CCSDS Mission Operations Services are Getting Real!

CCSDS Spacecraft Monitor & Control Working Group[1] and its chairman, Mario Merri, ESA

[1] The CCSDS SM&C WG has active participants from the following Space Agencies: ASI, BNSC, CNES, CSA, DLR, ESA, FSA, INPE, JAXA, NASA (GSFC, JSC, MSFC and JPL)

European Space Agency


Phone Services
• Place call
• Receive call
• Show contacts
• ...
Music Services
• Stream songs
• View music library
• By song
• By author
• By album
• ...


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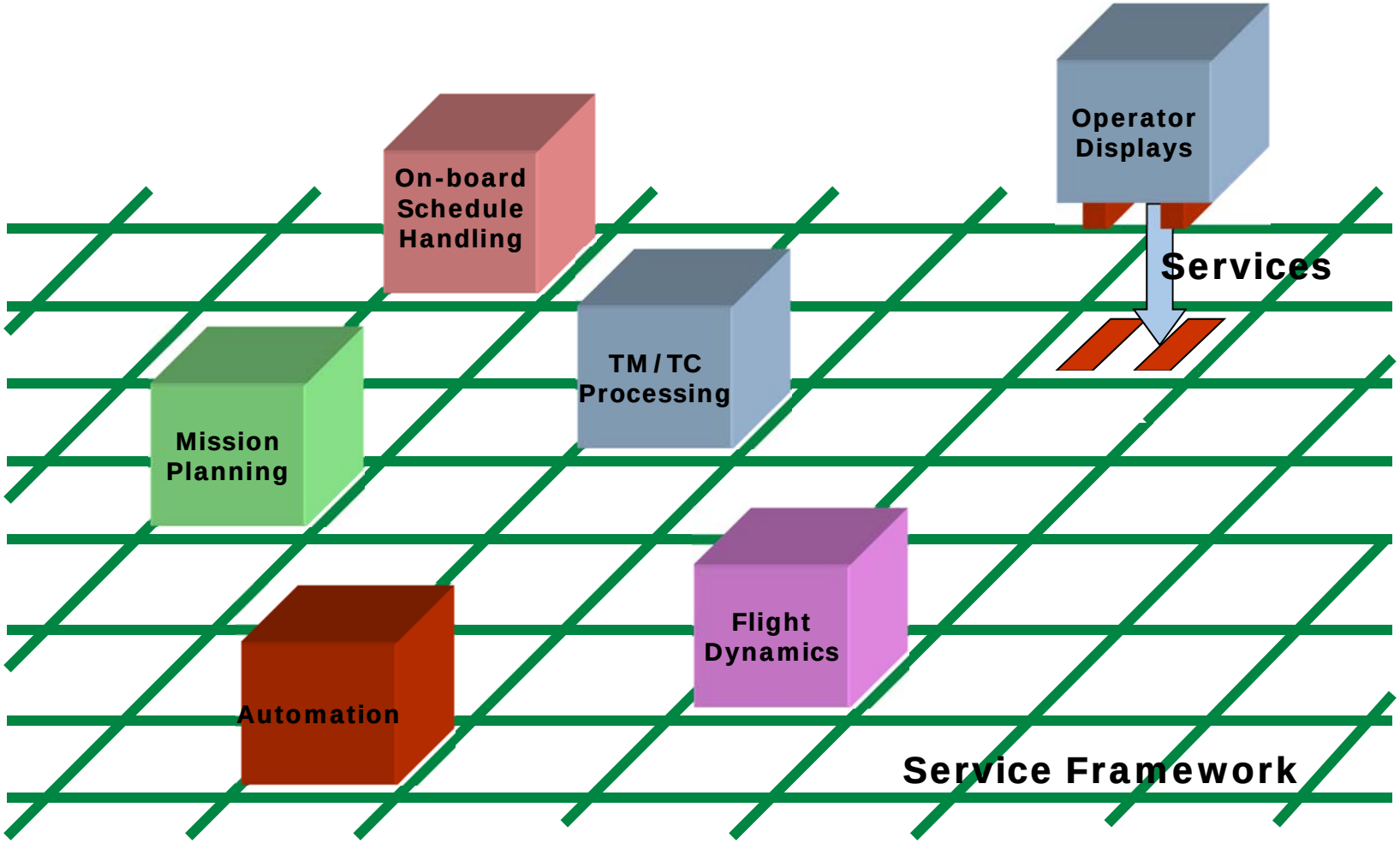
What Can We Learn From This Analogy?

- Communication is an enabling technology
  - Necessary condition (must have it)

- … but the real breakthrough is in the definition of semantically rich application-level services
  - Independent on the communication technology (Bluetooth, wire/USB, …)
  - Allows independent developments at the two ends of the interface
    - Any Bluetooth telephone works with any Bluetooth-enabled car stereo
    - Does not prevent innovation
    - Increase the availability of commercial solutions => boost competition => cost reduction
    - Increase long term maintainability
      - You can replace the phone w/o replacing the car

How Does This Apply to Mission Operations (MO)?



Benefits of MO Services

- **Increased re-use**:
  - Of components (ground/on-board) between/across missions
  - Of operational concept across missions (even from different Primes)
  - Of people (share operational knowledge across missions)
  - Of legacy systems
  - Ability to establish common multi-mission infrastructure
- **Reduced cost**:
  - Integration of re-usable components (i.e. shorter schedules, less risks, …)
  - Increased competition in the provision of commercial tools
  - Vendor independence
- **Increased flexibility**:
  - More interoperability between agencies
  - Flexible deployment boundaries and function locations (ground/on-board)
  - Capability of "bridging" between technologies
  - Improved long-term maintainability (both for components and infrastructure)
- **Higher quality**:
  - Ability to select the best product from a range of compatible components
  - Increased field-specific innovation

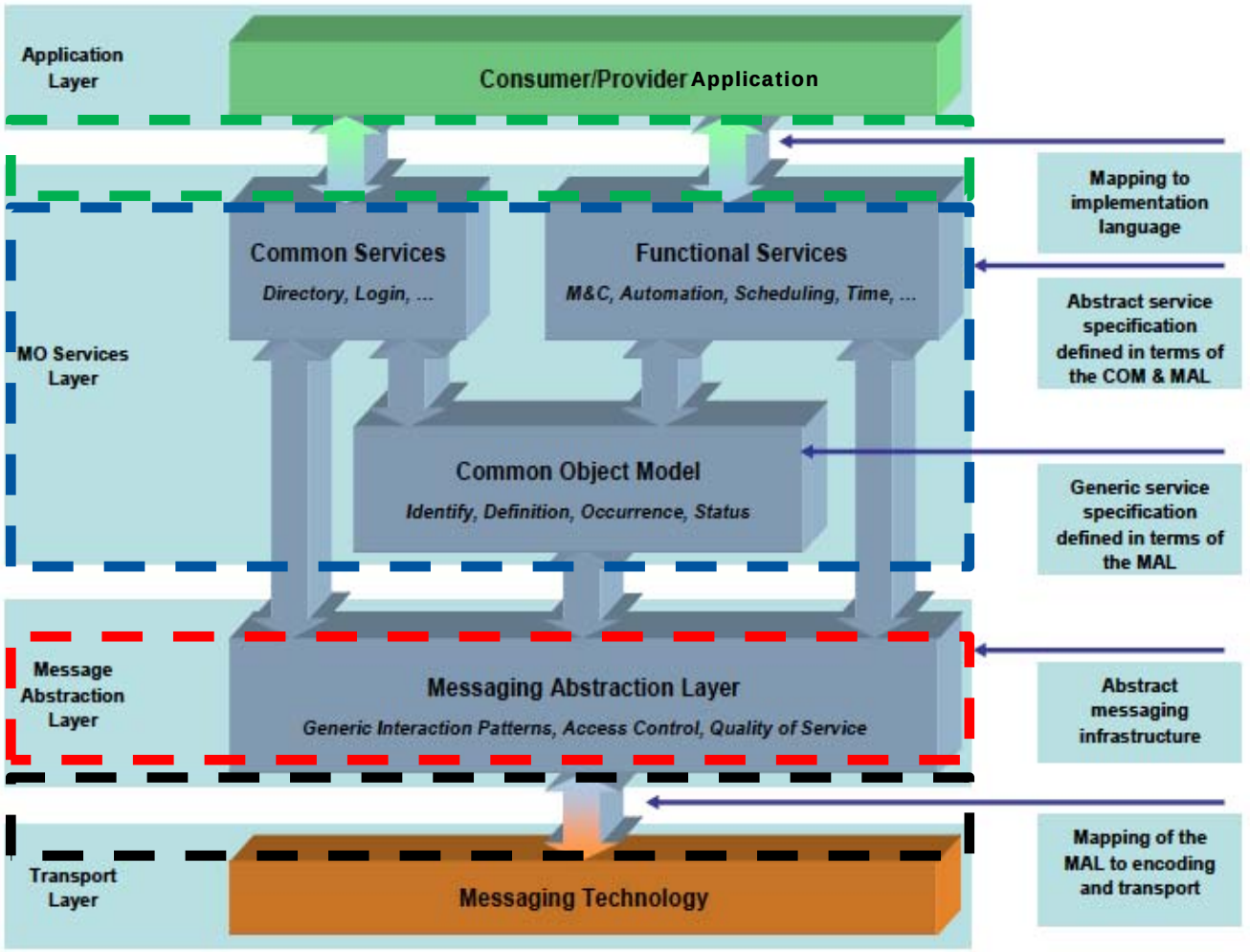
The CCSDS MO Service Framework: a layered approach

MO Services may be used by Applications coded in different languages

MO Services are expressed in terms of the MAL

Message Abstraction Layer (MAL) provides technology and location independence

MO Services may "travel" over different encoding / transport technologies



What Are MO Services?

- Coherent set of **application-level** services needed to operate a space mission, such as:
  - Classical M&C (TM, TC, Events)
  - Navigation (e.g. orbit, attitude, events)
  - Mission planning, scheduling and automation
  - Mission product data (file) management
  - Time management
  - Remote software management
  - Interaction with the operator
  - … and more (extensible)

- Key technical proprieties of MO Services:
  - Follow **SOA** approach
  - Standardise exchange of **semantically rich data**
  - Are defined in a common way (**service framework**)
  - Are **technology and location independent**
  - Are compatible with **model driven development** and **autocoding**

Why are MO Services are Getting Real?

Because they are being used more an more!

CCSDS Prototypes

CCSDS requires that each new standard is validated via 2 independently-developed and interoperable prototypes

Test Bed available that simplifies this work and might also be used in the future to “certify” compliant MO applications

So far 3 space agencies (CNES, DLR, ESA) are involved

Other Prototypes / Studies

Since 2006, about 29 (known) prototypes:

- Astrium-D -> 1
- CNES -> 6
- DLR -> 1
- ESA -> 4
- EUMETSAT -> 1
- NASA/GSFC -> 2
- NASA/KSC -> 1
- NASA/JPL -> 2
- NASA/JSC -> 7
- NASA/MSFC -> 2
- UKSA -> 2

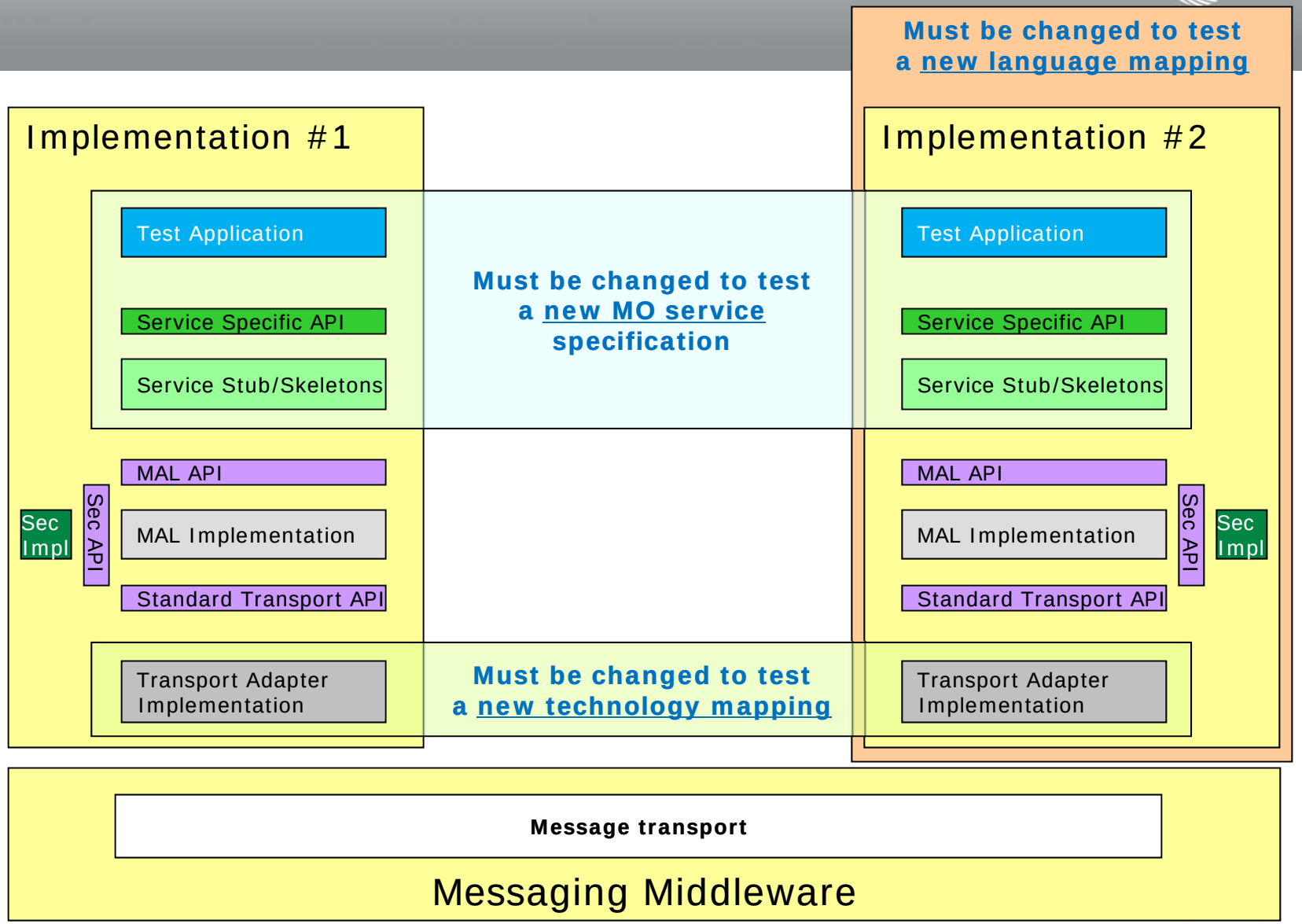
Several studies

A number of Ph.D.’s

Actual Projects

- ISIS: CNES new ground segment infrastructure
- ESOC SW Infrastructure
- EGS-CC: new European Ground System Common Core
- METERON: ISS experiment
- OPS-SAT: ESA new cubesat

CCSDS MO Test Bed Overview



Current Status of MO Service Standardisation

- MO Framework is available
  - **MAL** book is published (software soon available as Open Source)
  - **COM** book under finalisation
- MAL language mapping
  - **JAVA API** under finalisation
  - **C++ API** in draft format
- MAL encoding and transport mapping
  - **CCSDS Space Packet** under finalisation
- MO Services:
  - **M&C Service** under finalisation
  - **Mission Planning Service** may be next
  - … inputs from the operator community are being provided

Check out: www.ccsds.org

Do We Really Need MO Services?

Of course not,

we can live without them,

but …


Antique car have a charm,
does this applies also to old spacecraft and ground systems?

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