4D Trajectory Management creates an environment where air and ground stakeholders share a common view of the aircraft’s trajectory, so that the flight can be managed as closely as possible to the Airspace User’s ideal profile, while optimising the flow of air traffic.
AOCs share their intent as soon as they plan to fly from A to B: Shared Business Trajectory (SBT). For military users Shared Mission Trajectory (MBT) developed by WOCs.

AOC/WOC and ANSPs collaborate to progressively refine the SBT.

Shortly before take-off the SBT becomes the Reference Business/Mission Trajectory (RB/MT), that the AU agrees to fly and the ANSP agrees to facilitate.
Traditional Ground Trajectory Prediction is enriched by use of the Extended Projected Profile (EPP), which is a list of the aircraft’s 4D predicted trajectory as calculated by the FMS, downlinked via ADS-C. This makes projected speed and vertical schedule known to ground:

- Better time estimates
- Improved vertical estimates (including TOC/TOD)
- 2D route discrepancies resolved
Goal is to establish a mechanism for all ground actors, as well as the aircraft itself, to share flight information, including trajectory.

This allows airborne systems to benefit from the knowledge of information that was previously known to ground actors only, and facilitates that the flight be handled seamlessly across ATSU boundaries.
Controlled Time Over/Controlled Time of Arrival (CTO/CTA)

Time constraint is sent from ground to aircraft using ADS-C (ATNB2)

Flight crew enters time constraint on FMS; RTA will be met with +/- 10 seconds accuracy

i4D operations: single time constraint at a time, used for arrival metering (CTA) or for en-route metering or separation (CTO)
No human intervention is required on the ground, conflict is detected by ground systems, which interrogate aircraft systems on RTA min/max via ADS-C and uplink CTO automatically via CPDLC. Flight crew enter RTA on FMS.
Free Route

Enabled by dynamic management of ARES, which minimizes the time that special use airspace is not available.

Direct routes are cross-border, which is very important in Europe.

Needs systems to support flight plans that do not refer to pre-defined waypoints.

A step-wise approach has been taken in SESAR, with some improvements like cross border directs being currently operational after SESAR demonstrations, with work continuing in more advanced features.
Short Term ATFCM Measures (STAM)

Layered approach to ATFCM:

- Europe’s well consolidated ATFCM system based on ground delay applied only in case of severe overload prediction
- Most common situations can be handled though the use of STAMs:
  - Applied to individual flights (cherry picking) or full traffic flows
  - Short duration, very precise
  - Locally managed
  - Toolbox includes a variety of measures to allow catering for all needs (minimum departure interval, short-notice low duration ground delay, level capping, miles-in-trail, etc.)
UDPP

Allows users to participate in ATM decision making. Slot-swapping is the first UDPP feature, which is operational today with a basic functionality, with its advanced functionality being currently under development in SESAR.

For STEP 2 user preferences, as recorded in the SBT, will be taken into account by the ANSP/NM for slot allocation. Users will make known which flights are more important to them through the Fleet Delay Assignment (FDA) ratings, and advanced swapping will be made possible through the use of Operating Credit (OC) schemes.
Enhanced Arrival Management

Arrival Management Horizon extended to 200 NM, and to even 500 NM (long-range AMAN) in specific cases.

A larger horizon allows for en-route delay absorption by having aircraft fly slower, which saves fuel and avoids traffic bunching at holding patterns.

There is a need for constant cross-boundary coordination, because aircraft are often considered in the arrival sequence before they enter the arrival TMA ATSU.
A net-centric approach for connecting multiple stakeholders, each running its own information system, and using SWIM to communicate.

SWIM users share the SWIM Registry and Certification Authority; SWIM nodes are distributed among users.

Different needs require different solutions, each with a specific combination of requirements. Security, exchange patterns, performance, availability and middle-ware specifications are combined to create three different SWIM profiles.
Performance of Short Term Conflict Alert (STCA) is enhanced by improved knowledge of aircraft intent derived from Downlinked Aircraft Parameters (DAP): Selected Flight Level (SFL) and Track Angle Rate (TAR).

Trajectory information will be used to enhance Area Proximity Warning (APW), Minimum Safe Altitude Warning (MSAW) and Conformance Monitoring, including Approach Path Monitoring (APM).

David please add sth. about ACAS
All weather information (both existing and newly developed) will be accessed through SWIM, via the 4D Wx Cube.

The 4D Wx Cube can be viewed as:
- A virtual repository of shared meteorological information;
- Being produced by multiple data contributors, from a variety of locations;
- Providing end users with a common weather picture;
- The interface between SWIM and providers of MET information, being a single point of contact for all ATM MET information; and
- ‘Hiding’ the complexity of the MET system infrastructure from the ATM domain.
Thanks for your attention