

A Federated Model for UTM/USS standards, testing and certification

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the challenge



...current centralized ANSP model is incredibly robust, but expensive and complex to scale

Projected US* Commercial Fleet Growth

Source: FAA
FY2019-2039
Global Forecast

	Total non-Model Fleet		
	(no. of '000 units)		
year	Low	Base	High
2018	277	277	277
2019	369	400	426
2020	460	545	638
2021	552	711	932
2022	588	789	1,112
2023	603	835	1,290



... ANSP operational and certification standards have been developed & refined over the last century, to ensure the safe & efficient flow of manned air traffic

...work on UTM started ~5 years ago ... and we need to *finish* the work in ≤ 5 years



...the system we design must:



...support real-time, secure, automated network topology management – no “*central point of reliability*”

...be easily adopted on a global scale through interoperable & secure internet-connected services

...be built on existing technologies & mechanisms

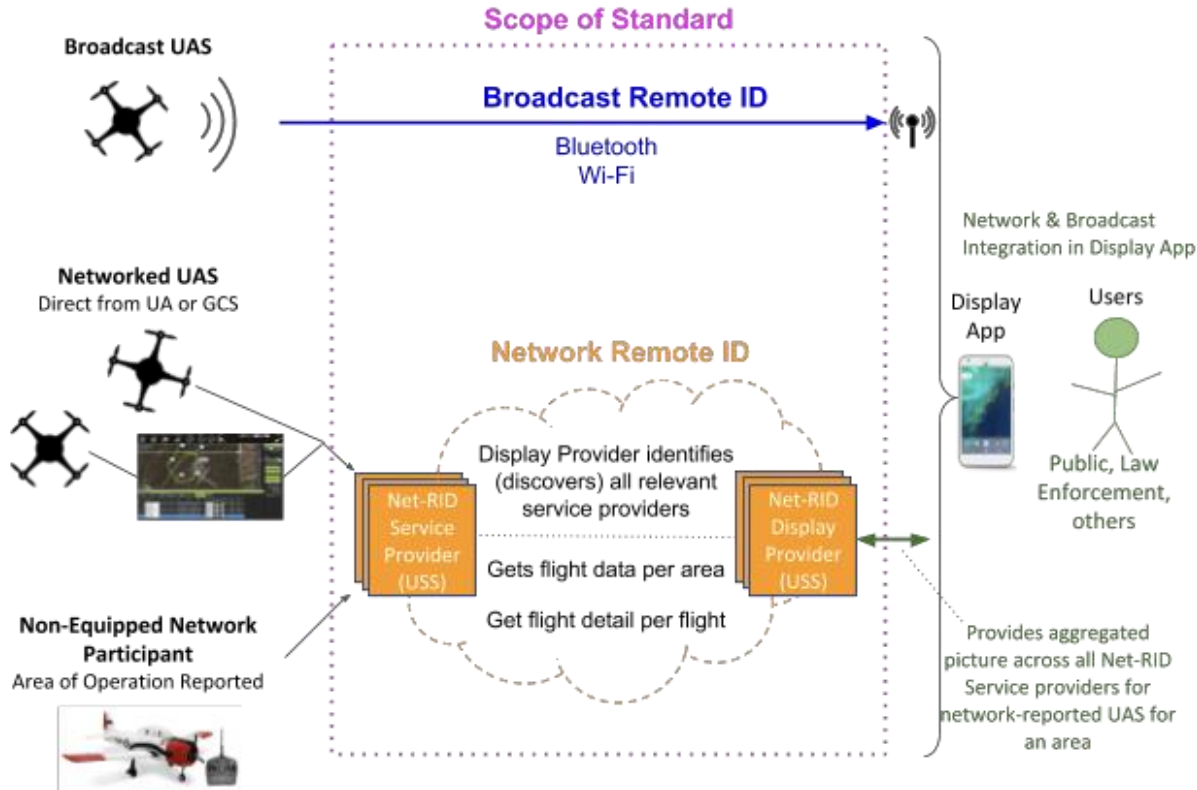
...be credentialed by the relevant National Aviation Authority (NAA)

...enable in-region and cross-border interoperability of certified systems produced anywhere in the world



recap: Remote ID





Broadcast Remote ID:
Ad-Hoc communications directly between nodes, (e.g. “*beacon mode*”) – *does not require a network*

Network Remote ID:
a Federated USS to USS approach, w/ at least one USS with a “*user display provider*” capability.



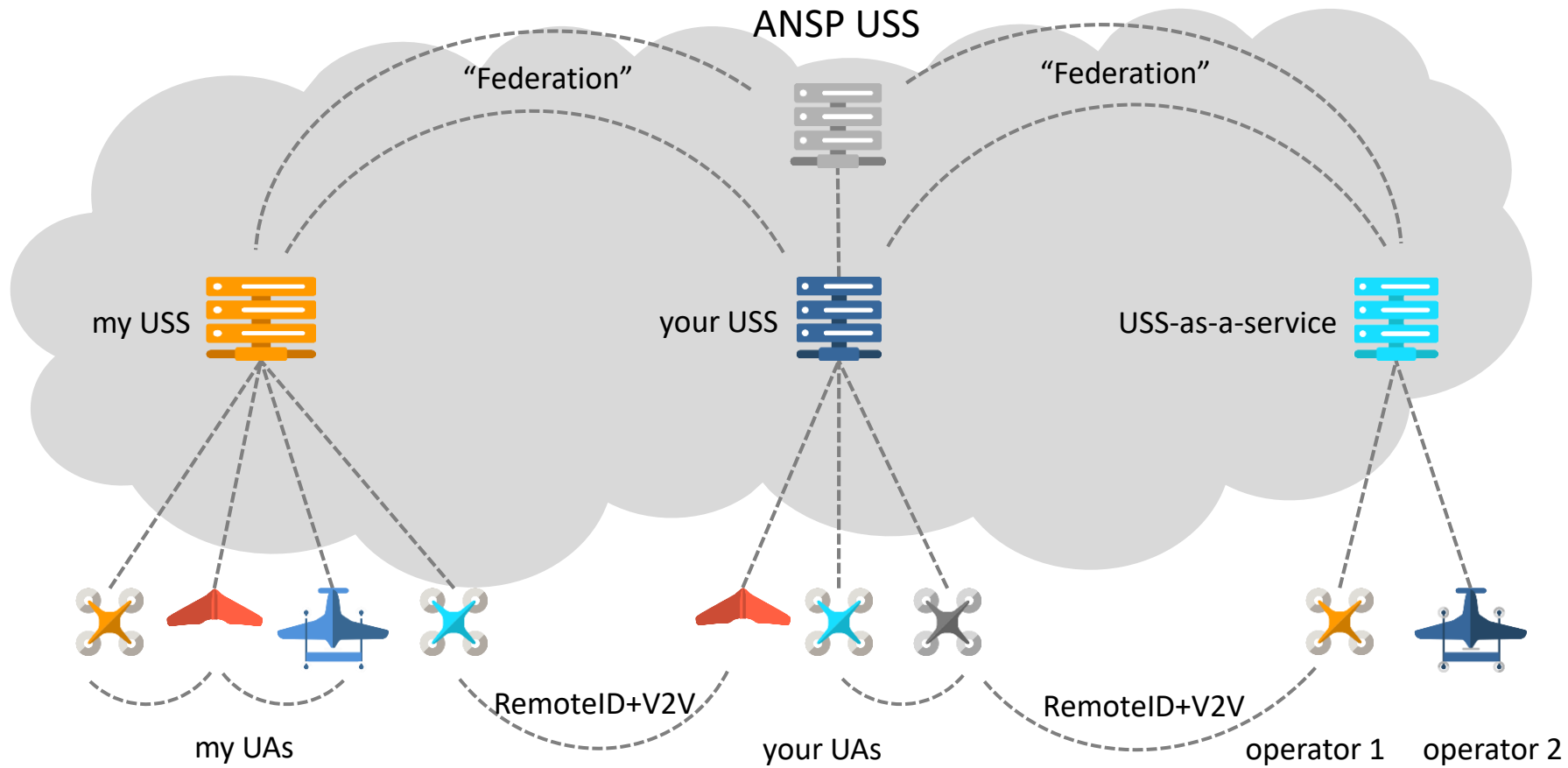
recap: Federated Architecture

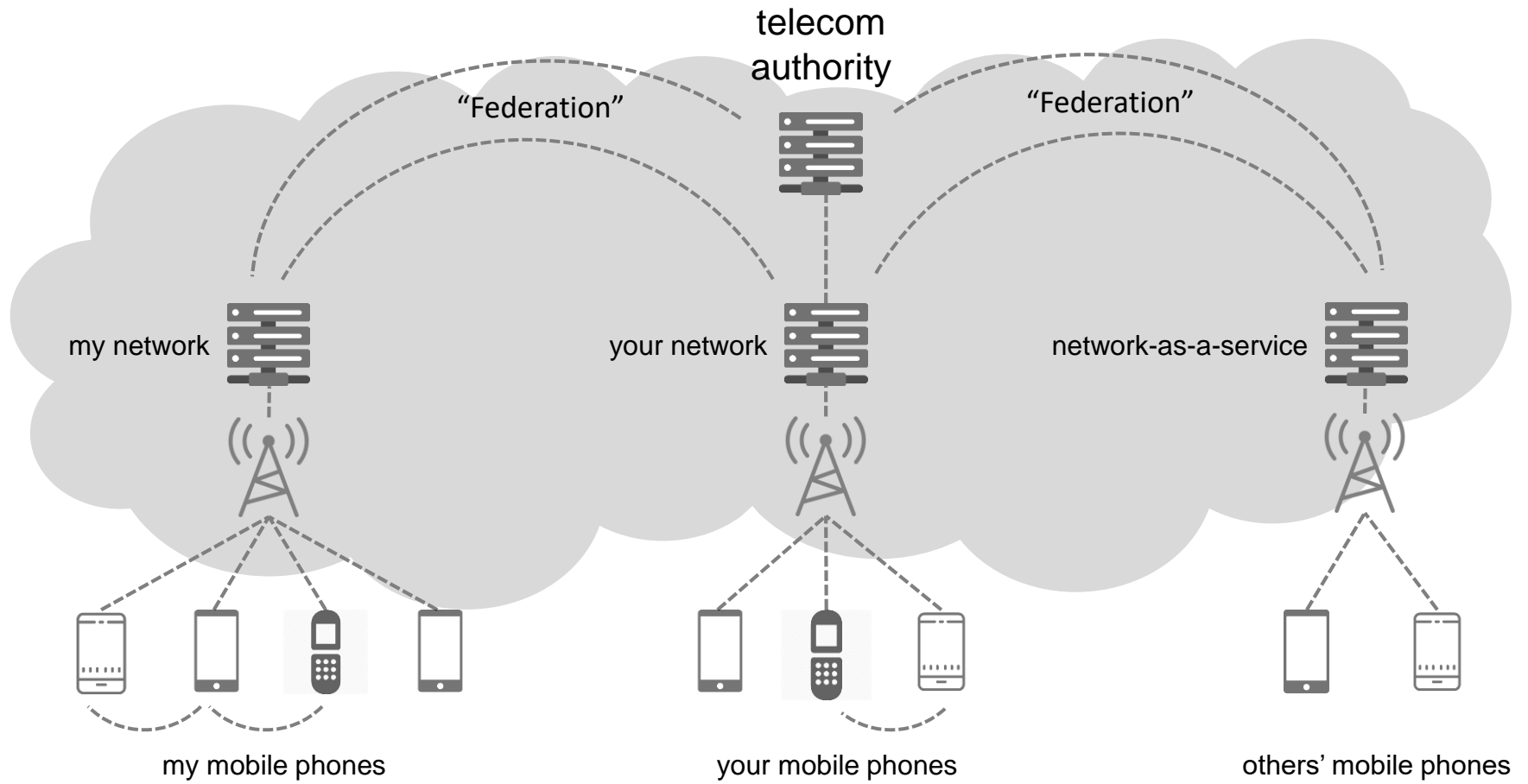


...in the proposed system, each unmanned aircraft (UA) is connected to their USS (and it to other USSs) using standard protocols, running highly automated and provably correct software services that:

- (i) ...manage UAS operations and interactions
- (ii) ...enable real-time, on-demand flight planning, inc. dynamic re-planning during flight
- (iii) ...communicate (“federate”) with other USSs that have overlapping flight areas, and
- (iv) ...assure strategic and tactical deconfliction, without disrupting existing manned aviation system

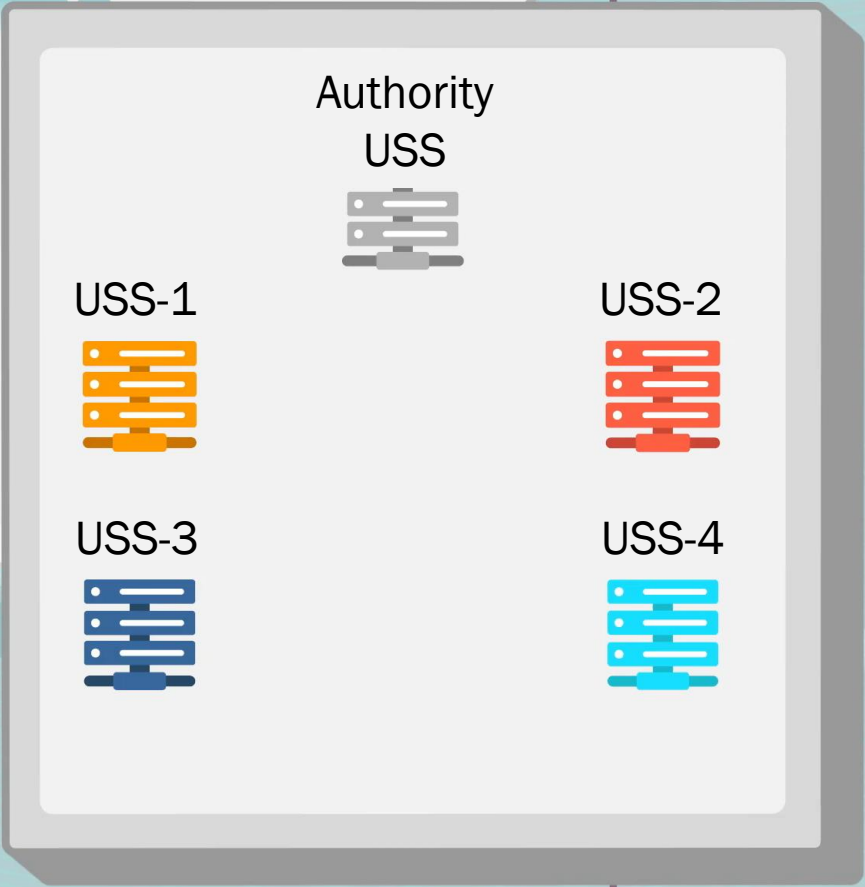
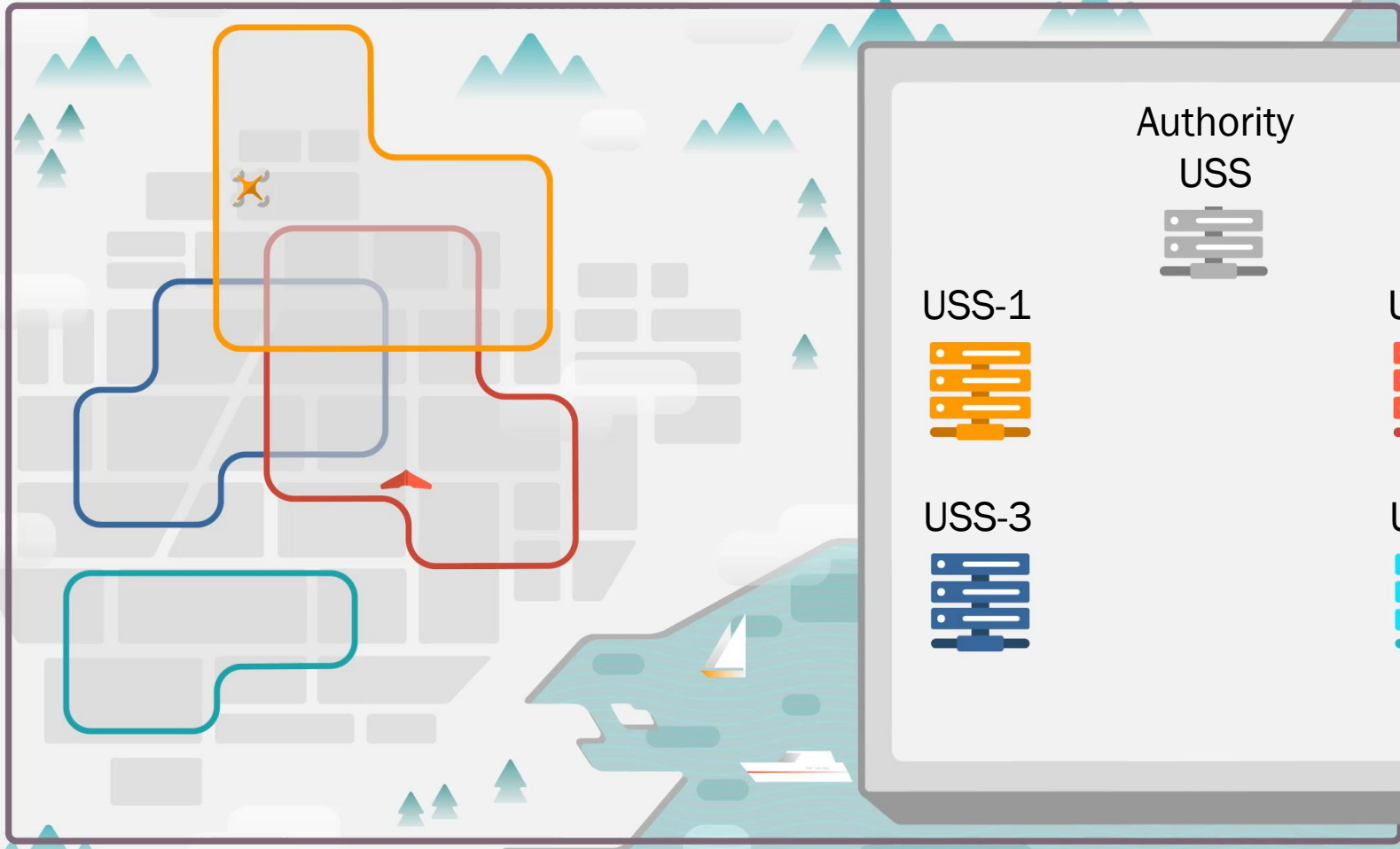






example: dynamic deconfliction





...this is not just a “concept” -
it already works

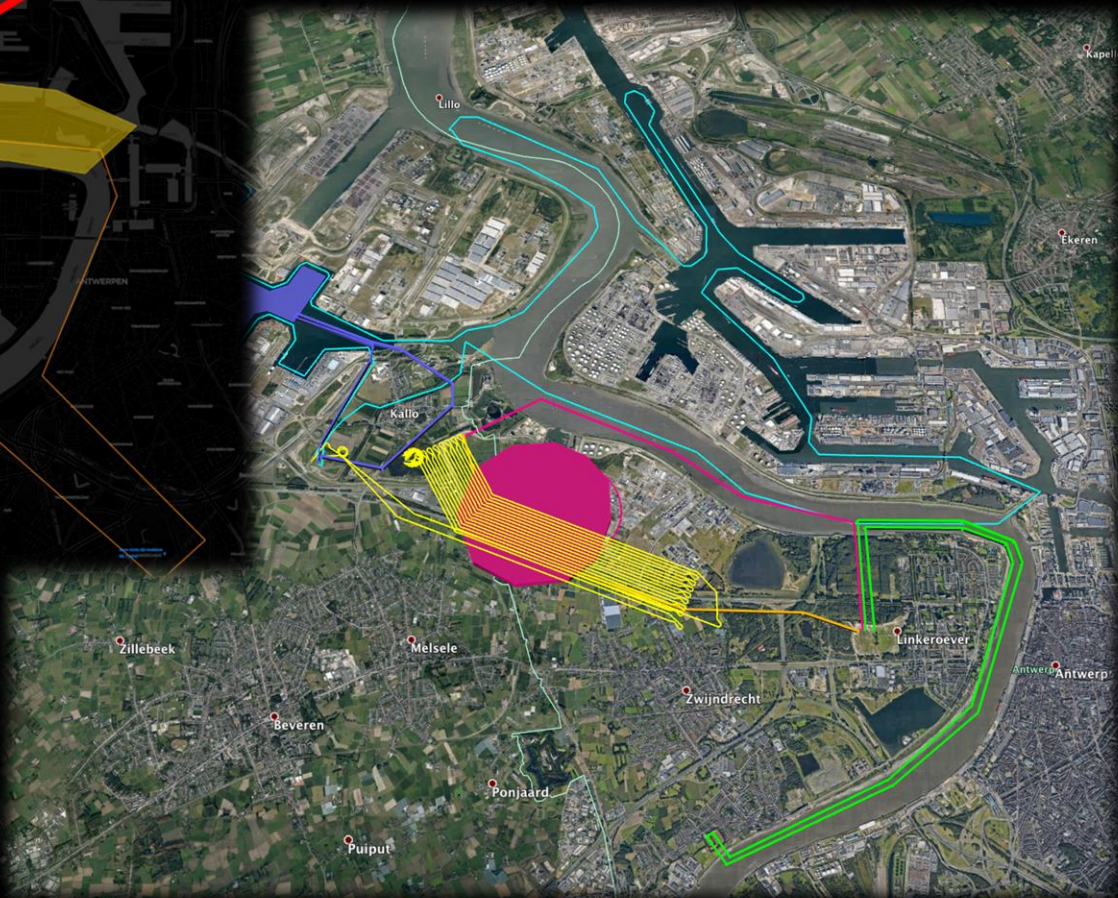


SESAR U-Space SAFIR Federated Interoperability Demonstration

Dynamic Flight Restriction

Prime Air aircraft in flight

...multiple service providers (USSs) and a air navigation service provider (ANSP) managing the same airspace, together



USS structures and requirements



...each USS publishes a portfolio of services – one or more public-facing, secure interoperability endpoints; these services are discovered by other USSs.

...syntactic and simulation testing against these endpoints ensure correctness & interoperability; continued testing (“airworthiness”) of implementations ensure no regressions are introduced over time.

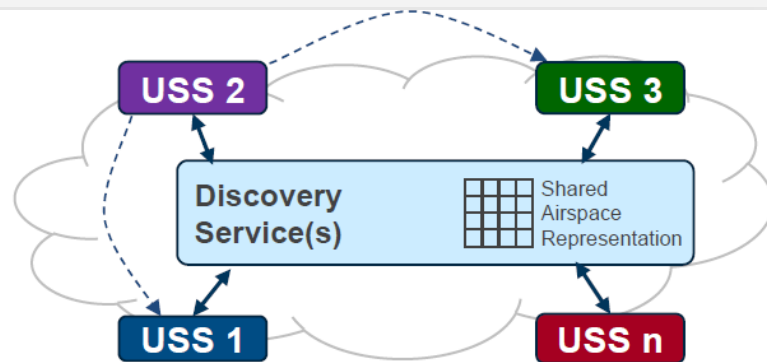
...role of “*approved testing providers*” to verify interoperability and compliance should be defined.

...verified implementations of globally adopted technical and performance standards reduce the burden and timeline to support cross-NAA / pan Member State UA operations, and can be applied to VLL (below 500 feet AGL) as well as Class E above A (above FL600)



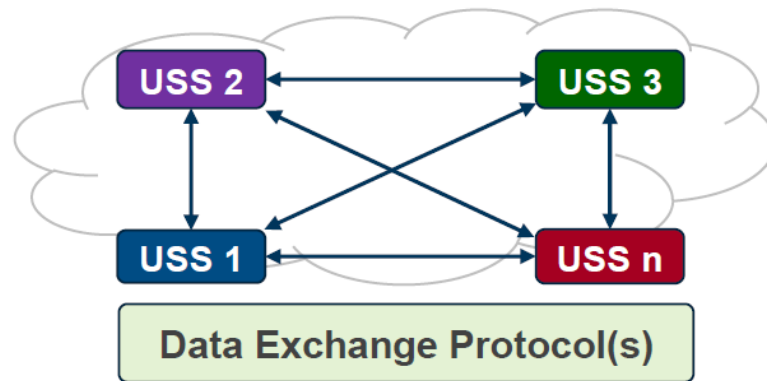
1. Spatial based 'Discovery' of peers

- Enables a USS to determine with whom data exchange is required and what data exchange protocol is required for this exchange
- Ensures USSs have a complete and up-to-date view of operations & constraints when planning/declaring a new operation
- Supports establishing persistent (subscription) based relationships between USS providers



2. Service-specific data exchange protocols

- Direct (Peer) USS-USS interfaces that include specific data and formats allow for decoupling of service interoperability
- Allows the system to support both polling based models and push / notification based strategies (and on a per USS service model)



...focus areas for Verification & Certification

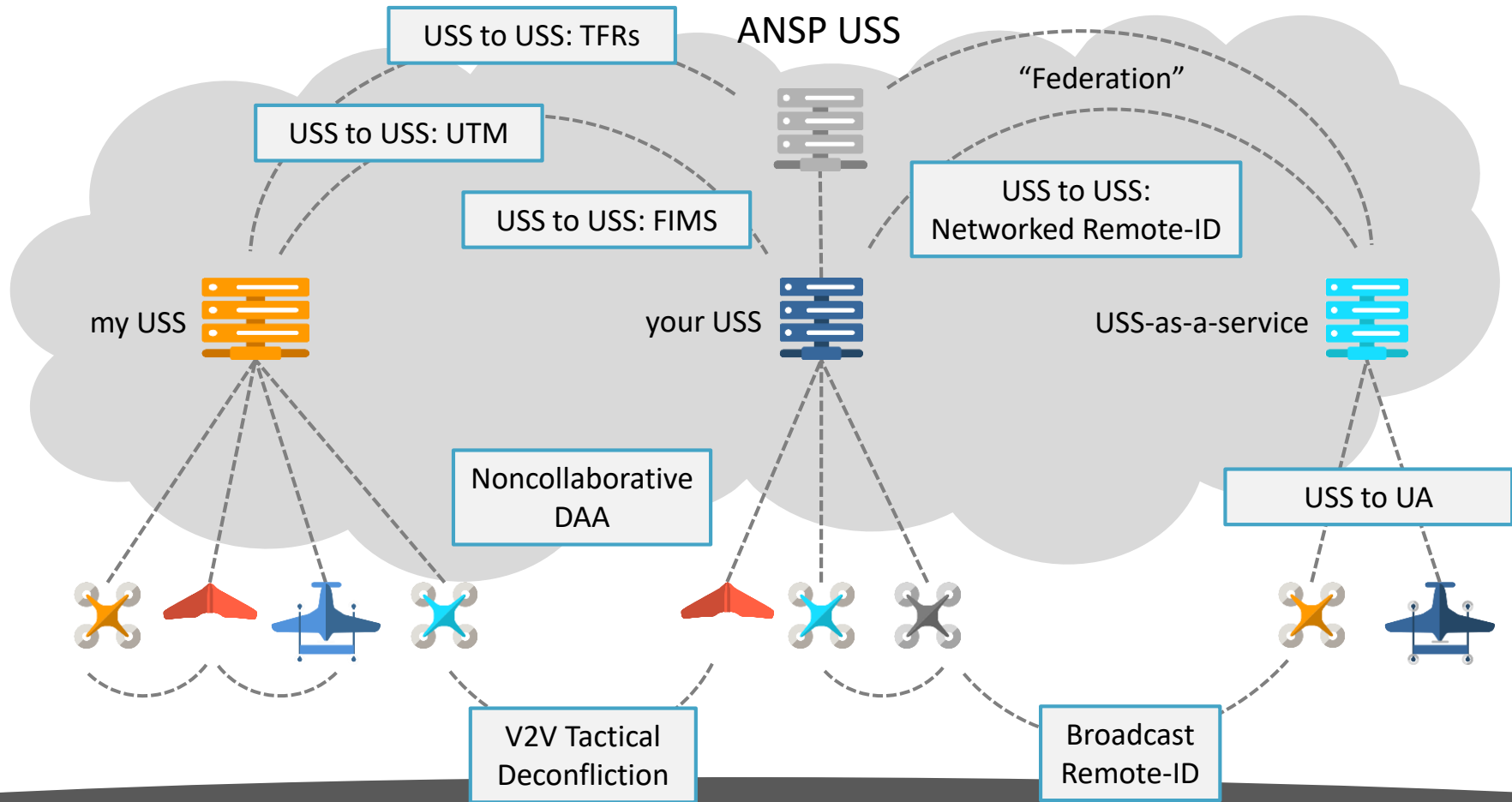


- ...discovery and spatial interactions with peer USSs
- ...volumetric performance and scalability vs. latency
- ...flight planning, conflict detection, & strategic separation
- ...data retention and handling policies
- ...timely and fair responses to queries and conflicts; and
- ...formally correct interpretation of the technical standards, APIs, Protocol Semantics, Interfaces/Messages
- ...correct and deterministic behavior for conflict detection and separation algorithms



...interfaces of interest,
systems-architecture view





...conclusion



...to be adopted by a large number of member states, the system we design must be safe, economical, scalable, and critically - *interoperable* - using harmonized technical and performance standards

...to establish trust for both newcomers and incumbents, all USS providers must be certified to conform (and remain in conformance) to the standards, with appropriate testing and validation of the technical interoperability and performance requirements



thank you!

500 feet

400 feet



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