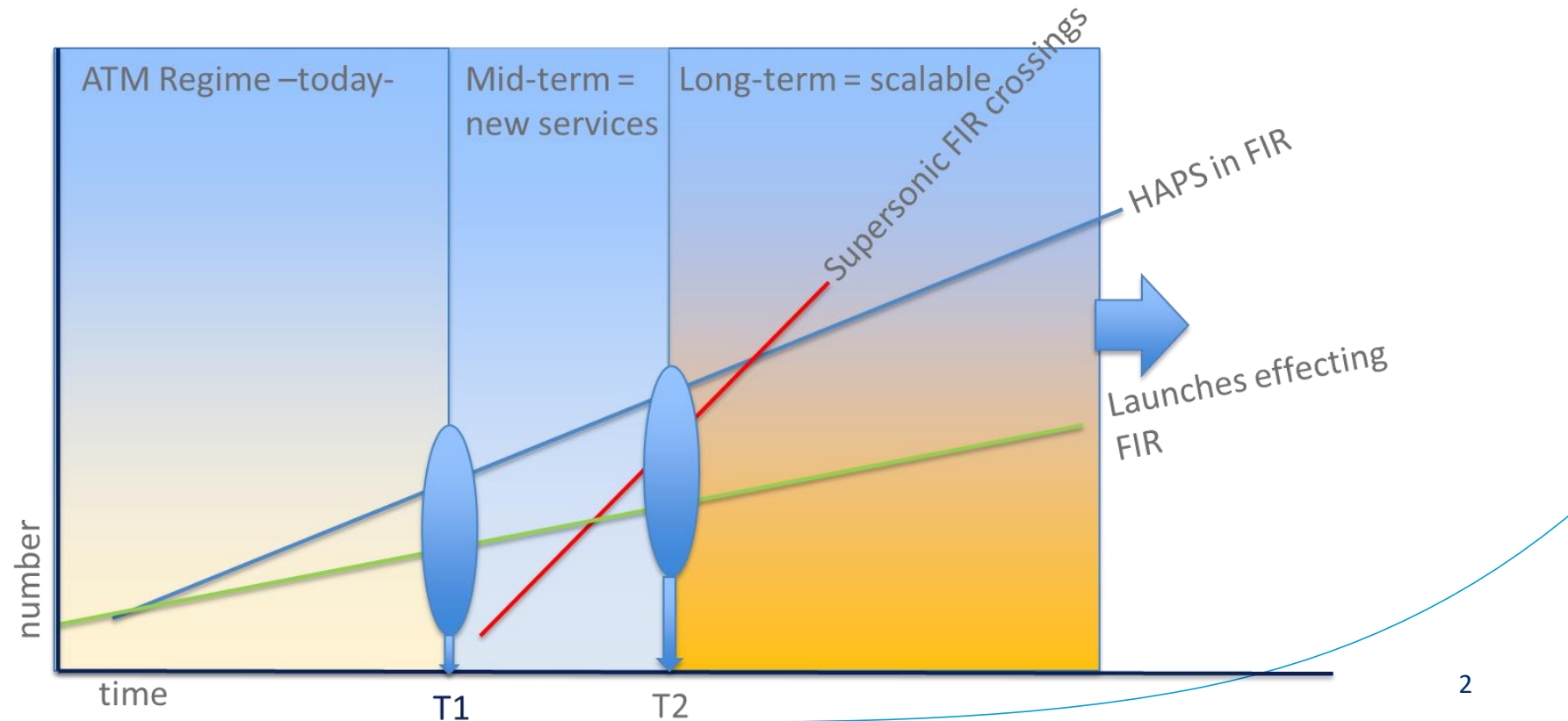
Workshop 2

ECHO Demand Scenarios

Sven Kaltenhäuser, Lorenz Losensky
European Concept for Higher Airspace Operations (ECHO)
Workshop 2, Brussels, 20 04 2022

Time as input or as output?

- T1: year from which new services for HAO are needed (start of mid term)
- T2: year from which additional new services are needed for scalable HAO (start of long term)

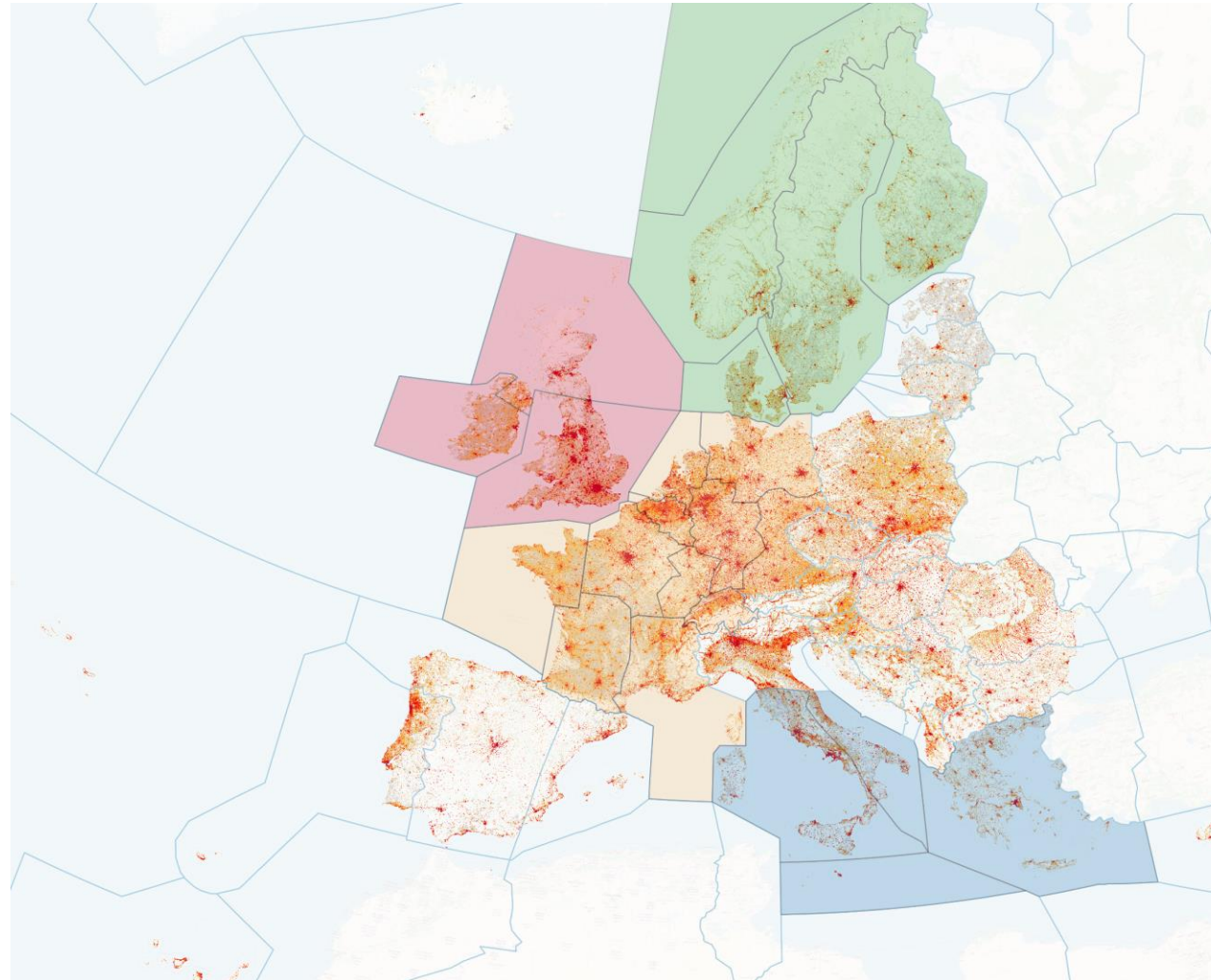


Scenario Overview

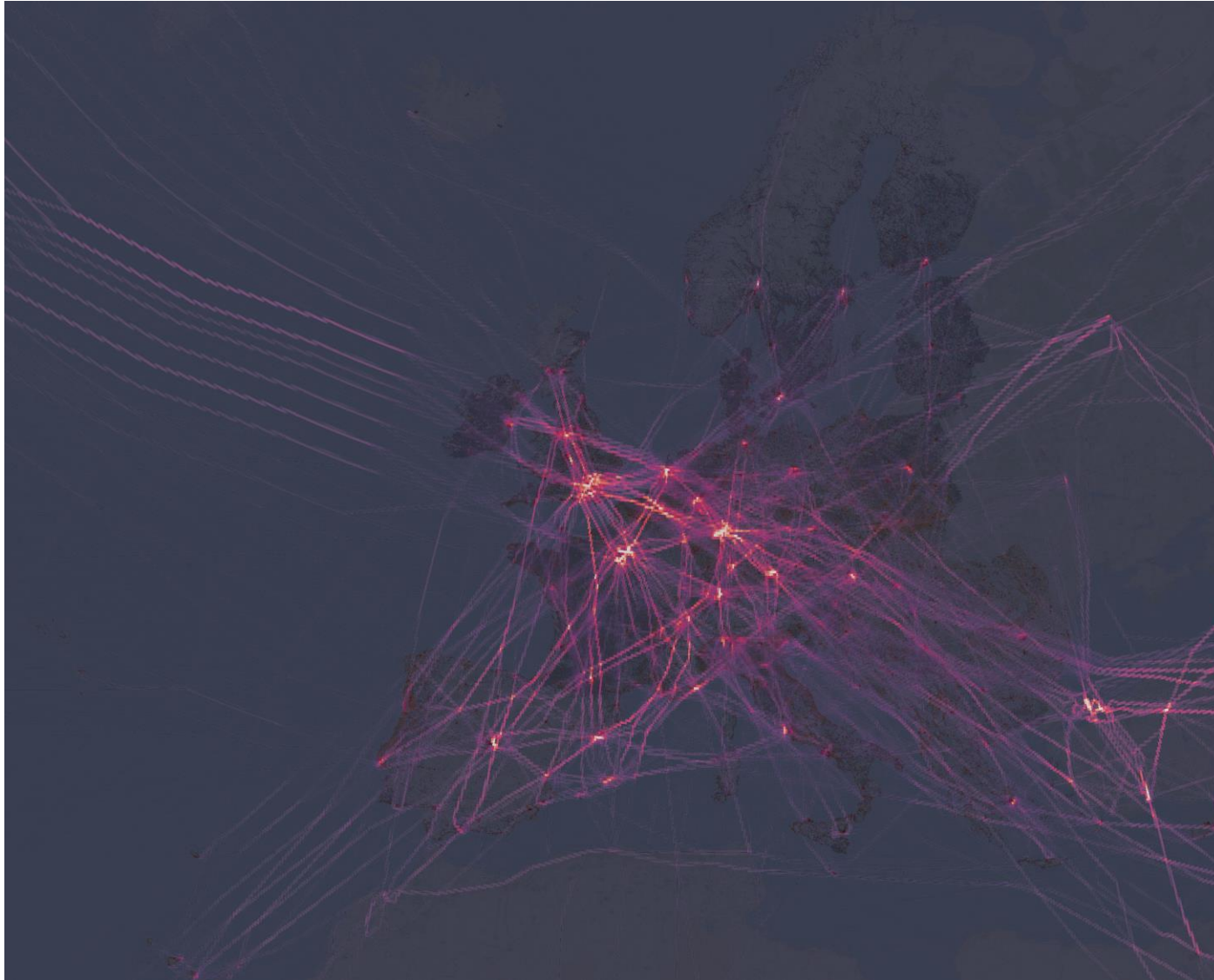
Qualitative Baseline Parameters

Regional Scenario	Population & Fragmentation	(Current) Air traffic density	Latitude
Scandinavia (≈DK-SE FAB & NEFAB)	<ul style="list-style-type: none"> Predominantly low fragmentation over sparsely populated areas 	low	high
UK-Ireland FAB	<ul style="list-style-type: none"> Significant maritime area Around 25% low fragmentation over sparsely populated areas, otherwise medium-high fragmentation over medium-densely populated areas 	high	middle/high
FABEC	<ul style="list-style-type: none"> High Fragmentation over medium to high densely populated areas 	high	middle
(East) Mediterranean (≈BLUE MED FAB)	<ul style="list-style-type: none"> >50% maritime area; Average fragmentation over medium densely populated areas 	medium	low/middle

European Area Population Density, Airspace Structure & Areas investigated



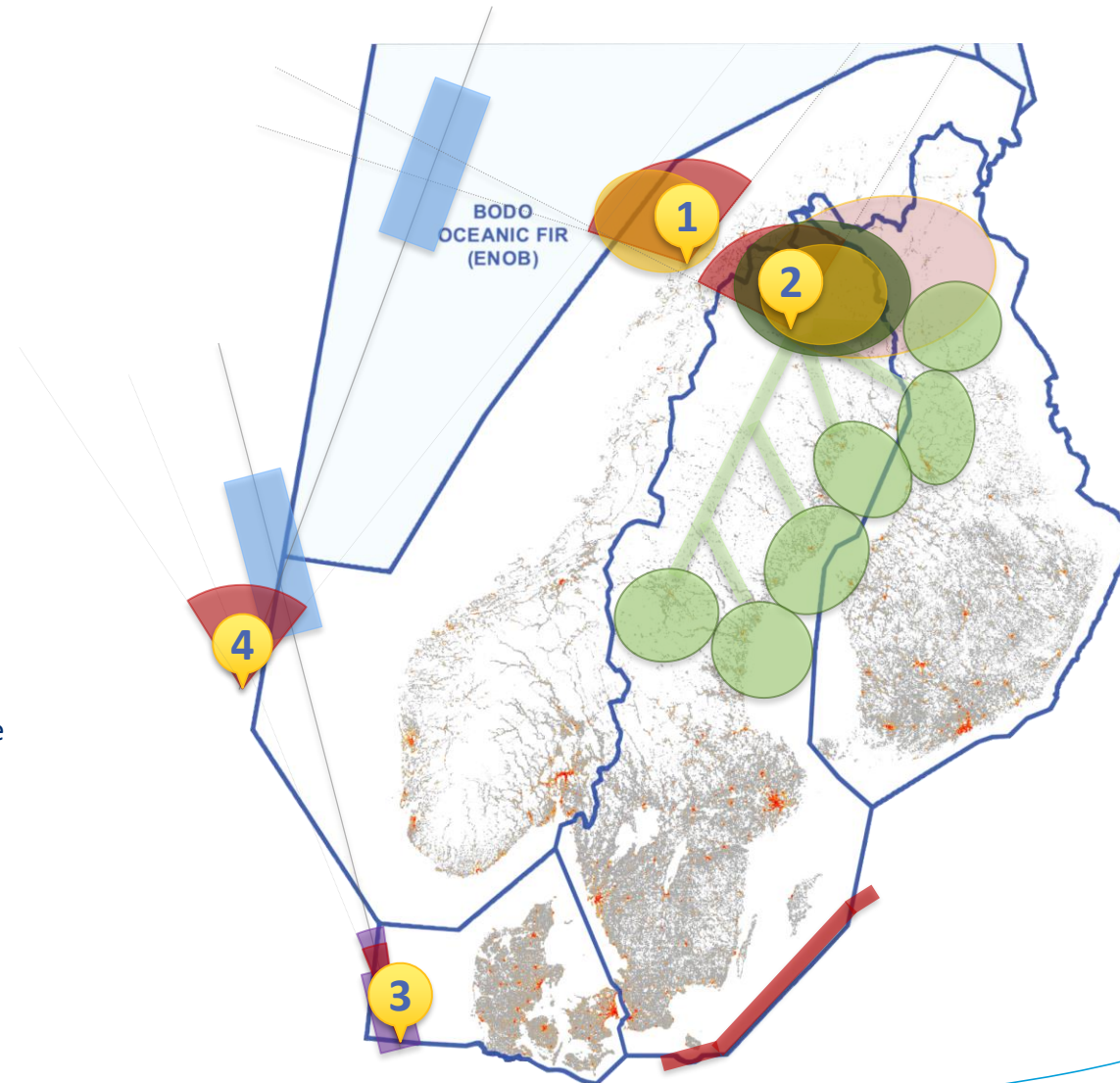
European Area Air Traffic Density (24 June 2019)



Scenario: Scandinavia I

Manageable with today's procedures and systems

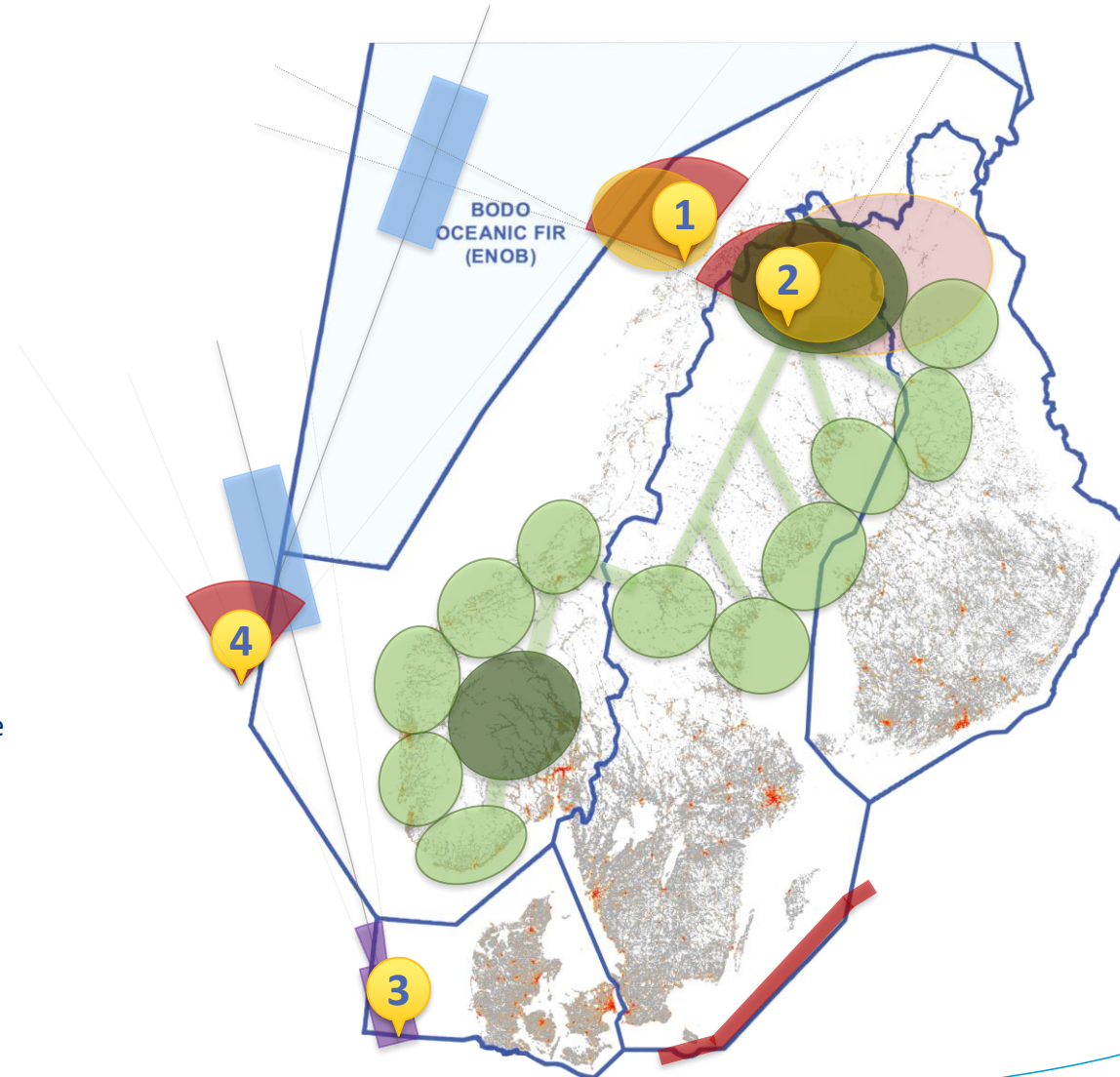
- 1 Andoya Space Center, NO
 - 2 Kiruna Esrange & Spaceport, SE
 - 3 "German Offshore Spaceport" & Air-launch area, DE
 - 4 SaxaVord Spaceport, UK
-
- Vertical rocket launch restricted area
 - Air-launch restricted area
 - Rocket stage drop zone
 - Sounding rocket operating zone
 - Balloon-HAPS operating zone
 - HAPS vertical operation / transition zone
 - HAPS transfer corridor
 - HAPS operating zone
 - Super-/Hypersonic crossing (S/H)
 - Military HALE UAS corridors



Scenario: Scandinavia II

Additional services needed

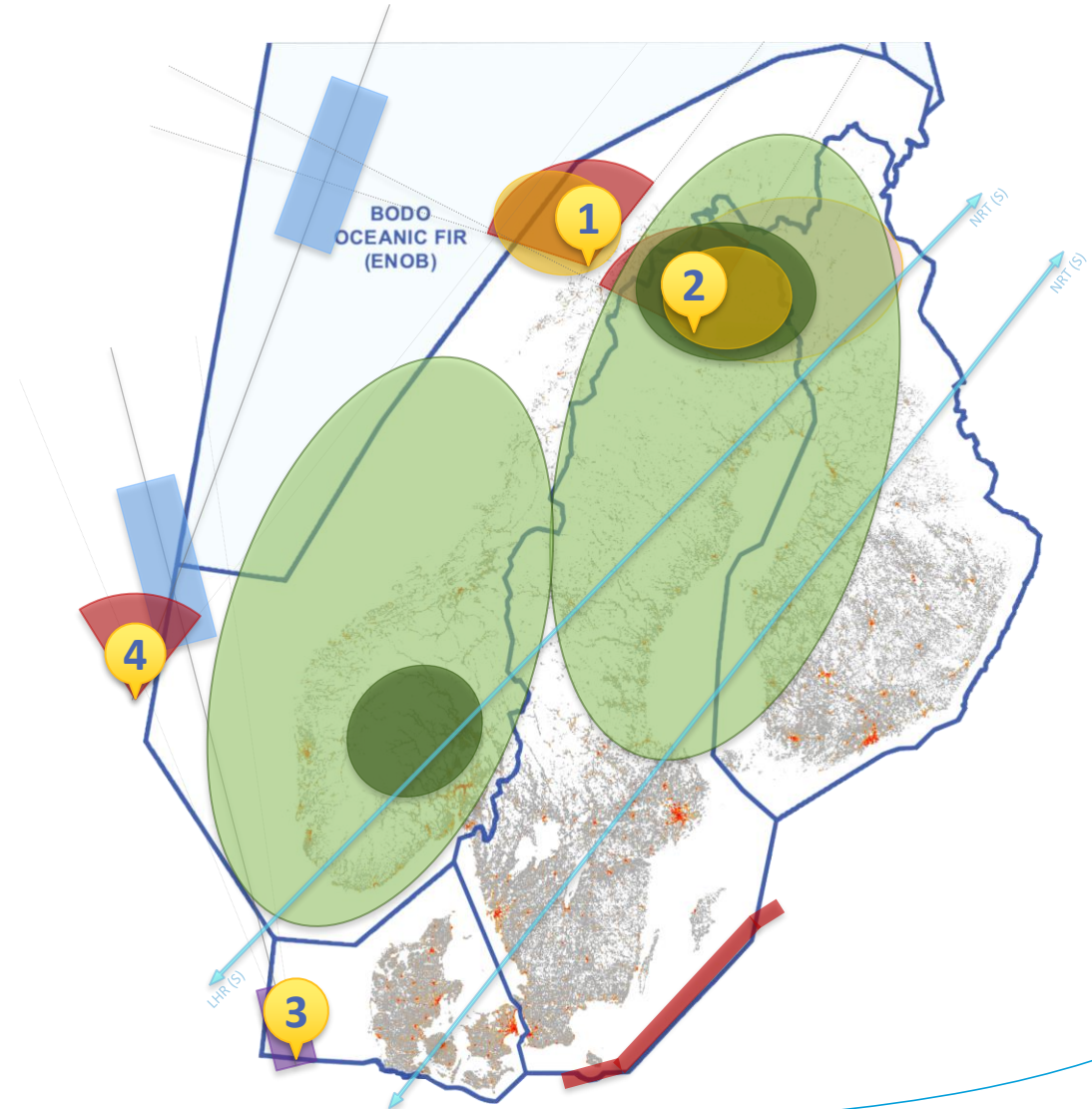
- 1 Andoya Space Center, NO
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 - HAPS transfer corridor
 - HAPS operating zone
 - Super-/Hypersonic crossing (S/H)
 - Military HALE UAS corridors



Scenario: Scandinavia III

Scalable approach covering enhanced demands

- 1 Andoya Space Center, NO
 - 2 Kiruna Esrange & Spaceport, SE
 - 3 "German Offshore Spaceport" & Air-launch area, DE
 - 4 SaxaVord Spaceport, UK
-
- Vertical rocket launch restricted area
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 - Sounding rocket operating zone
 - Balloon-HAPS operating zone
 - HAPS vertical operation / transition zone
 - HAPS transfer corridor
 - HAPS operating zone
 - Super-/Hypersonic crossing (S/H)
 - Military HALE UAS corridors



Part III: Vehicle / Fleet Operations

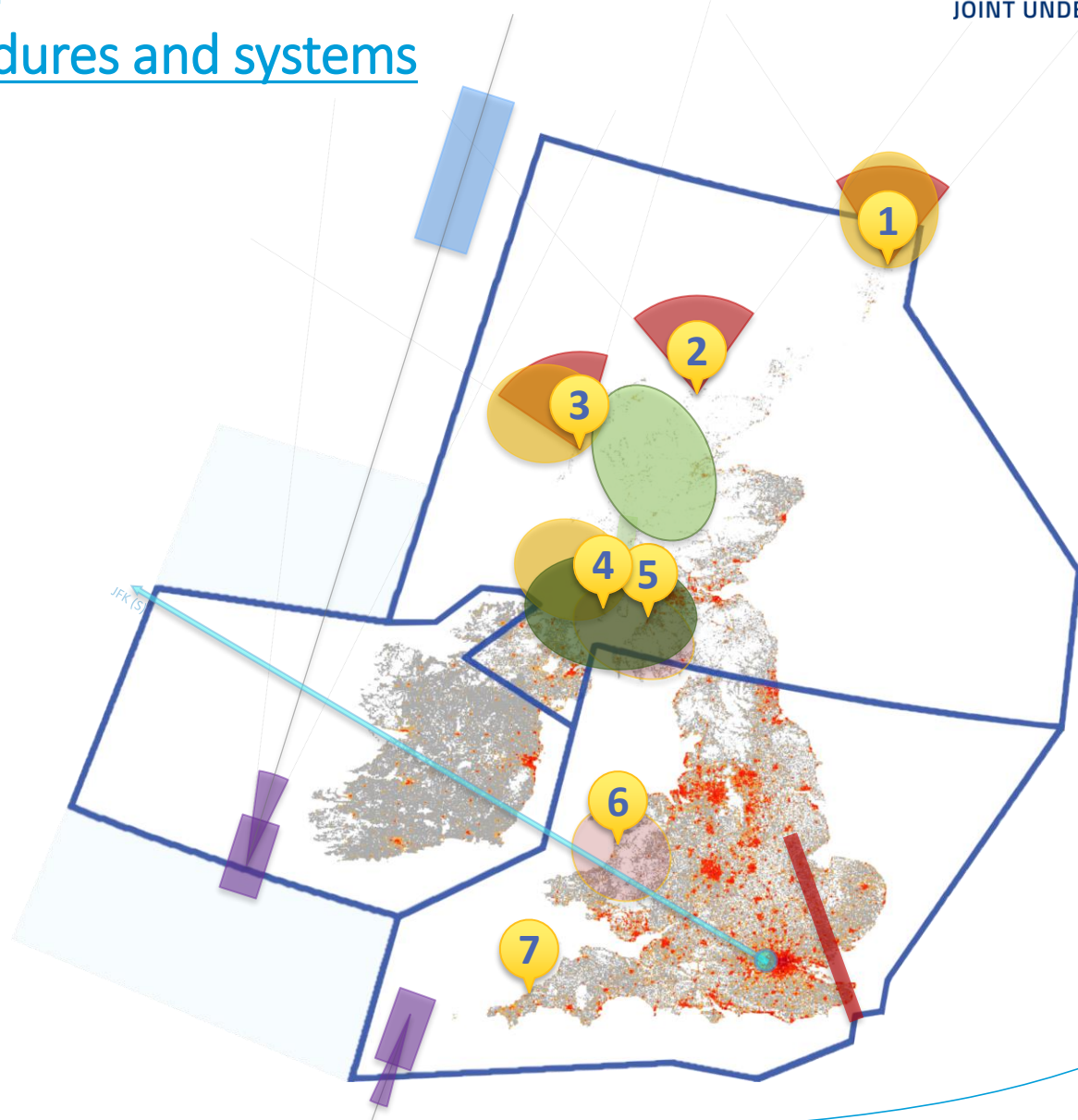
Polaris FIR, Koebenhavn FIR, Sweden FIR, Helsinki FIR

		Manageable with todays procedures and systems	Demand Scenario I	Additional services needed for...	Demand Scenario II	Scalable approach covering enhanced demands with...	Demand Scenario III
Frequency of hyper-/supersonic flights	Note: Crossings do not include originating or arriving flights	Supersonic airspace crossings: no constraint (e.g. LHR/CDG/AMS/FRA – NRT/PEK/PVG/HKG/SYD)	None	<u>Hypersonic overflights</u> > 30 km: Danger Areas needed (not ATC controllable)	None		Crossings: 4-6/1/day (S/H)
Business use of hyper-/supersonic flights	Note: Crossings do not include originating or arriving flights	Supersonic airspace crossings: no constraint	None	<u>Hypersonic overflights</u> > 30 km: Danger Areas needed (not ATC controllable)	None		Airspace crossings: 3-4/day (S) Departure/Arrival: 1-2/day (S)
Number of HAPS/ clusters FIR specific & operating area	Continuous operations taking place	1 HAPS per operating area	4-7 operating/day	<ul style="list-style-type: none"> > 1 HAPS per operating area <u>Transition / operation over denser populated areas</u> 	20-30 operating/day	<u>Transition / operation in unsegregated airspace</u>	25-50 operating/day
	Altitude Band	Segregated ascent/descent (0-18km)				<u>Unsegregated ascent/descent</u>	
	Size of operational volume	<ul style="list-style-type: none"> 50-150 NM (tbc) diameter at cone summit (18km) Large operational area > 300 km 				<u>No segregation needed</u>	
Launch/ descent frequency	Balloon-HAPS	1/day and launch site	12/y		12/y		12/y
	HAPS max. transitions per day	1 ascent & 1 descent per day and launch site (morning & evening)	2 transitions/day	> 1 simultaneous transition	3-4 transitions/day		3-4 transitions /day
Number/ type of space & sub-orbital launches/ re-entries	Sounding rockets	1/day and launch site	12-18/y		12-18/y		12-18/y
	(Other) Sub-orbital	1/day	None		3-4/y		8-12/y
	Orbital	1/day and launch site (Andoya, Kiruna & Shetland not simultaneously)	6/y		15-20/y		30-50/y

Scenario: UK & Ireland I

Manageable with today's procedures and systems

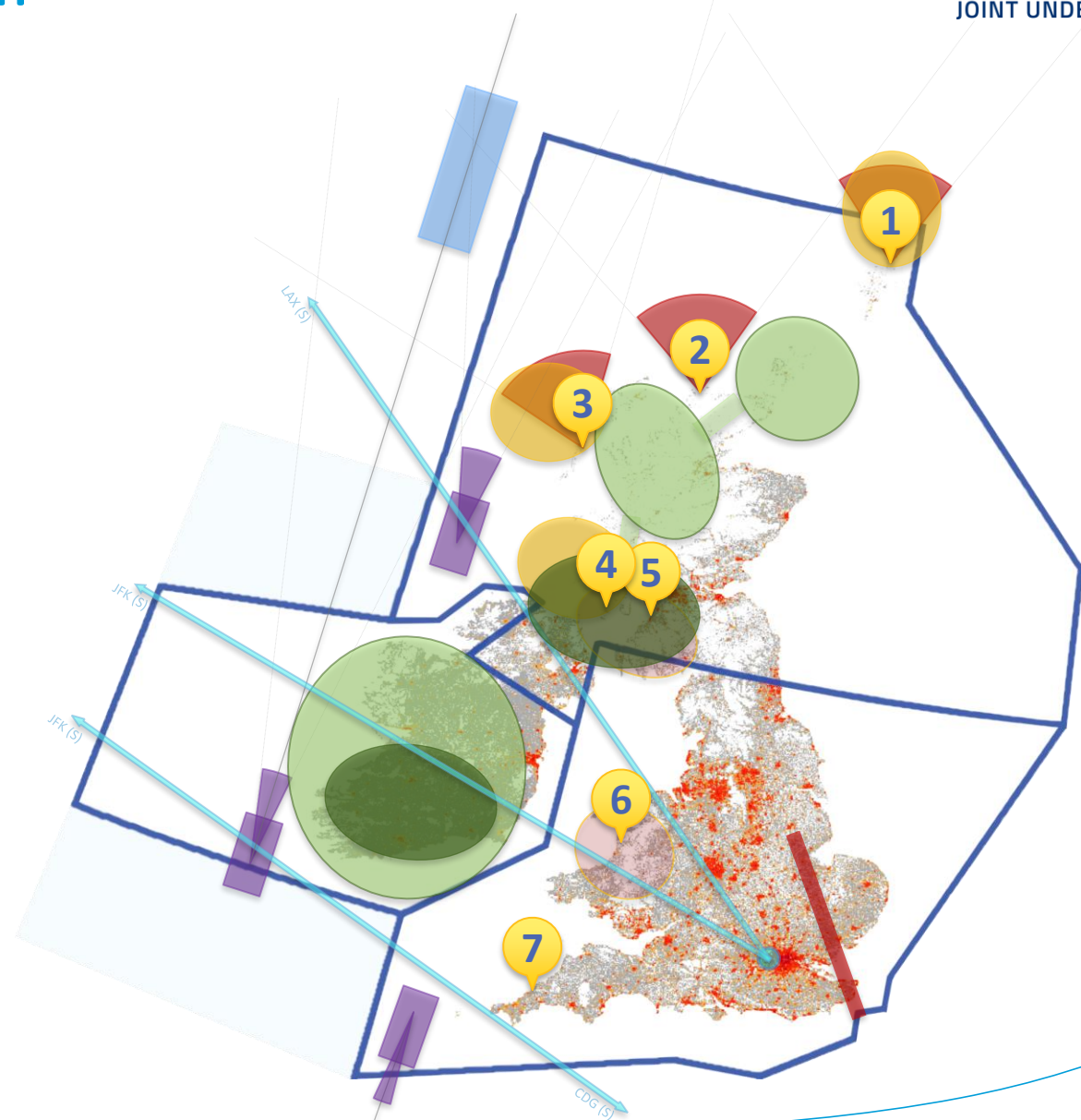
- 1 SaxaVord Spaceport
 - 2 Space Hub Sutherland
 - 3 Spaceport 1
 - 4 Spaceport Machrihanish
 - 5 Prestwick Spaceport
 - 6 Spaceport Snowdonia
 - 7 Spaceport Cornwall
-
- Vertical rocket launch restricted area
 - Air-launch restricted area
 - Rocket stage drop zone
 - Sounding rocket operating zone
 - Balloon-HAPS operating zone
 - HAPS vertical operation / transition zone
 - HAPS transfer zone
 - HAPS operating zone
 - Super-/Hypersonic operations (S/H)
 - Military HALE UAS corridors



Scenario: UK & Ireland II

Additional services needed

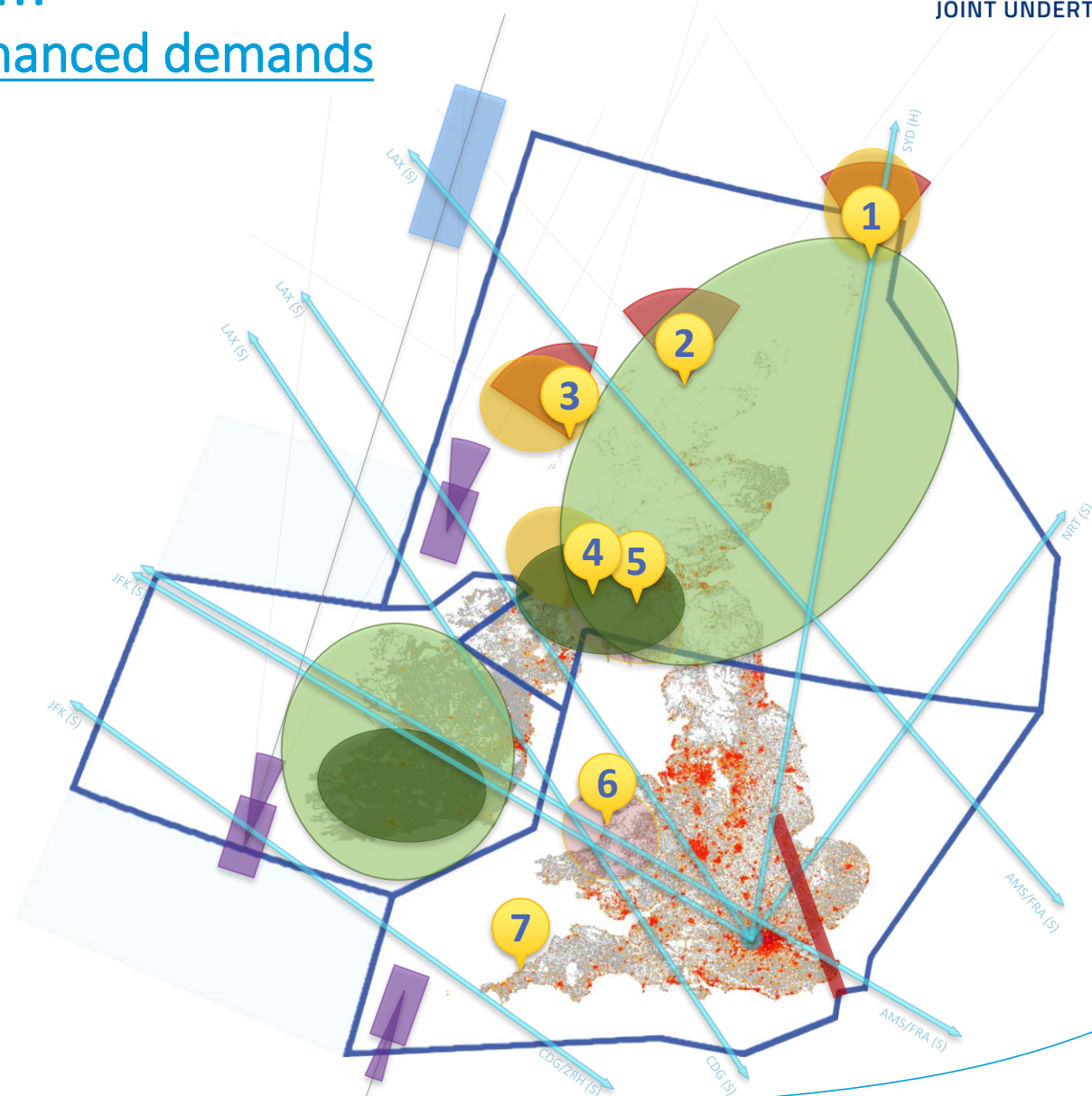
- 1 SaxaVord Spaceport
 - 2 Space Hub Sutherland
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 - 4 Spaceport Machrihanish
 - 5 Prestwick Spaceport
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 - HAPS transfer zone
 - HAPS operating zone
 - Super-/Hypersonic operations (S/H)
 - Military HALE UAS corridors



Scenario: UK & Ireland III

Scalable approach covering enhanced demands

- 1 SaxaVord Spaceport
 - 2 Space Hub Sutherland
 - 3 Spaceport 1
 - 4 Spaceport Machrihanish
 - 5 Prestwick Spaceport
 - 6 Spaceport Snowdonia
 - 7 Spaceport Cornwall
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 - HAPS operating zone
 - Super-/Hypersonic operations (S/H)
 - Military HALE UAS corridors



Part III: Vehicle / Fleet Operations

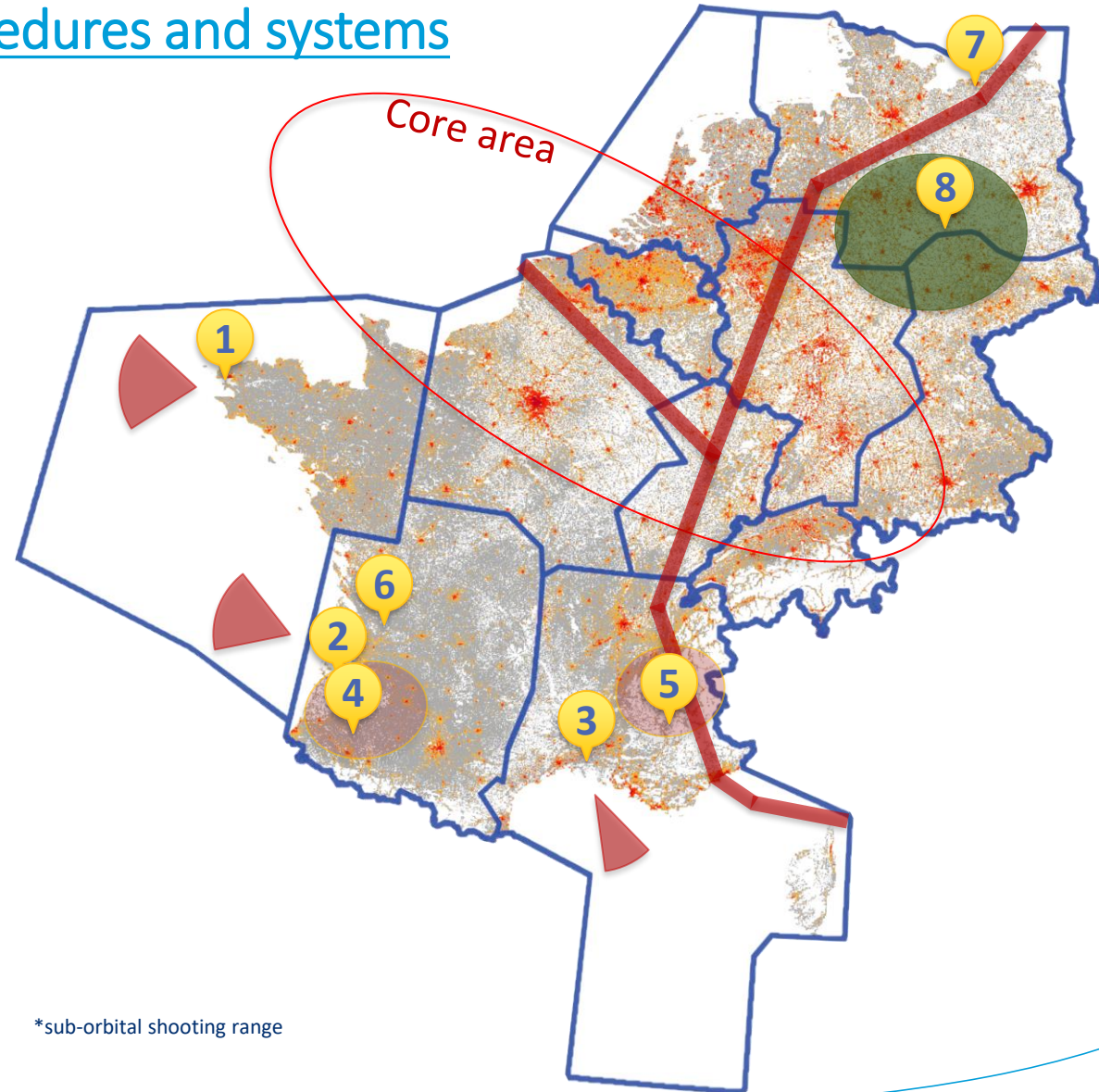
Shannon FIR, London FIR, Scottish FIR

	Manageable with todays procedures and systems	Demand Scenario I	Additional services needed for...	Demand Scenario II	Scalable approach covering enhanced demands with...	Demand Scenario III
Frequency of hyper-/supersonic flights	Note: Crossings do not include originating or arriving flights Supersonic airspace crossings: no constraint (e.g. CDG/AMS/FRA – JFK/SFO/LAX) Supersonic departure/arrival (LHR): minor constraints	Departure/ Arrival: 1-2/day (S)	Hypersonic overflights > 30 km: Danger Areas needed (not ATC controllable)	Crossings: 6-8/day (S) Departure/Arrival: 2-3/day (S)		Crossings: 16-24/day (S) Departure/ Arrival: 4-8/0-1/day (S/H)
Business use of hyper-/supersonic flights	Note: Crossings do not include originating or arriving flights Supersonic airspace crossings: no constraint Supersonic departure/arrival other airport than LHR/LGW: no constraints	None	Hypersonic overflights > 30 km: Danger Areas needed (not ATC controllable)	Airspace crossings: 2-3/day (S) Departure/Arrival: 2-3/day (S)		Airspace crossings: 8-12/day Departure/ Arrival: 4-6/day
Number of HAPS/ clusters FIR specific & operating area	Continuous operations taking place	1 HAPS per operating area	1-2 operating/ day	<ul style="list-style-type: none"> > 1 HAPS per operating area Transition / operation over denser populated areas 	10-20 operating/day	Transition/operation in unsegregated airspace
	Altitude Band	Segregated ascent/descent (0-18km)			Unsegregated ascent/descent	
	Size of operational volume	<ul style="list-style-type: none"> 50-150 NM (tbc) diameter at cone summit (18km) Large operational area > 300 km 			No segregation needed	
Launch/ descent frequency	Balloon-HAPS	1/day and launch site	None	0-6/y		0-6/y
	HAPS max. transitions per day	1 ascent & 1 descent per day and launch site (morning & evening)	1 transition/ day	> 1 simultaneous transition	1-2 transition/day	2 transitions/day
Number/ type of space & sub-orbital launches/ re-entries	Sounding rockets	1/day and launch site	12-18/y	12-18/y		12-18/y
	(Other) Sub-orbital	1/day	2-4/y	12/y		25-30/y
	Orbital	1/day and launch site	4-8/y	20-25/y		40-60/y

Scenario: FABEC / Core Area I

Manageable with today's procedures and systems

- 1 Brest (mil), FR
 - 2 Cazaux (test, civ/mil), FR
 - 3 Istres (FI test, civ/mil), FR
 - 4 Aire-sur-Adour (CNES), FR
 - 5 Gap (CNES), FR
 - 6 Bordeaux (bal), FR
 - 7 Rostock Laage "Spaceport", DE
 - 8 Cochstedt (DLR), DE
-  Vertical rocket launch restricted area*
 -  Air-launch restricted area
 -  Re-entry module corridor
 -  Sounding rocket operating zone
 -  Balloon-HAPS operating zone
 -  HAPS vertical operation / transition zone
 -  HAPS operating zone
 -  Super-/Hypersonic operations (S/H)
 -  Military HALE UAS corridors

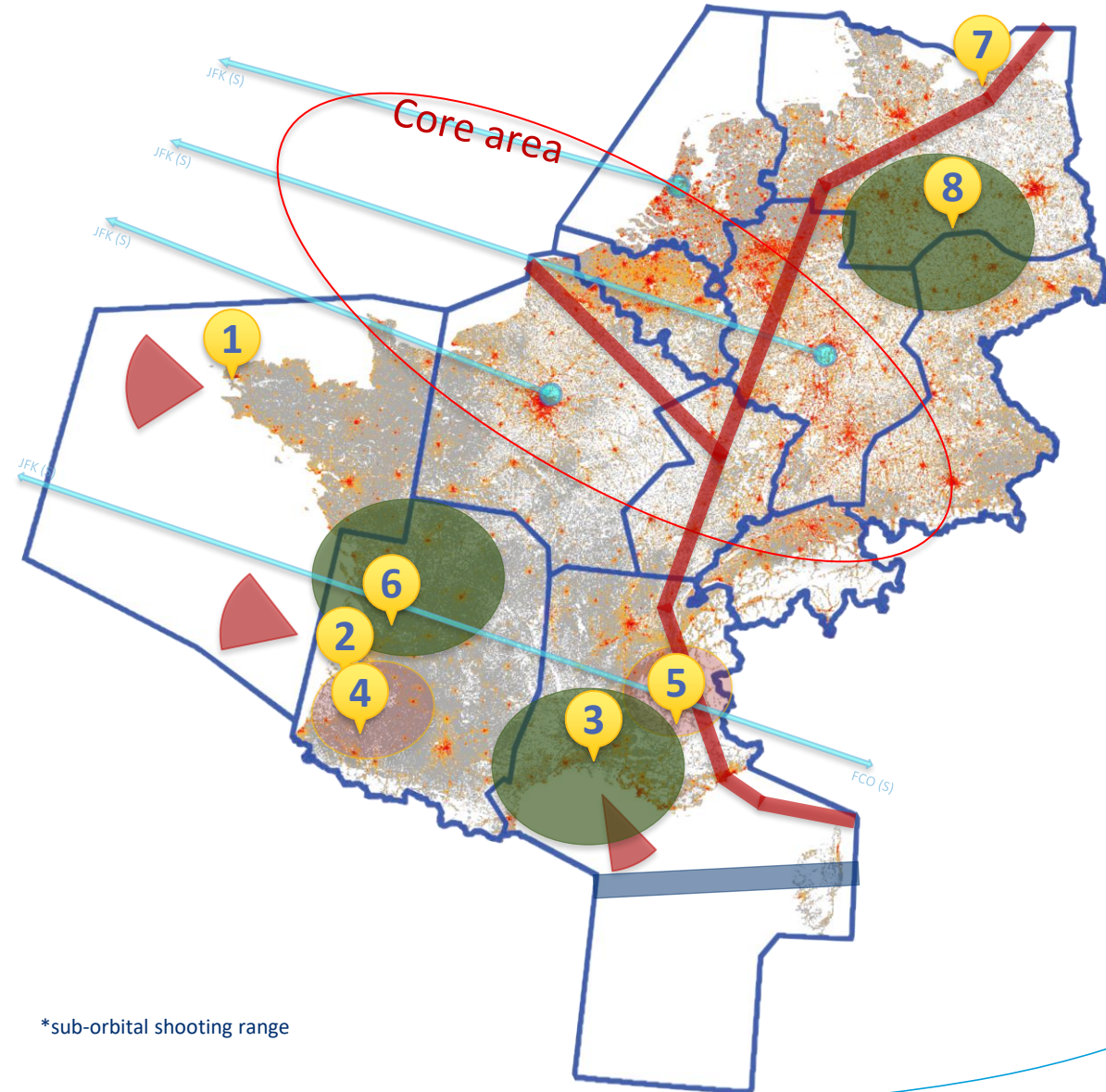


*sub-orbital shooting range

Scenario: FABEC / Core Area II

Additional services needed

- 1 Brest (mil), FR
 - 2 Cazaux (test, civ/mil), FR
 - 3 Istres (FI test, civ/mil), FR
 - 4 Aire-sur-Adour (CNES), FR
 - 5 Gap (CNES), FR
 - 6 Bordeaux (bal), FR
 - 7 Rostock Laage "Spaceport", DE
 - 8 Cochstedt (DLR), DE
-  Vertical rocket launch restricted area*
 -  Air-launch restricted area
 -  Re-entry module corridor
 -  Sounding rocket operating zone
 -  Balloon-HAPS operating zone
 -  HAPS vertical operation / transition zone
 -  HAPS operating zone
 -  Super-/Hypersonic operations (S/H)
 -  Military HALE UAS corridors

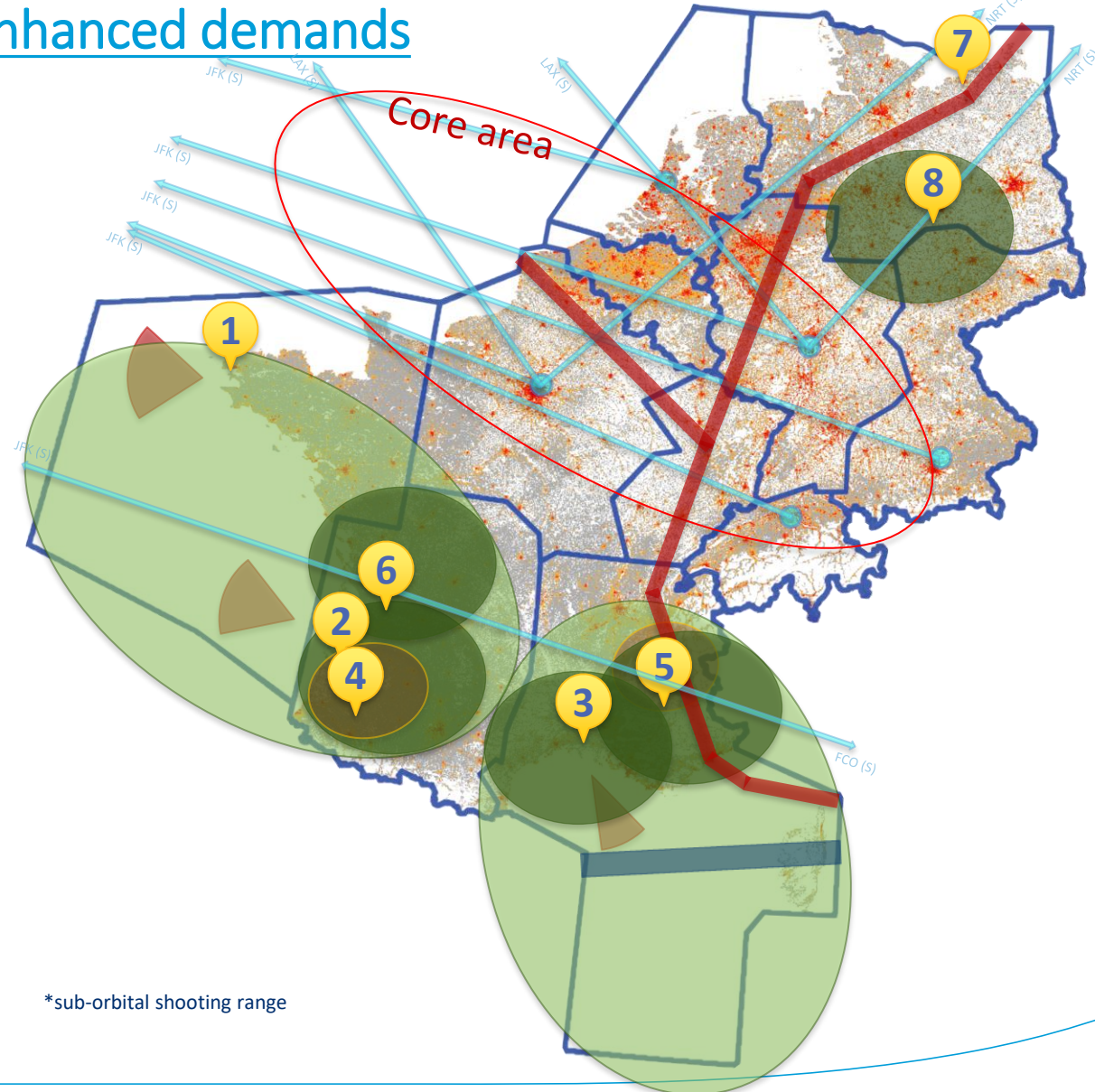


*sub-orbital shooting range

Scenario: FABEC / Core Area III

Scalable approach covering enhanced demands

- 1 Brest (mil), FR
 - 2 Cazaux (test, civ/mil), FR
 - 3 Istres (FI test, civ/mil), FR
 - 4 Aire-sur-Adour (CNES), FR
 - 5 Gap (CNES), FR
 - 6 Bordeaux (bal), FR
 - 7 Rostock Laage "Spaceport", DE
 - 8 Cochstedt (DLR), DE
- Vertical rocket launch restricted area*
 - Air-launch restricted area
 - Re-entry module corridor
 - Sounding rocket operating zone
 - Balloon-HAPS operating zone
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 - HAPS operating zone
 - Super-/Hypersonic operations (S/H)
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*sub-orbital shooting range



Part III: Vehicle / Fleet Operations

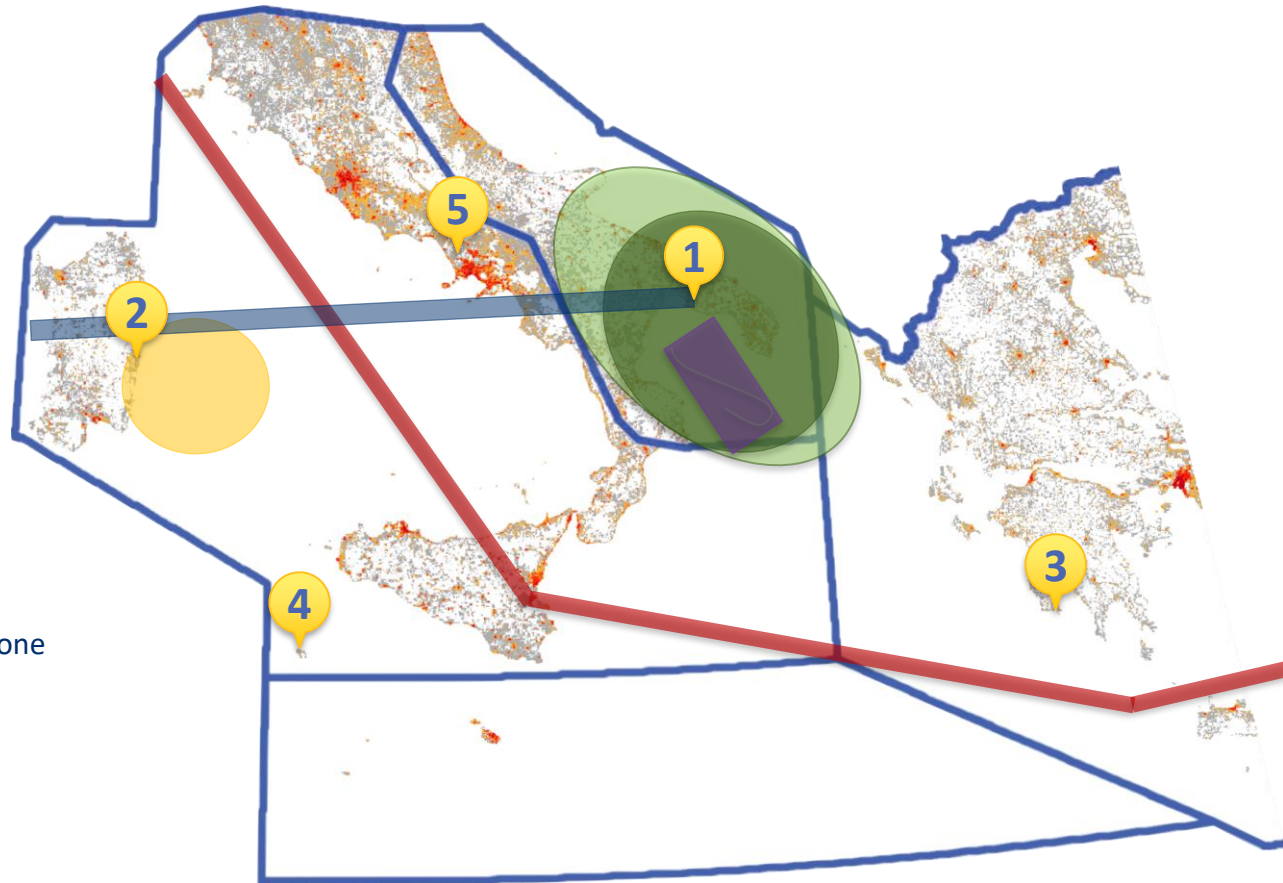
Brest FIR, Bordeaux FIR, Paris FIR, Marseille FIR, Brussels FIR, Amsterdam FIR, Reims FIR, Switzerland FIR, Langen FIR, Bremen FIR, Muenchen FIR

		Manageable with todays procedures and systems	Demand Scenario I	Additional services needed for...	Demand Scenario II	Scalable approach covering enhanced demands with...	Demand Scenario III
Frequency of hyper-/supersonic flights	Note: Crossings do not include originating or arriving flights	Supersonic airspace crossings: no constraint (e.g. CDG/AMS/FRA – JFK/LAX) Supersonic departure/arrival: minor constraints	None	Hypersonic overflights > 30 km: Danger Areas needed (not ATC controllable)	Crossings: 2-4/day (S) Departure/ Arrival: 3/day (S)		Crossings: 4-8/0-1/day (S/H) Departure/ Arrival: 8-12/0-1/day (S/H)
Business use of hyper-/supersonic flights	Note: Crossings do not include originating or arriving flights	Supersonic airspace crossings: no constraint Supersonic departure/arrival other airport than major airports: no constraints	None	Hypersonic overflights > 30 km: Danger Areas needed (not ATC controllable)	Crossings: 2-3/day (S) Departure/Arrival: 2-3/day (S)		Airspace crossings: 4.6/day (S) Departure/Arrival: 4-6/day (S)
Number of HAPS/ clusters FIR specific & operating area	Continuous operations taking place	1 HAPS per operating area	1 operating/ day	<ul style="list-style-type: none"> > 1 HAPS per operating area Transition / operation over denser populated areas 	10-12 operating/ day	Transition/operation in unsegregated airspace	15-20 operating/ day
	Altitude Band	Segregated ascent/descent (0-18km)				Unsegregated ascent/descent	
	Size of operational volume	<ul style="list-style-type: none"> 150 NM diameter at cone summit (18km) Large operational area > 300 km 				No segregation needed	
Launch/ descent frequency	Balloon-HAPS	1/day and launch site	None		0-6/y		0-6/y
	HAPS max. transitions per day	1 ascent & 1 descent per day and launch site (morning & evening)	1 transition/ day	> 1 simultaneous transition	1-2 transitions/day		2-3 transitions/day
Number/ type of space & sub-orbital launches/ re-entries	Sounding rockets	1/day and launch site	None		None		None
	(Other) Sub-orbital	1/day	Mil (on demand)		Mil (on demand)		0-1/day
	Orbital	1/day and launch site	None		None		None

Scenario: (East) Mediterranean I




Manageable with today's procedures and systems

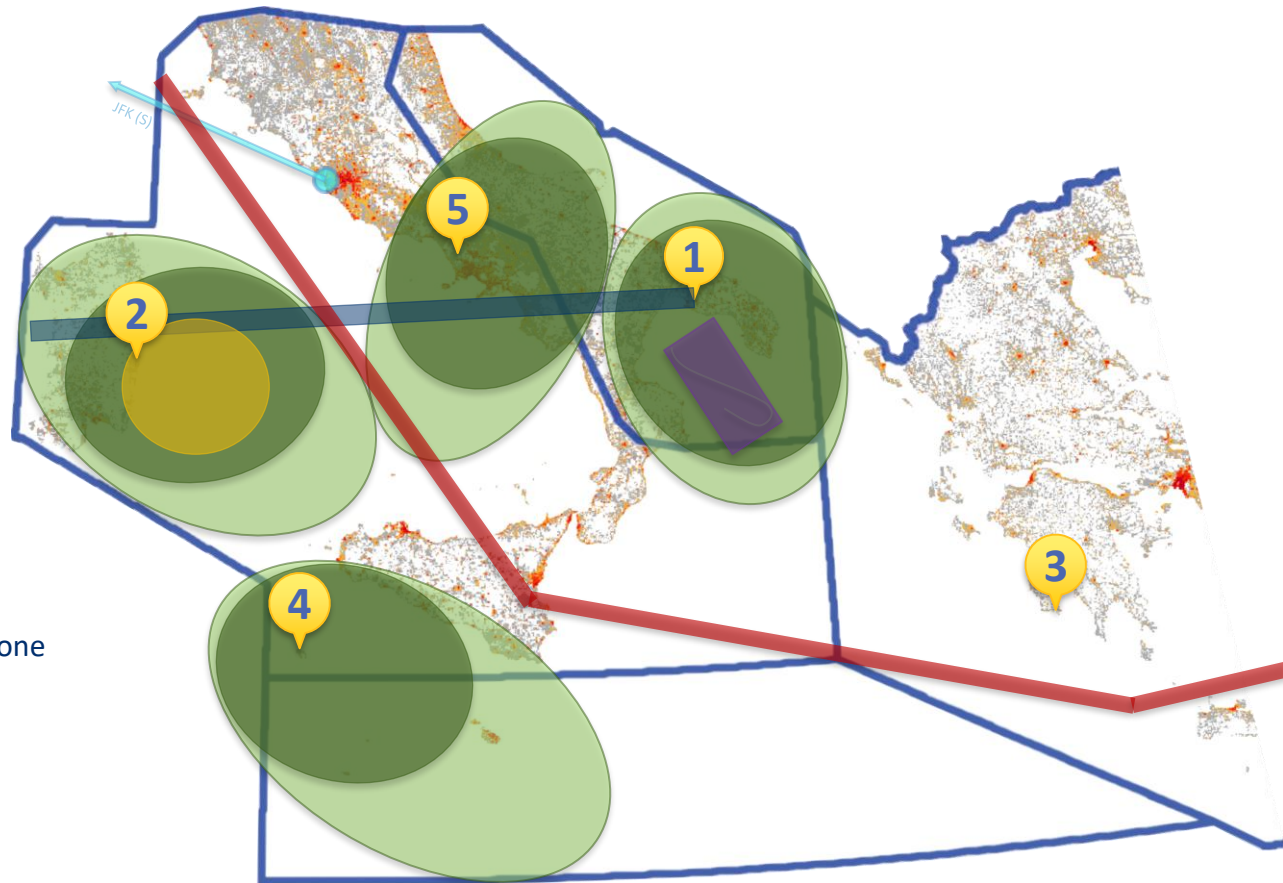
- 1 Spazioporto di Grottaglie, IT
 - 2 Salto di Quirra, IT
 - 3 Koroni, GR
 - 4 Pantelleria, IT
 - 5 Capua, IT
-  Air-launch restricted area
 -  Re-entry module corridors
 -  Sounding rocket operating zone
 -  HAPS vertical operation / transition zone
 -  HAPS operating zone
 -  Super-/Hypersonic operations (S/H)
 -  Military HALE UAS corridors



Scenario: (East) Mediterranean II






Additional services needed

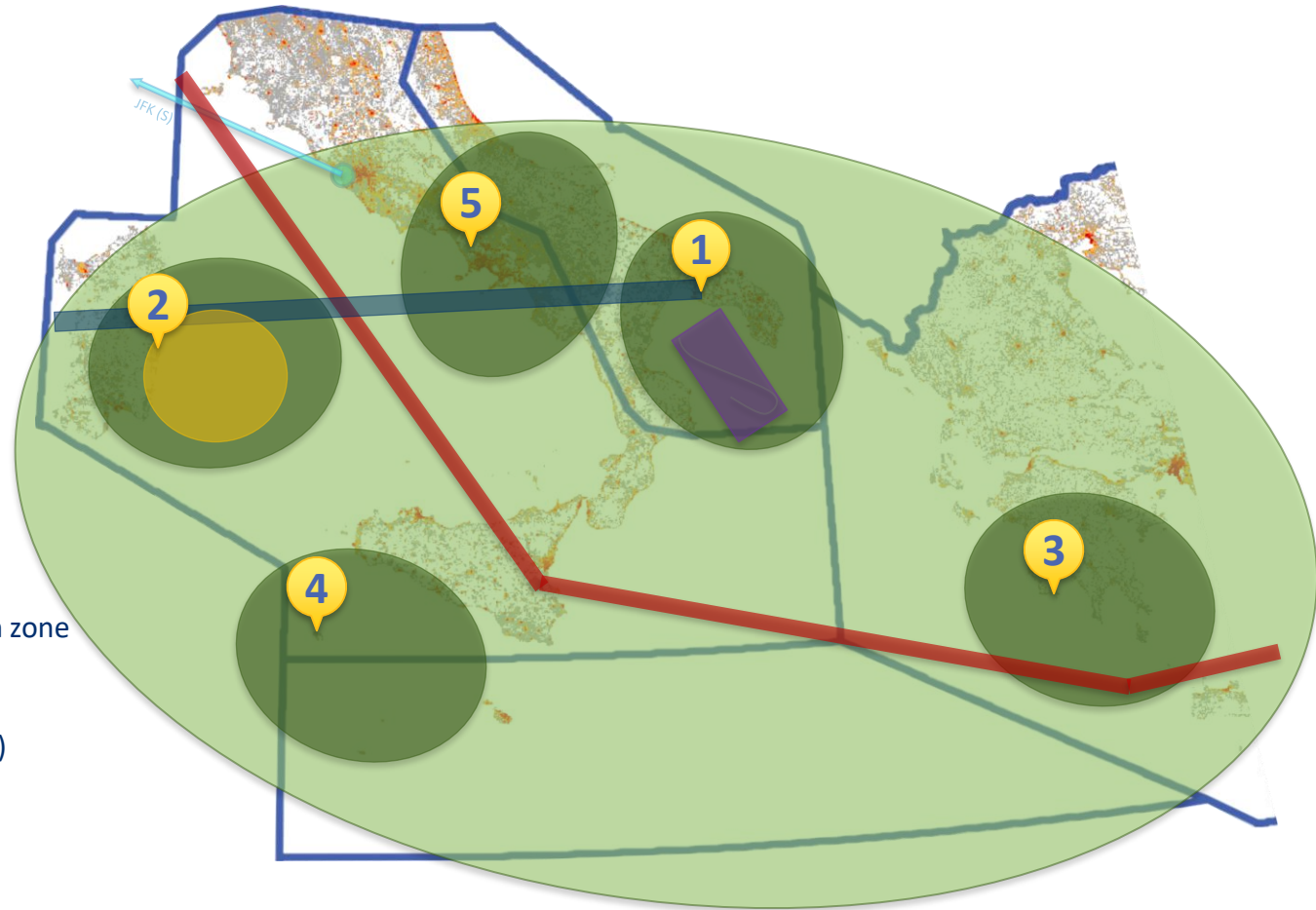
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Scenario: (East) Mediterranean I

Scalable approach covering enhanced demands

- 1 Spazioporto di Grottaglie, IT
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 - 3 Koroni, GR
 - 4 Pantelleria, IT
 - 5 Capua, IT
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 -  Re-entry module corridors
 -  Sounding rocket operating zone
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 -  HAPS operating zone
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 -  Military HALE UAS corridors



Part III: Vehicle / Fleet Operations

Roma FIR, Malta FIR, Brindisi FIR, Athinai FIR

Manageable with today's procedures and systems		Demand Scenario I		Additional services needed for...	Demand Scenario II		Scalable approach covering enhanced demands with...	Demand Scenario III	
Frequency of hyper-/supersonic flights	Note: Crossings do not include originating or arriving flights	Crossings: no constraints, no routes planned	None	Hypersonic overflights > 30 km: Danger Areas needed (not ATC controllable)	Crossings: None Departure/Arrival: 1/day (S)			Crossings: None Departure/Arrival: 1-2/day (S)	
Business use of hyper-/supersonic flights	Note: Crossings do not include originating or arriving flights	Crossings: no constraints	None	Hypersonic overflights > 30 km: Danger Areas needed (not ATC controllable)	Airspace crossings: None Departure/Arrival: None			Airspace crossings: 1-2/day (S) Departure/Arrival: 1-2/day (S)	
Number of HAPS/ clusters FIR specific & operating area	Continuous operations taking place	1 HAPS per operating area	1-2 operating/ day	<ul style="list-style-type: none"> > 1 HAPS per operating area Transition / operation over denser populated areas 	8-10 operating/day		Transition/operation in unsegregated airspace	20-24 operating/day	
	Altitude Band	Segregated ascent/descent (0-18km)					Unsegregated ascent/descent		
	Size of operational volume	<ul style="list-style-type: none"> 150 NM diameter at cone summit (18km) Large operational area > 300 km 					No segregation needed		
Launch/ descent frequency	Balloon-HAPS	1/day and launch site	0-6/y		0-6/y			0-12/y	
	HAPS max. transitions per day	1 ascent & 1 descent per day and launch site (morning & evening)	1 transition/ day	> 1 simultaneous transition	1-2 transition/ day			2-3 transitions/day	
Number/ type of space & sub-orbital launches/ re-entries	Sounding rockets	1/day	None		None			None	
	(Other) Sub-orbital	1/day	1-2/y		12/y			50/y	
	Orbital	1/day	2/y		4-6/y			8-10/y	

We're looking forward to
your feedback !

Q1:

- In your opinion, are the scenarios realistic ?
(esp. with regard to the expected type, location, number and entry into service of operations)

Q2:

- Are there any operations that, in your opinion, have not been (sufficiently) considered ?