“Il ruolo dei satelliti nella realizzazione di sistemi *network-centrici* e di infrastrutture ICT”

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Summary

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- **Future systems and services will be based on the network centric paradigm: get the information to the right person, anywhere and in the right time; empower the individuals and, at the same time, allow them to share information and collaborate;**
- **To allow users to collaborate in a worldwide network centric environment, essential infrastructures and services must be in place;**
- **Satellite communications can play a pivotal role in providing the interoperable, robust, ubiquitous, "network-centric" communications needed for the provision of worldwide value-added services.**

TSIOLKOVSKY, GODDARD, OBERTH

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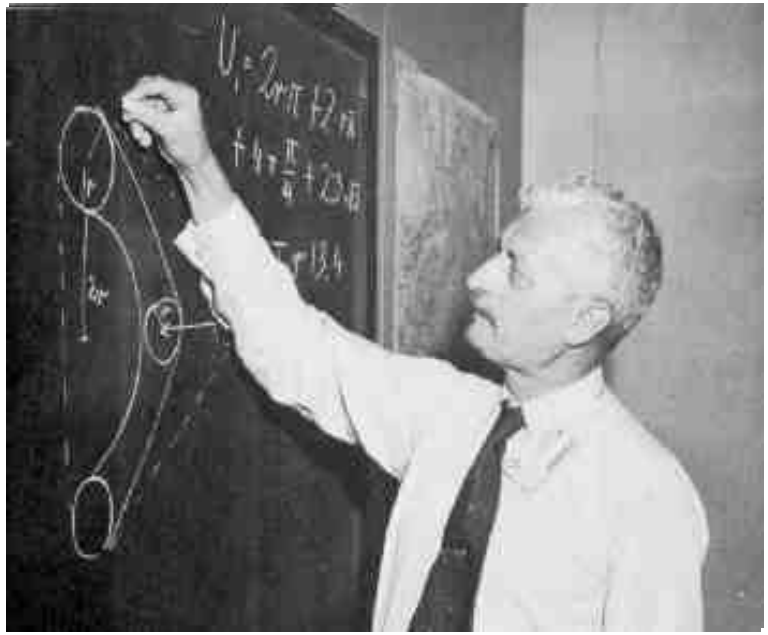

V2: “Vergeltungswaffe” (arma di rappresaglia) 2

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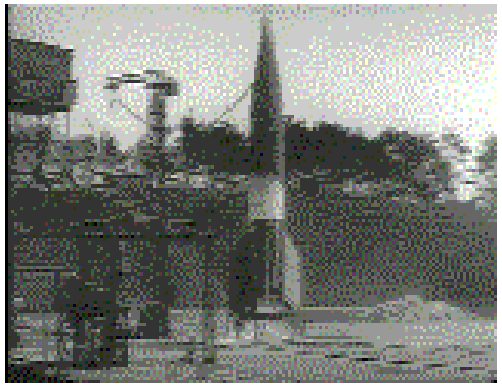

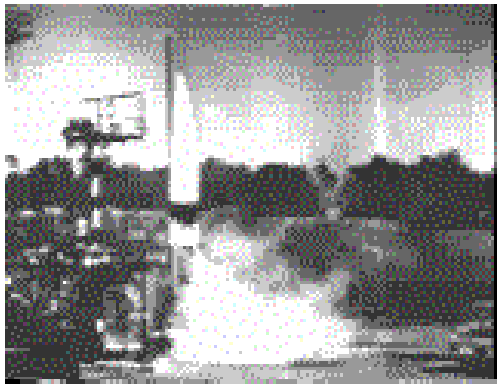

4 OTTOBRE 1957: SPUTNIK 1, INIZIA L'ERA SPAZIALE

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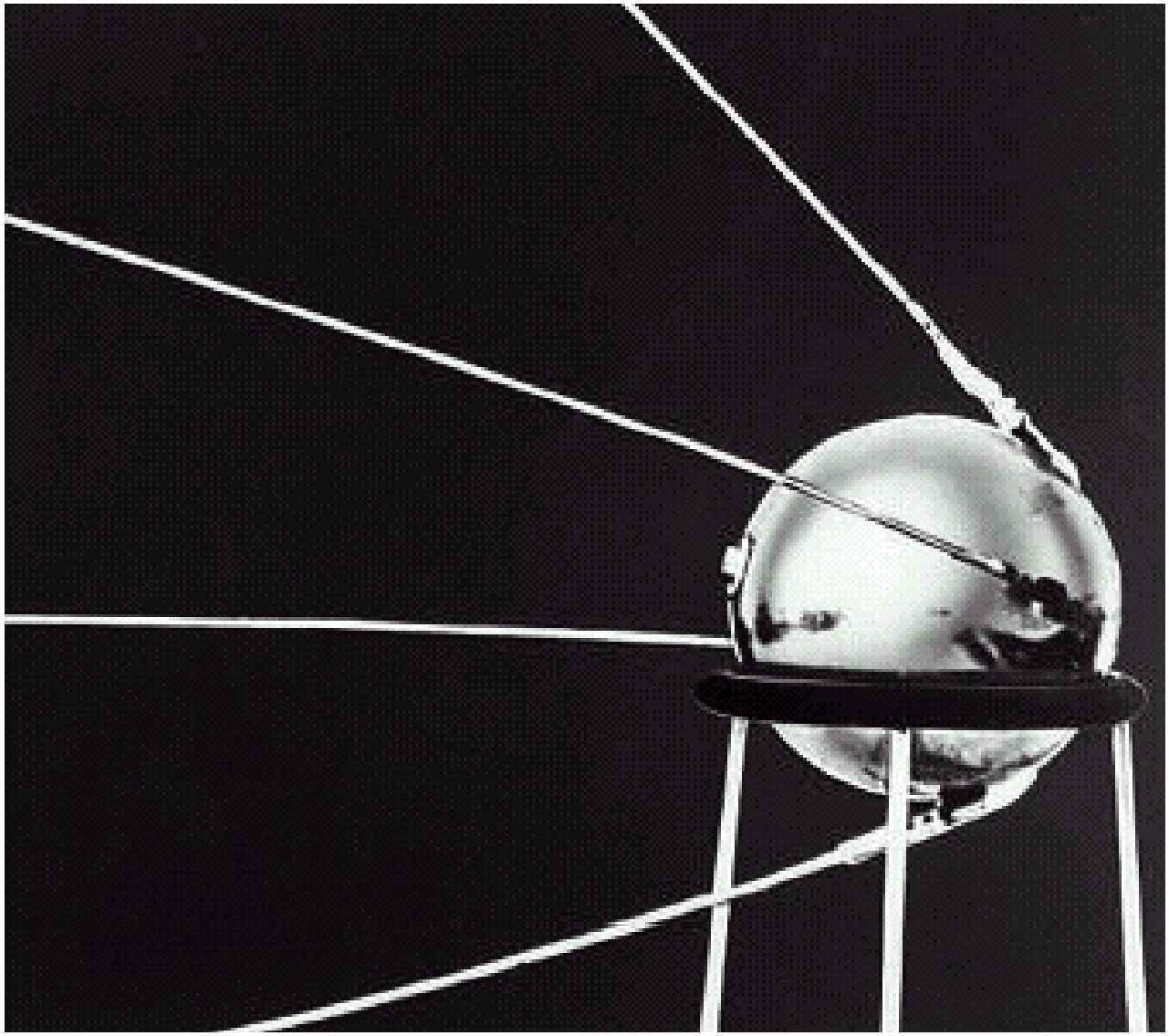

12 APRILE 1961: GAGARIN, PRIMO UOMO NELLO SPAZIO

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Yuri Gagarin andò soltanto una volta nello spazio. Il 12 aprile 1961 fu il primo essere umano a orbitare attorno alla Terra. La navicella di Gagarin, la *Vostok 1*, girò attorno alla Terra alla velocità di 27.400 chilometri l'ora. Il volo durò 108 minuti. Nel punto più alto, Gagarin si trovò a circa 327 chilometri sopra la superficie terrestre.

25 MAGGIO 1961: la decisione di andare sulla Luna

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Il progetto Apollo: una “vision” che divenne realtà

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"...if we are to win the battle that is now going on around the world between freedom and tyranny, the dramatic achievements in space which occurred in recent weeks should have made clear to all of us, as did Sputnik in 1957, the impact of this adventure on the minds of men everywhere... Now it is time to take longer strides-time for this nation to take a clearly leading role in space achievement, which in many ways may hold the key to our future on Earth. ...we have never made the national decisions or marshaled the national resources required for such leadership. We have never specified long-range goals on an urgent time schedule... Space is open to us now; and our eagerness to share its meaning is not governed by the efforts of others. We go into space because whatever mankind must undertake, free men must fully share...

I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to the Earth. No single space project...will be more exciting, or more impressive to mankind, or more important...and none will be so difficult or expensive to accomplish...".

President John F. Kennedy, May 1961

20 luglio 1969: otto anni e due mesi dopo…

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Il costo complessivo del programma Apollo fu di circa 24 miliardi di dollari, ma esso diede lavoro a oltre cinquecentomila tra tecnici e scienziati, che poi costituirono il nerbo dell'industria aerospaziale americana negli anni '70 ed '80.
Il "fall-out" tecnologico dell'esplorazione lunare beneficiò innumerevoli discipline scientifiche ed alla prova dei fatti ben centosessantamila brevetti e nuovi prodotti furono originati nel corso dell'intero programma.

WERNHER VON BRAUN

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1964: LA PIATTAFORMA SAN MARCO (MALINDI, KENYA)

Era il 15 dicembre del 1964 quando il primo satellite italiano fu mandato in orbita da una base americana. Il satellite si chiamava San Marco 1 ed era uno dei primi obiettivi raggiunti dal Progetto San Marco, il programma spaziale ideato da Luigi Broglio, preside della Scuola di ingegneria aerospaziale dell'Università La Sapienza di Roma, fondatore del Centro di ricerche aerospaziali (CRA) leader carismatico e padre delle conquiste spaziali italiane. Grazie anche al successo del San Marco l'Italia è stata il terzo paese, dopo Unione Sovietica e USA, a progettare, costruire e mettere in orbita un satellite.

1963: LA PRIMA ANTENNA DI TELESPAZIO

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4 GENNAIO 1963: LA PRIMA RICEZIONE TELEVISIVA

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26 AGOSTO 1977, CAPE CANAVERAL (FLORIDA): SIRIO

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Italy began its national space-based telecommunications program with the experimental Sirio spacecraft developed in the 1970's. These relatively small (approximately 220 kg on-station in GEO), spin-stabilized spacecraft were constructed by an Italian aerospace consortium to test the characteristics of 18/12 GHz transmissions. The drum-shaped spacecraft had a diameter of 1.4 m and a height of 1 m and was covered with solar cells which produced a maximum of 150 W. Sirio 1 was launched in 1977 and functioned well past its 2-year design life before being retired in 1992. Sirio 2 was lost in an Ariane launch failure in 1982.

16 gennaio 1991: ITALSAT F1

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ITALSAT F1 ed F2

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SATELLITES CHARACTERISTICS: ITALSAT F1/F2

DIMENSIONS (M)	WIDTH	LENGTH	HEIGHT
At launch	2.72/ 2.45	2.22/2.31	3.48/3.48 m
In trasfert orbit	2.72/2.45	6.32/6.88	3.48/3.48 m
In geostationary orbit	21/5.9	6.1/24.05	3.48/3.48 m

MASS (KG)	ITALSAT F1	ITALSAT F2
At launch	1.867 (platform 661) (payloads 299) (propellant 915)	1.983 (platform 709) (payloads 299) (propellant 975)
In orbit	1.122	1.185
Stabilisation	3-axis	3-axis
Power Supply (W)	1630 (solstice)	1990 (solstice)
	1.152 (eclipse)	1.409 (eclipse)
Frequency Bands (GHz)	20-30	20-30
	40-50	1.5-1.6
		12-14
Predicted Lifetime	5-8 years	8 years

The Dawn of a Knowledge-Based, Service-Oriented Economy

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- ***"It is knowledge that is the real and controlling resource and the absolutely decisive factor of production, not capital, nor labor, nor land."***

Peter Drucker

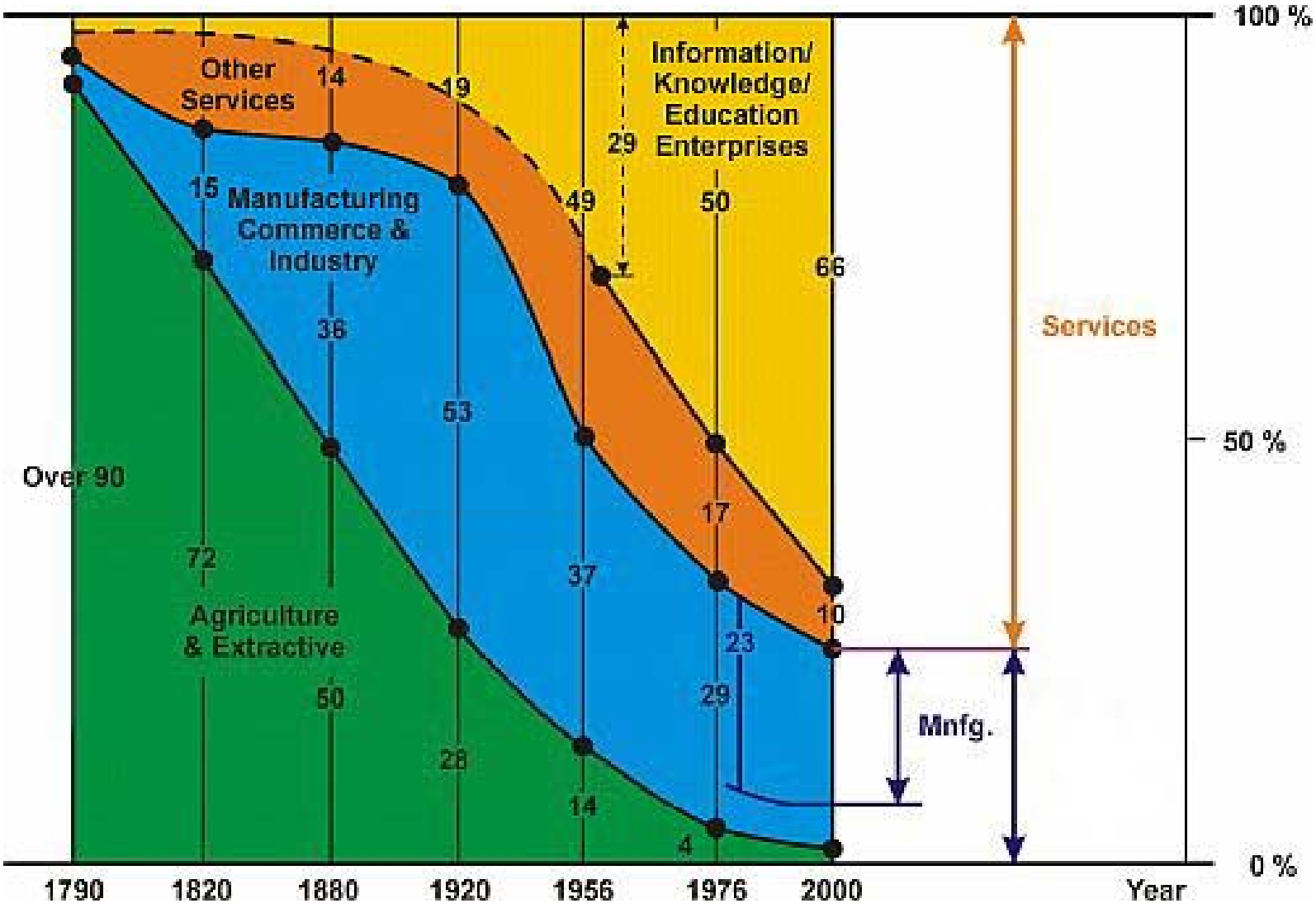
- **Over the past three decades, services (knowledge-intensive services) have become the largest part of most industrialized nations' economies**

- ***"As goods become more information-intensive and interactive and are continually upgraded, they change character. They lose their status as products and metamorphose into evolving services."***

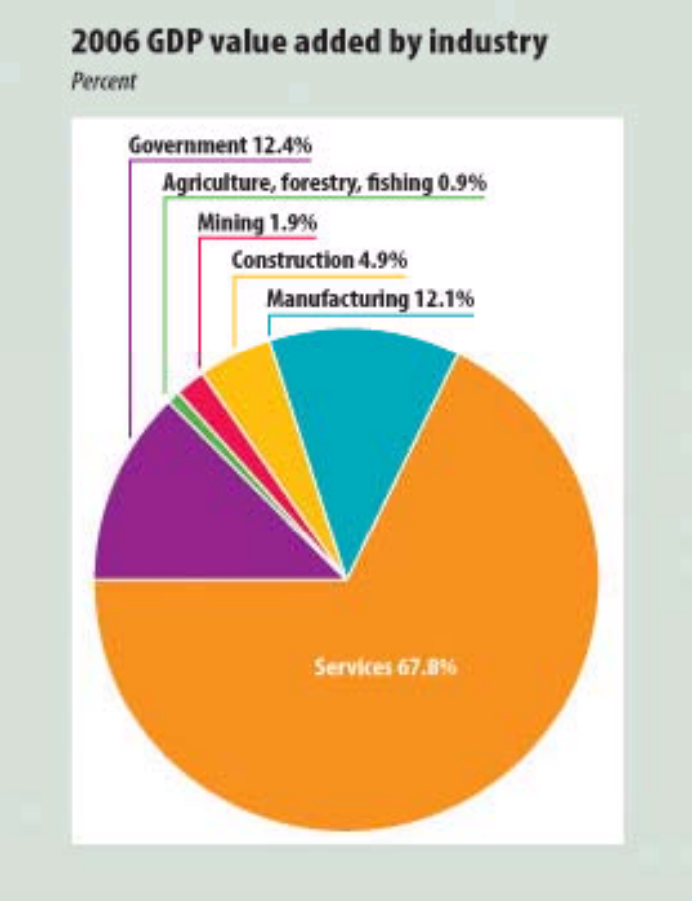
Jeremy Rifkin, "The Age of Access"

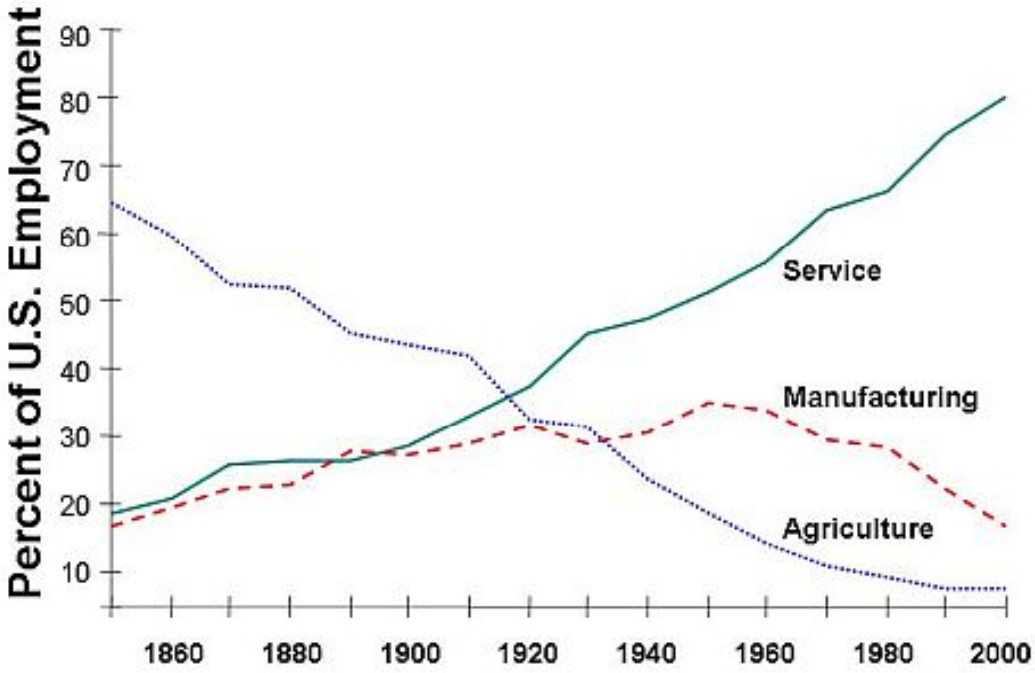
- **Many products are being transformed into services and, in general, products integrate a higher and higher service component into them.**

Towards a Knowledge-Based…



…and Service-Oriented Economy





Source: U.S. Department of Commerce, Bureau of the Census 2003

Projects and Systems Evolution

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- Products/Services more and more complex (“Systems of systems”) and “network-centric”
- The “network-centric” paradigm, originally conceived for military applications, progressively migrating towards “welfare” applications, such as safety, security, environment protection and monitoring
- Software intensive (typical software dimension for a network-centric system: about 25 million lines of code)
- Capability-based rather than equipment-based
- Enterprise organization rather than traditional structured hierarchy
- Operational performances are very important: Quality of Service (QoS), Reliability, Safety, Security, Flexibility, Expandability, Interoperability, Resilience

Increasing rate of technological innovation

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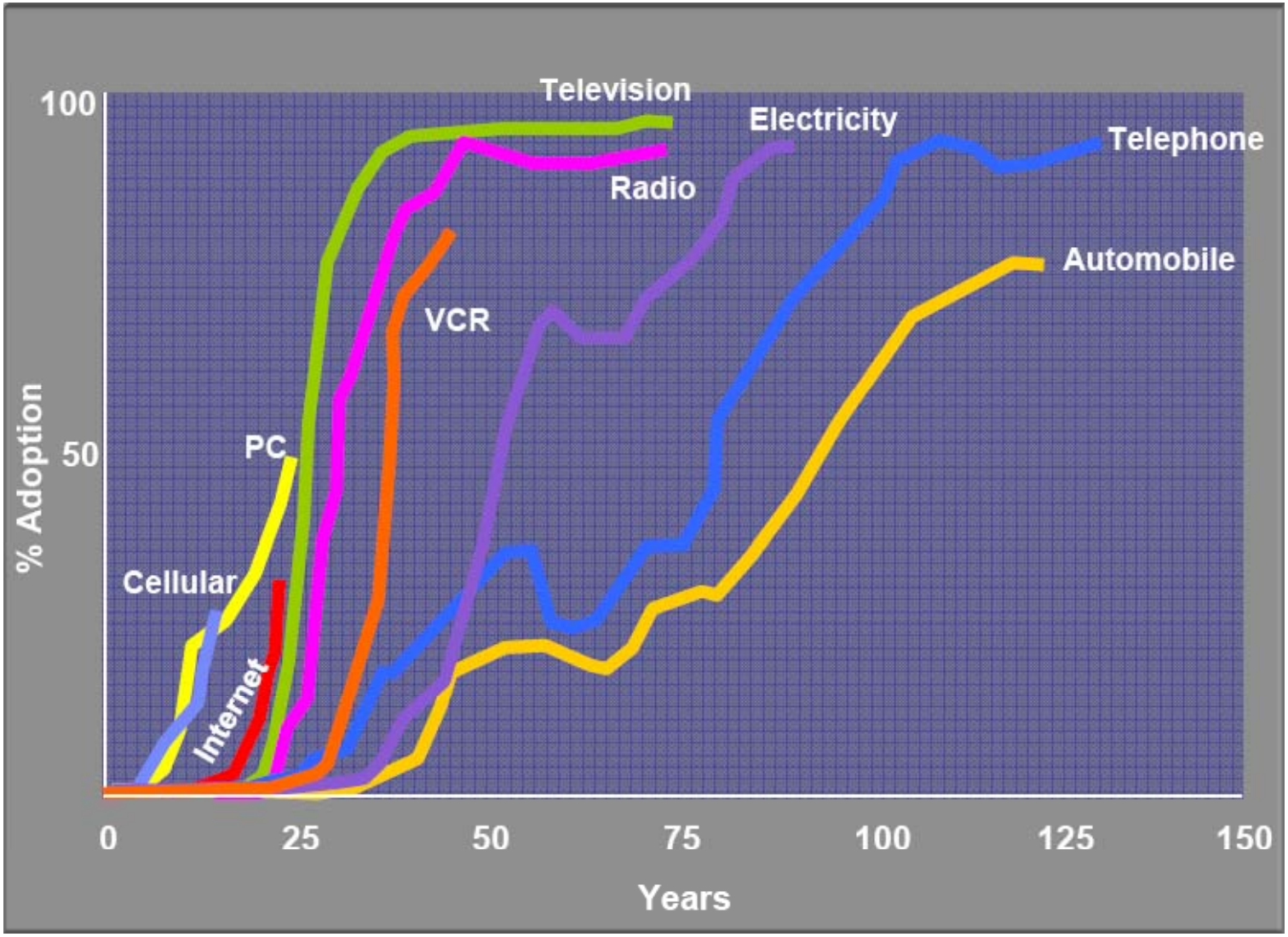

Products become more and more Software-intensive

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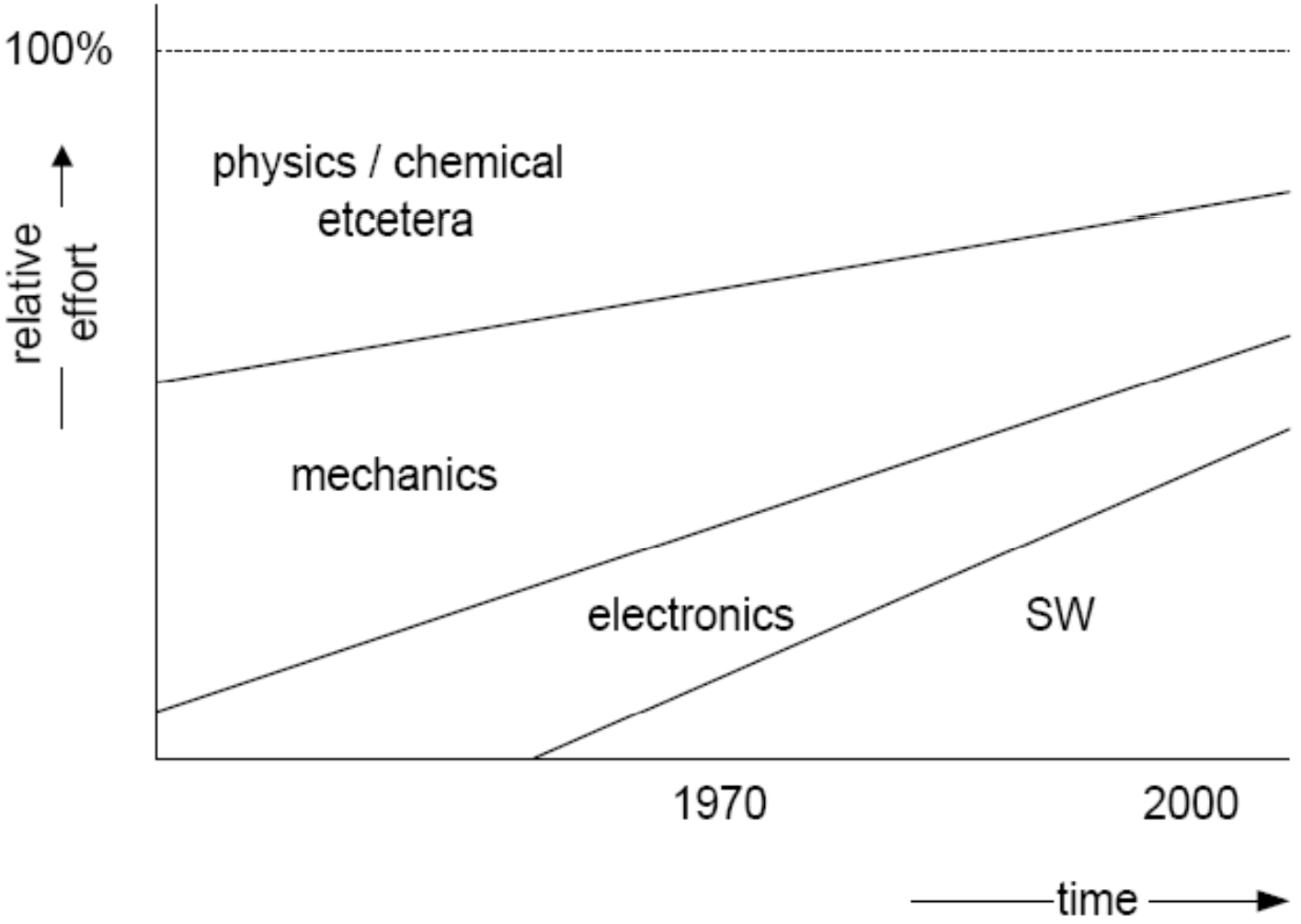

From Platforms to Systems of Systems

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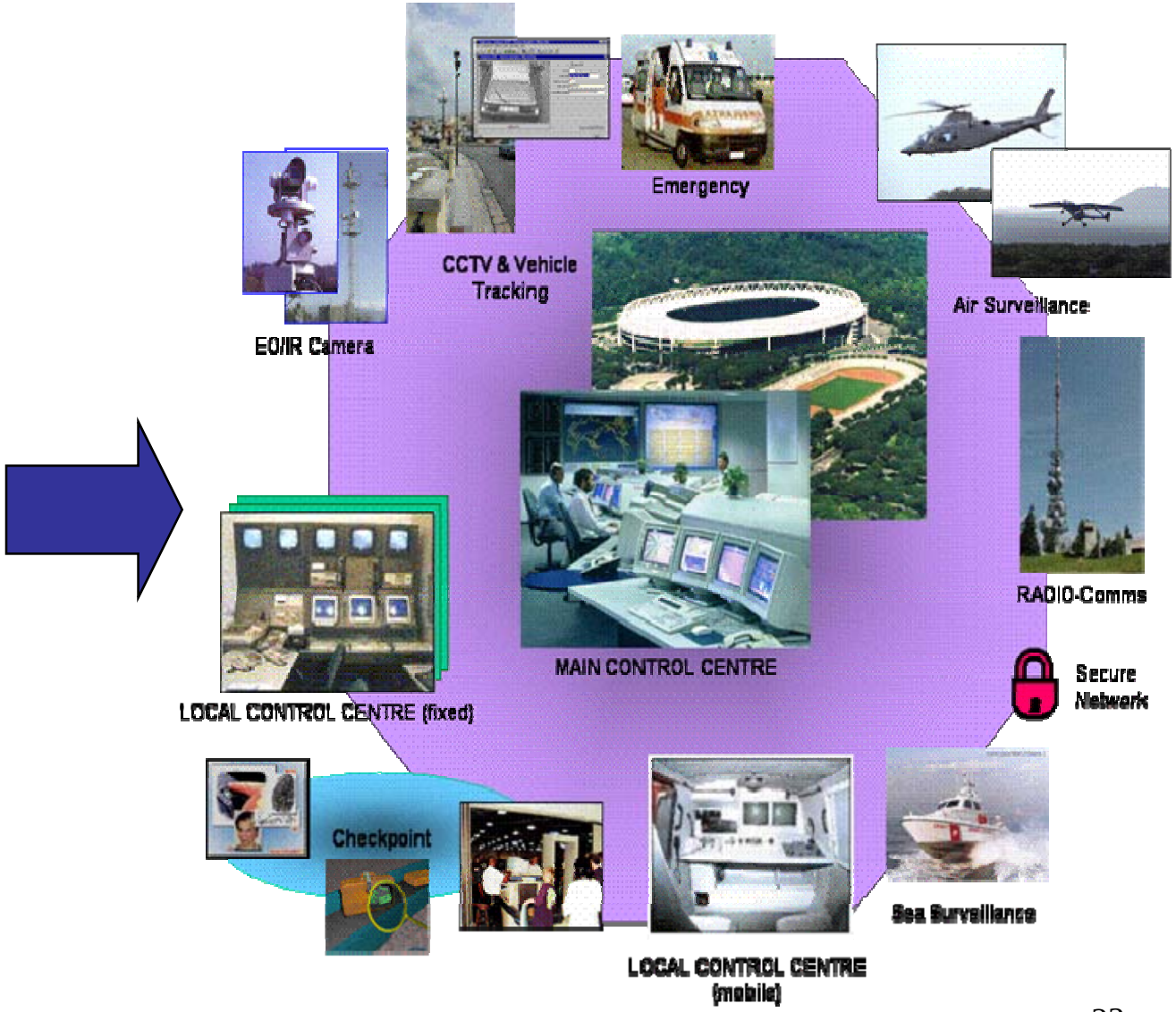

Network Centric Systems and Systems of Systems

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- The need for Net-Centricity and Systems of Systems derives from the paradigm shift taking place in the world, that is the advent of a service-based economy;
- A System of Systems connects multiple systems to solve a large scale problem; a system of systems is therefore network centric by its very nature;
- Service systems, that is, systems meant to deliver value-added services (capability-based rather than platform-based), are network centric and computational systems;
- Through service systems, the network centric paradigm, originally conceived in a warfare environment, is extending itself to Homeland Security and to other critical ICT infrastructures (Network Centric “Welfare” systems, such as Air Traffic Management, Emergency and Disaster Management, Electrical Distribution Management, etc.).

Network Centric
System of Systems Architecture

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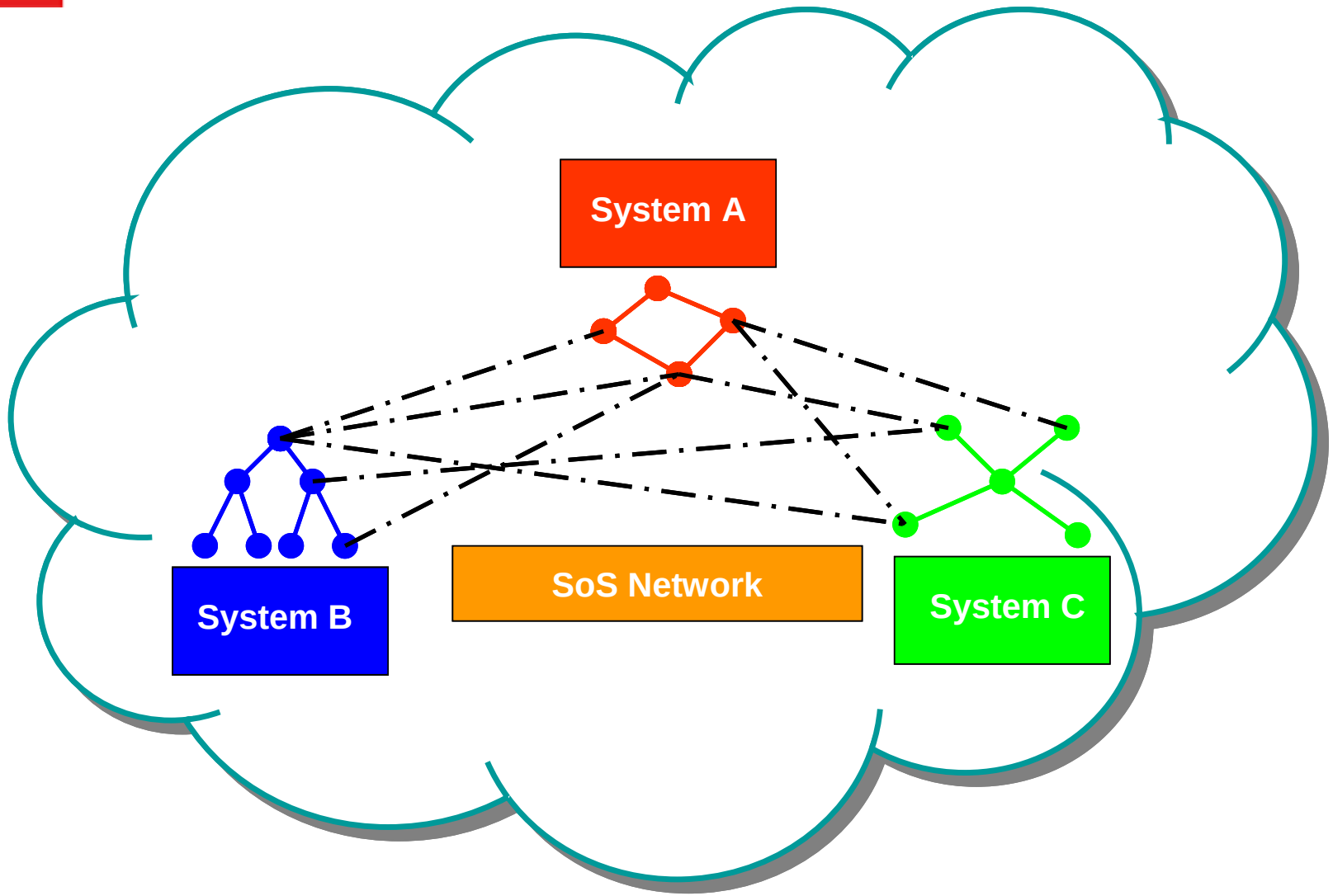

Satellites in Network-Centric Systems of Systems

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Network Centric “Welfare” Scenario

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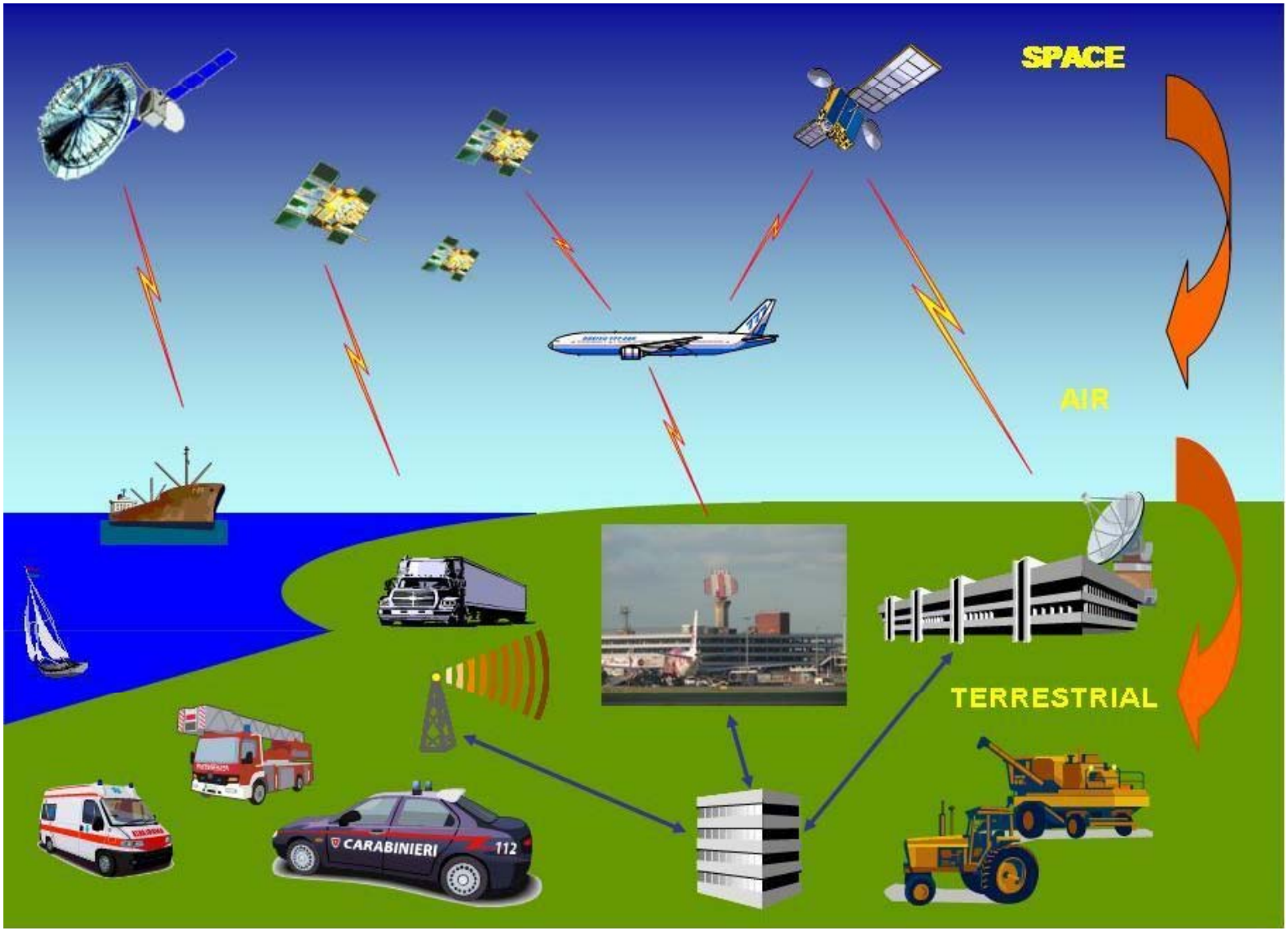

The Network-Centric Revolution

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- The world is “flat”
- Abundance (sometimes excess) of information
- Competition: providing ever higher value-added services
- Network-centric systems:
  - Decentralized, delocalized, distributed (e.g. Grid Computing)
  - Collaborative, concurring, interoperable (e.g. SOA, semantic technologies, Web 2.0)
  - “context sensitive” (e.g. infomobility)
  - Human and organizational factors (not just h/w and s/w)
- Network-centric society: ubiquitous, multimedial, interactive, “any to any, anytime, anywhere”.

The Evolving Role of Satellite Systems

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- Space-based systems have already an undeniable role in the provision of a wide range of valuable applications, spanning from global security to broadband communications, to Earth monitoring and to environmental and disaster management
- They are in fact ideal means to observe, gather and transmit information
- However, despite hard learned lessons and historic “flops”, the space industry still maintains a narrow-minded vision of its business
- Rather than being the core of stand-alone systems, satellites need to integrate into larger, complex systems, in a “network-centric” perspective
- Tomorrow’s space based systems must be service-centered rather than technology-centered.

The Killer Application is: “Integration”

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- Emerging scenario: integration of all communications networks (wireless nets, satellites, microwave and landline links) as well as a multi-layer convergence of networks, services and terminals
- In an integration perspective, operational performances of satellite systems assume special importance:
  - Quality of Service (QoS)
  - Reliability
  - Safety
  - Security
  - Dynamic reconfigurability
  - Flexibility
  - Expandability
  - Interoperability
- Flexibility of integration and dynamic reconfigurability can be achieved through Web services and Service Oriented Architecture (SOA) approaches.

Satellite Integration in Network-Centric Architectures

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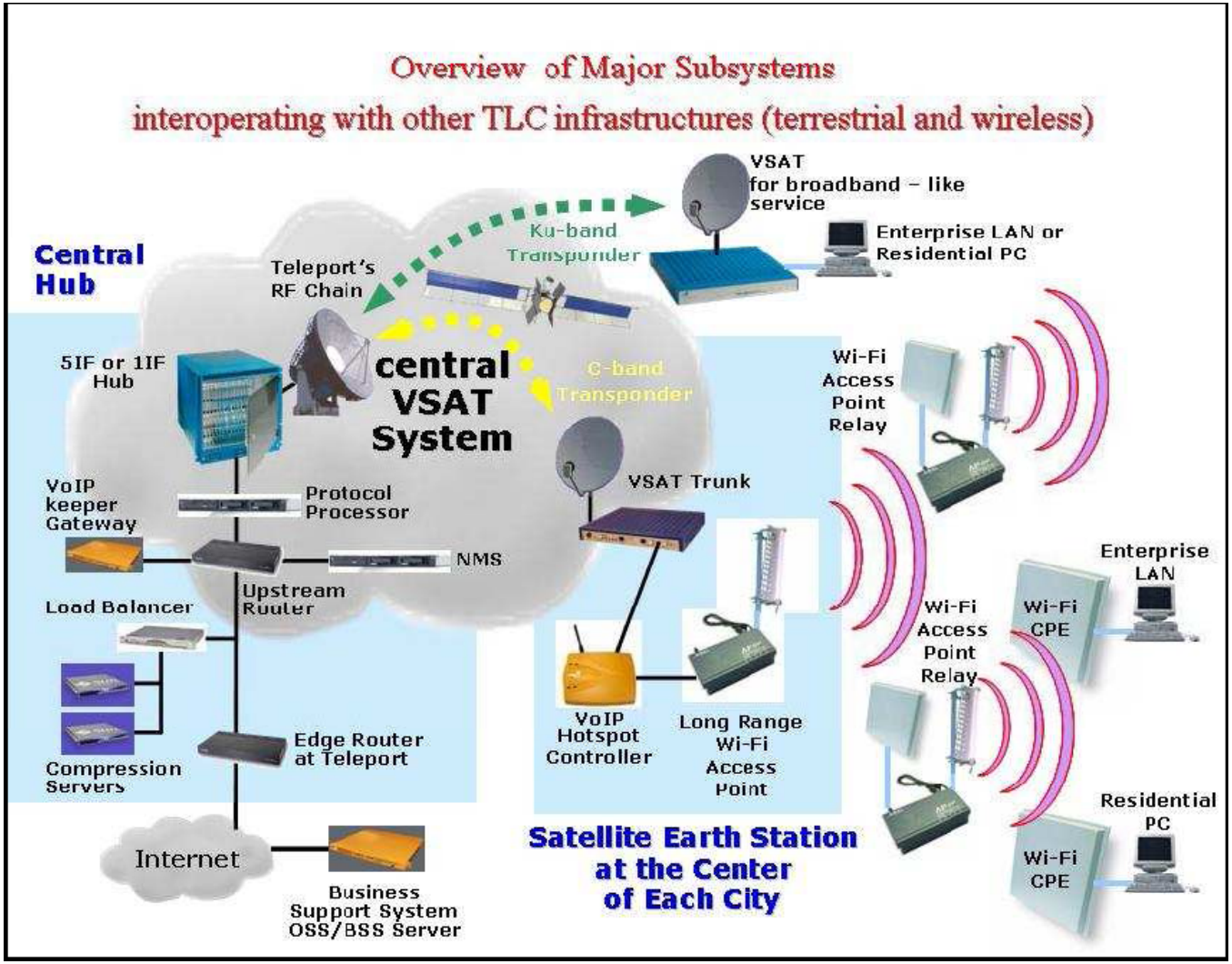

The Dual-Use COSMO-Skymed Earth observation System

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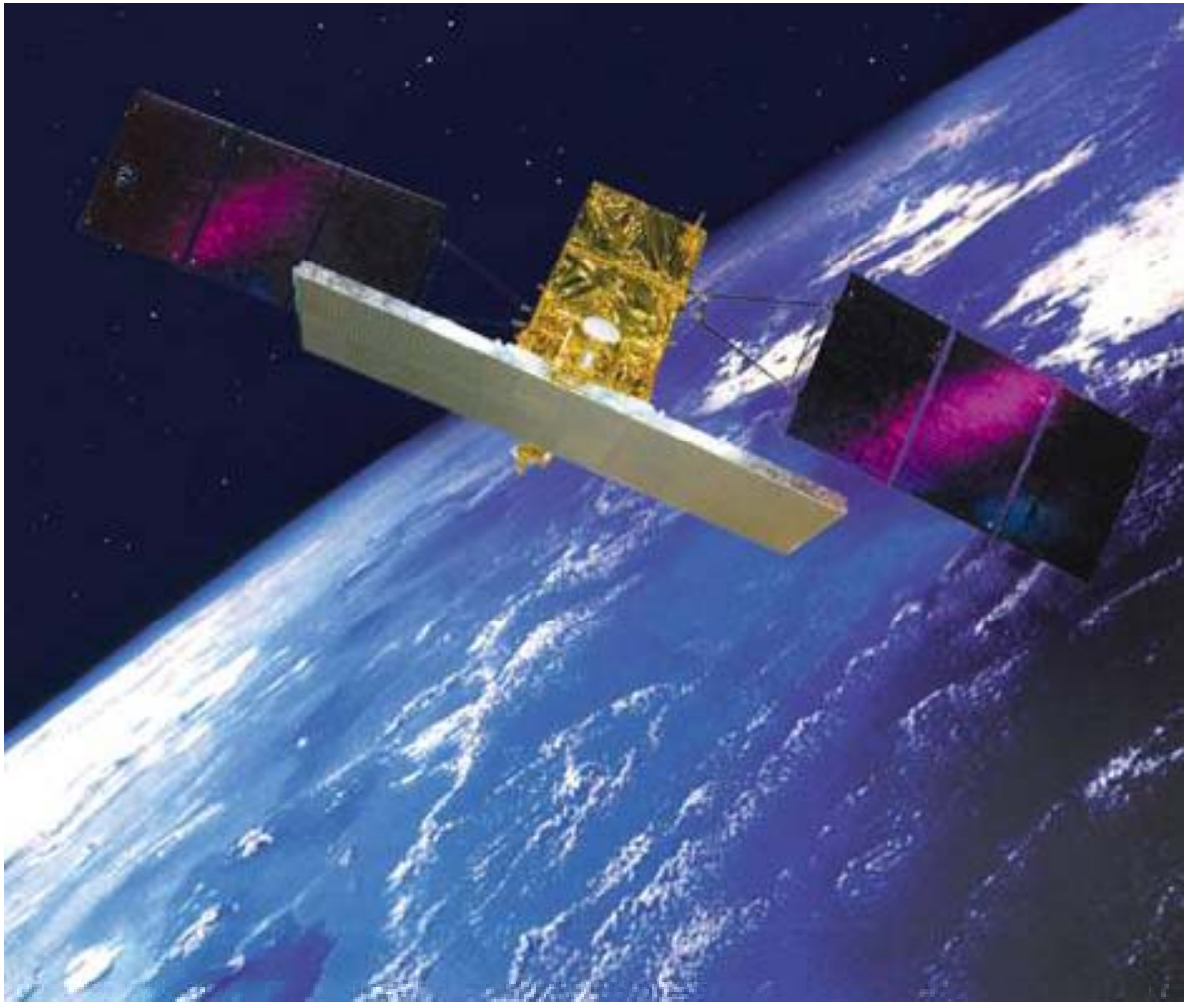

COSMO-Skymed Network-Centric Ground Segment

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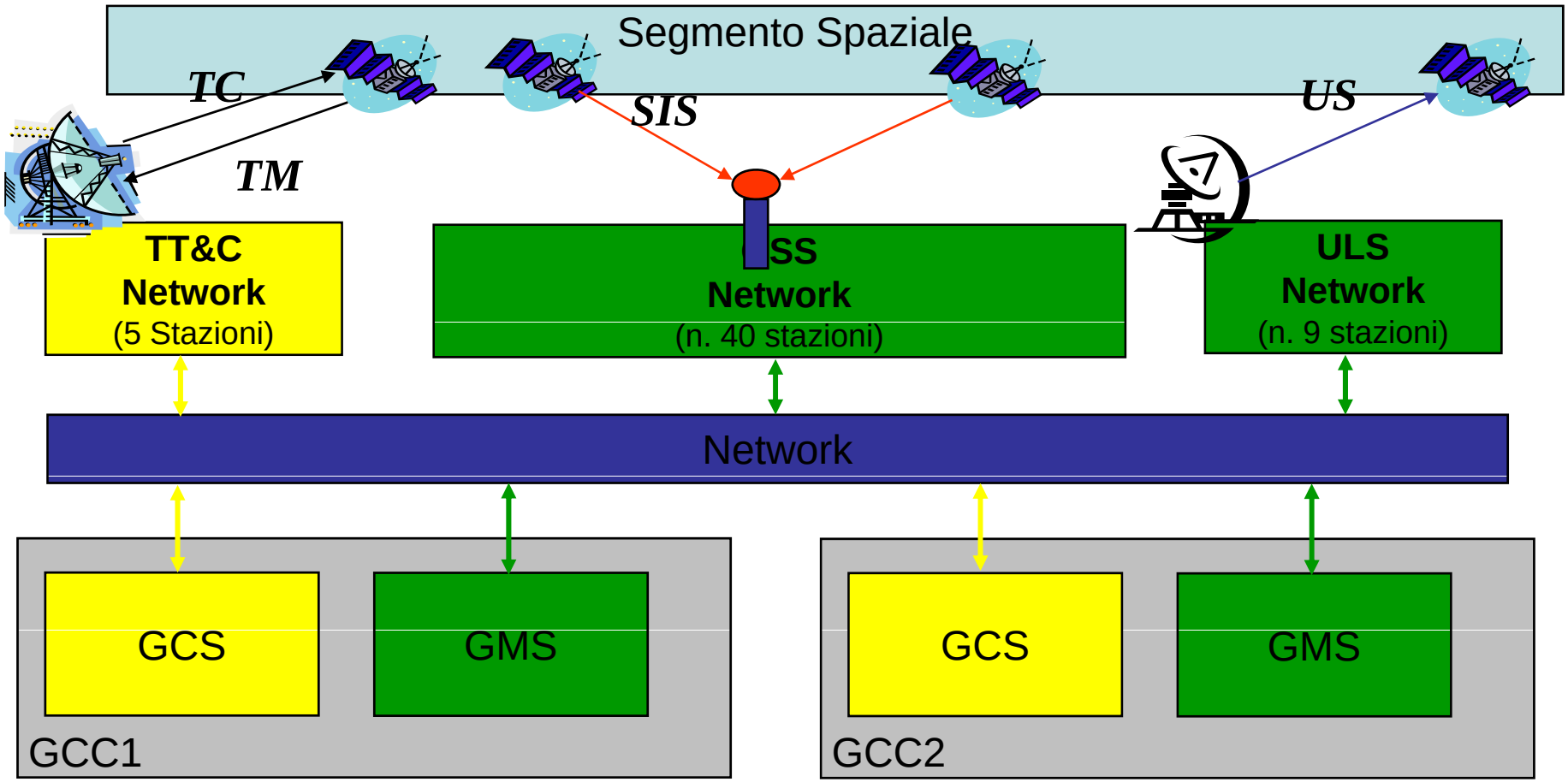
The European Galileo System



The Galileo “System of Systems”

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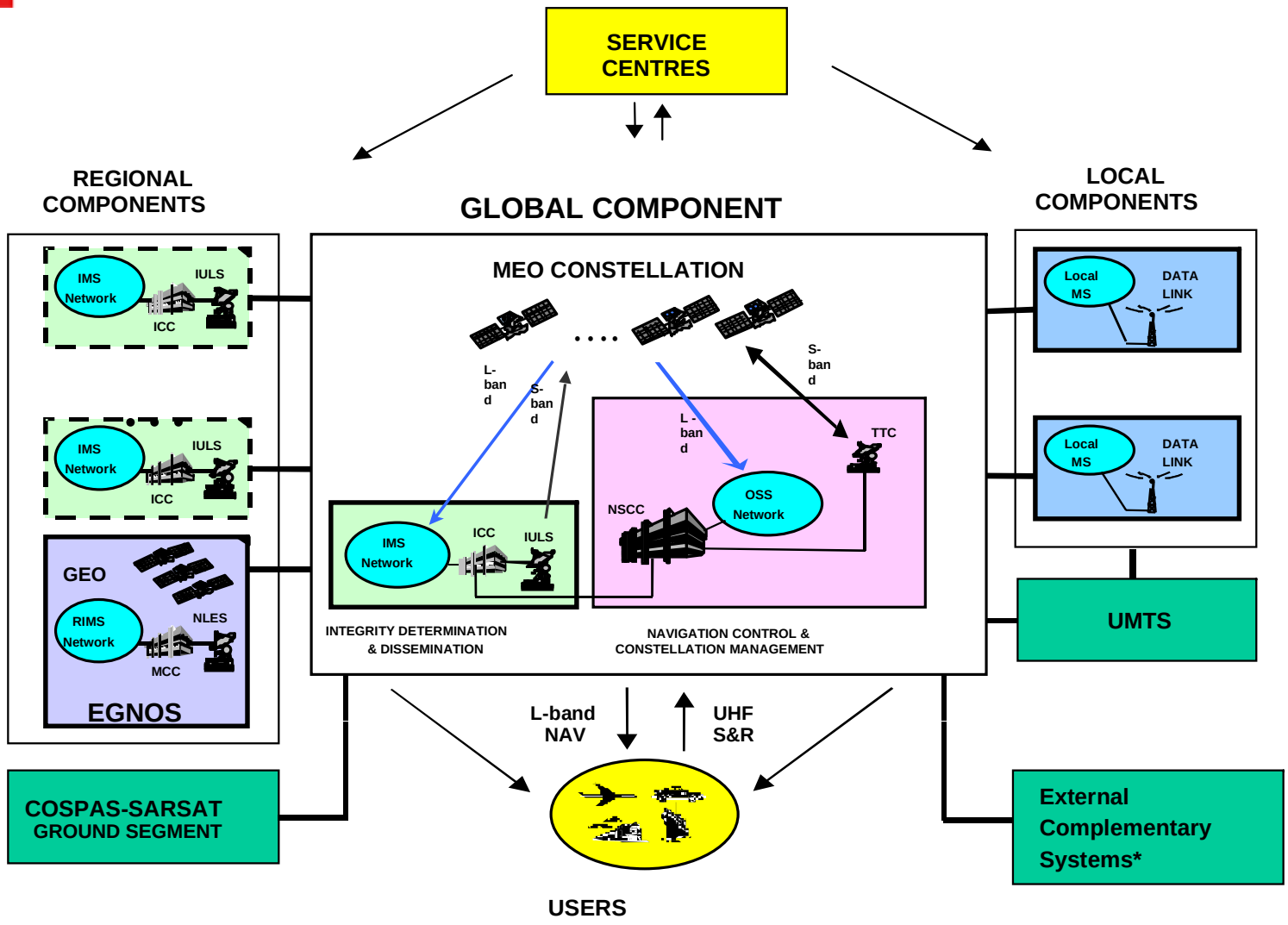

Location Based Services: “Network-Centric” Services

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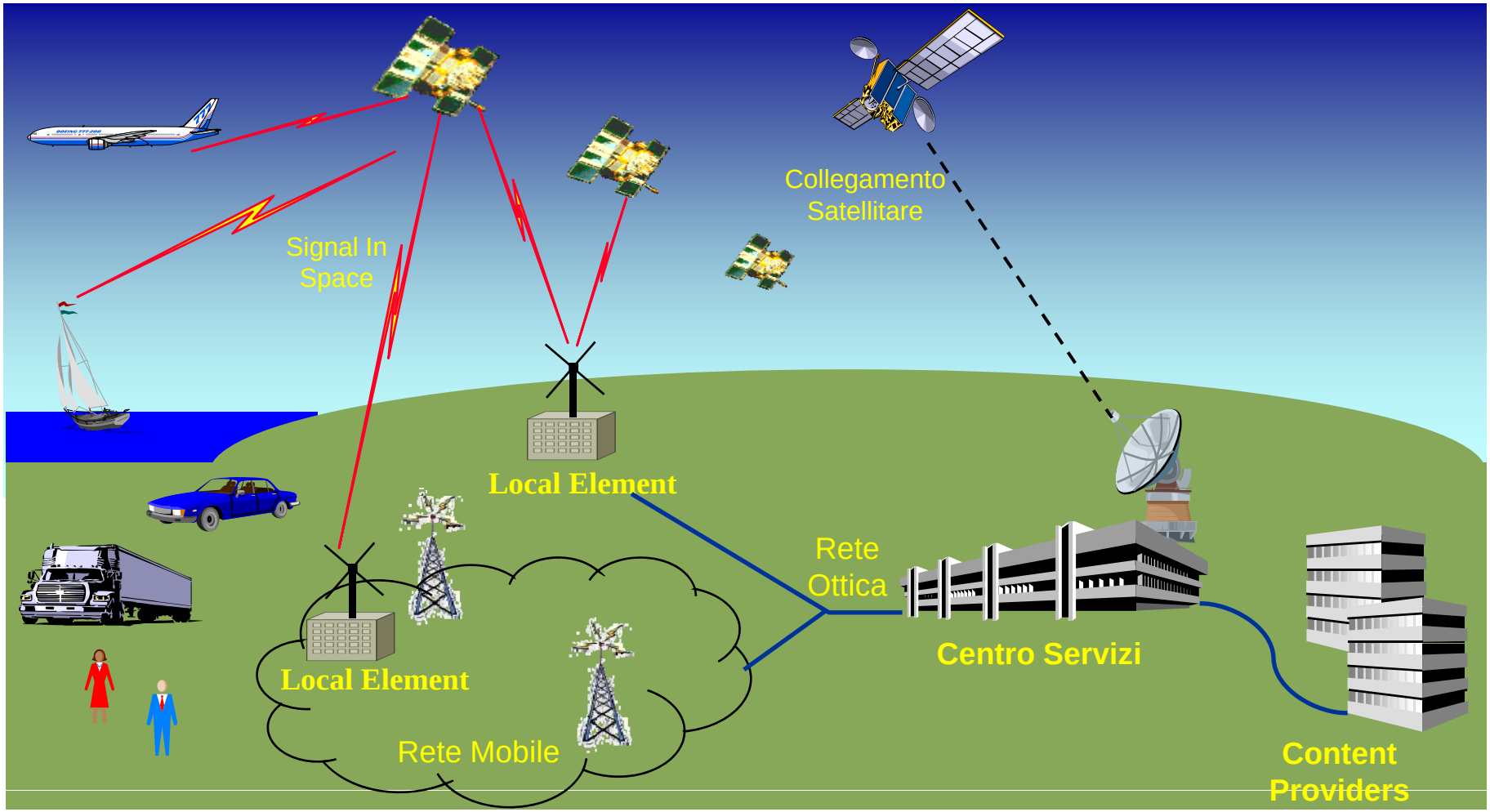

Today's Air Transportation System

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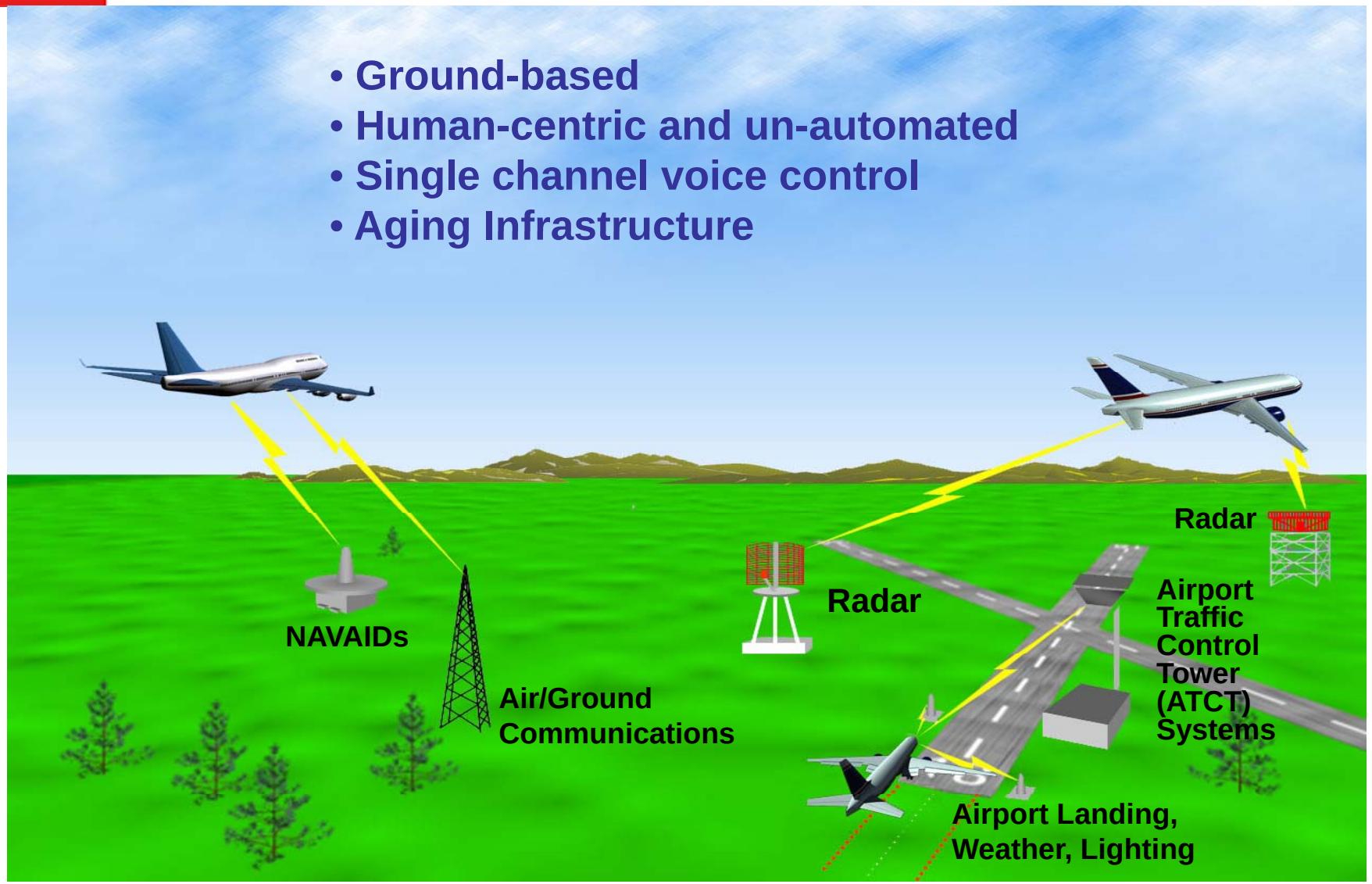

US Next Generation Air Transportation System (NextGen)

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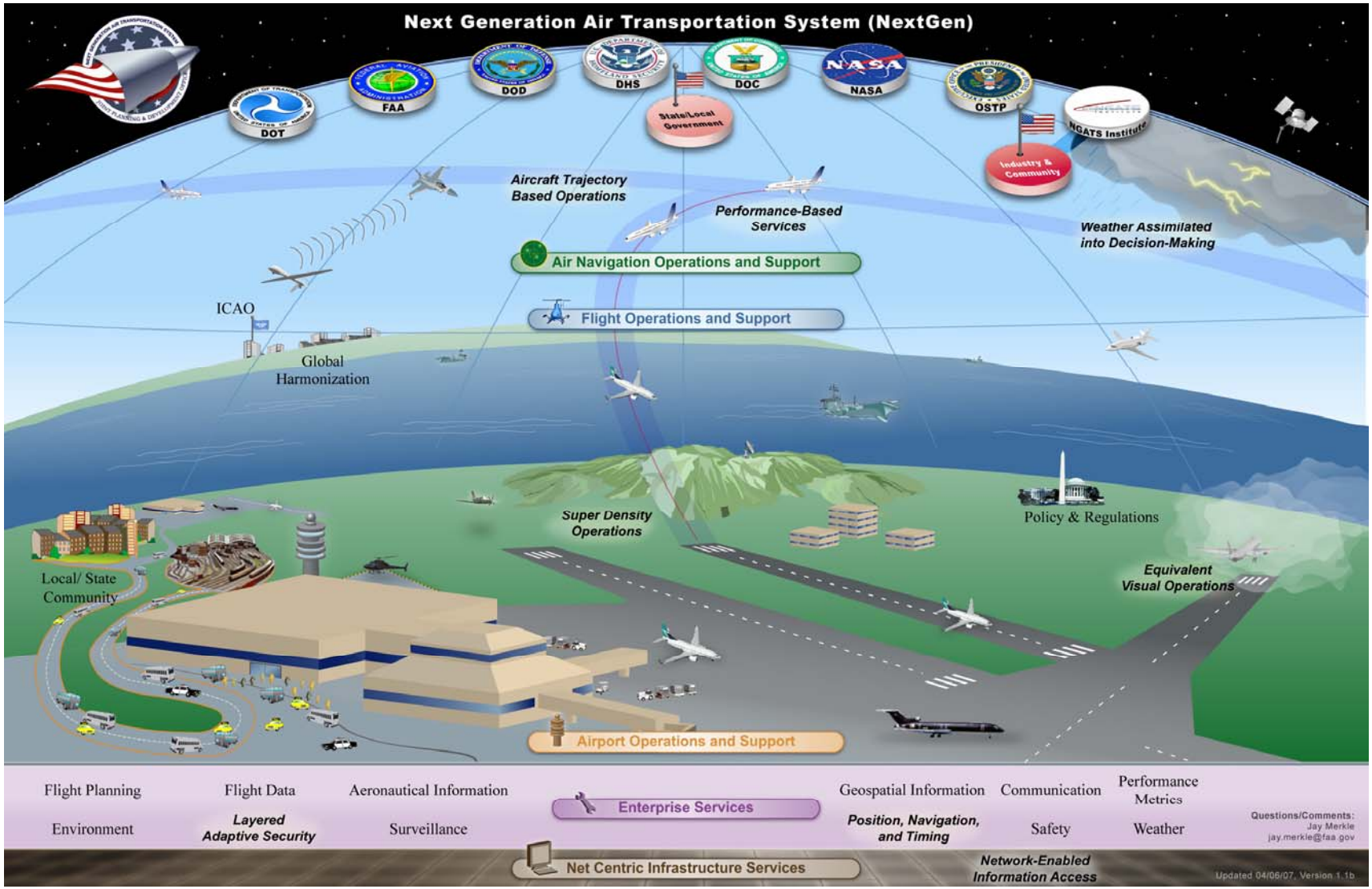

Single European Sky (SESAR)

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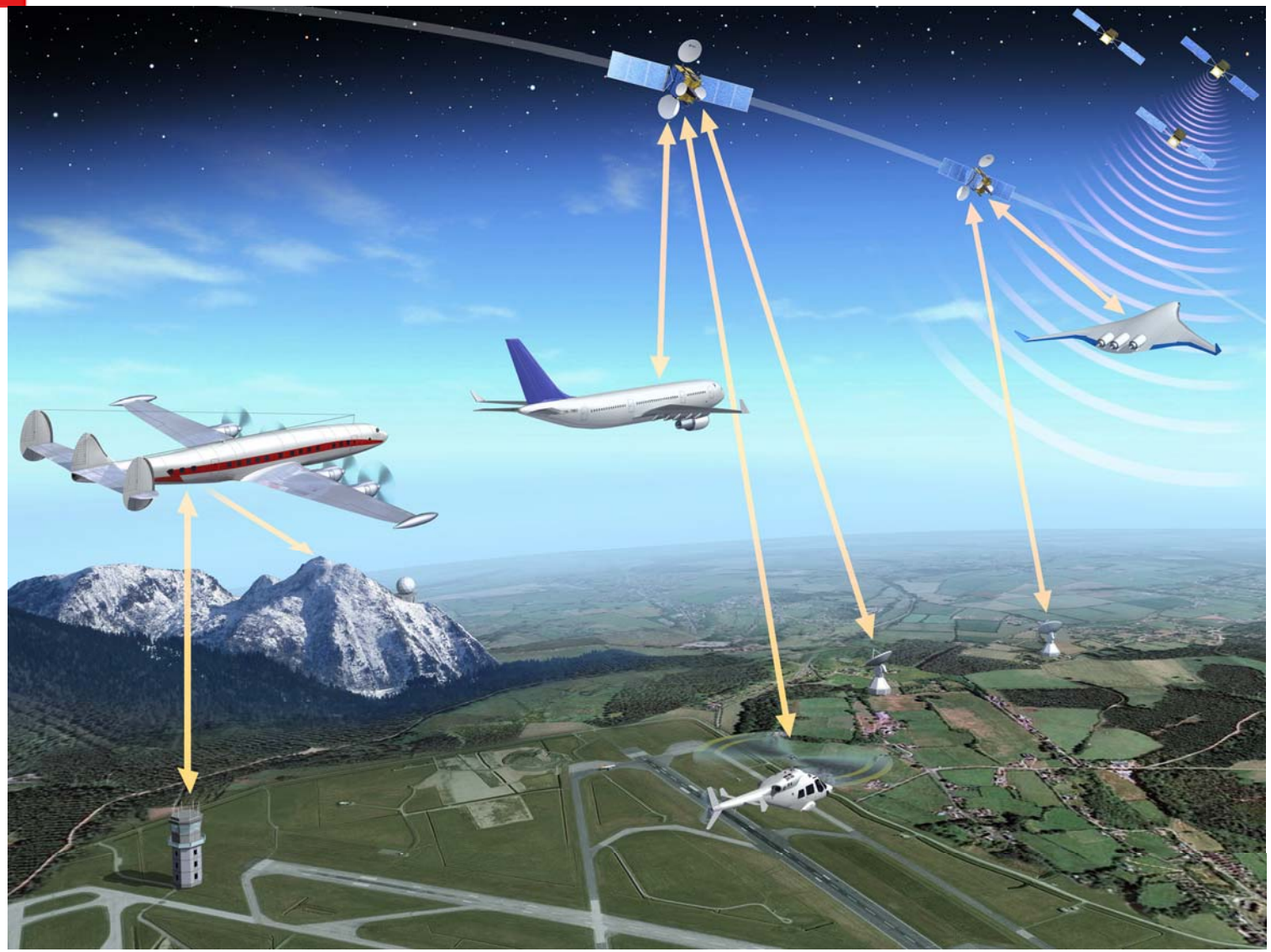

Are we getting ready for the next disaster?

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Network Centric Emergency Response Architecture

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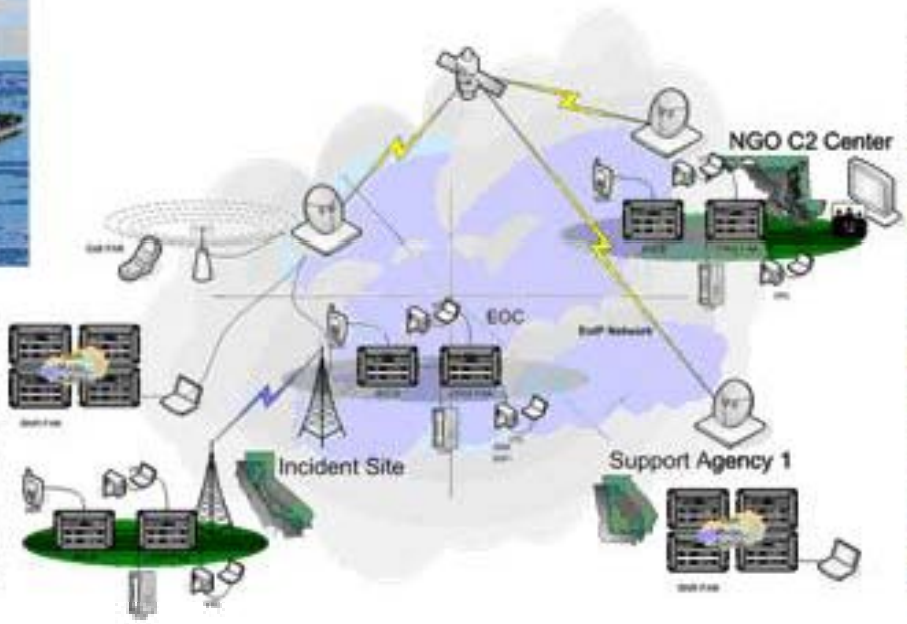

The Multinational Telecoms Adaptor (MTA) Project

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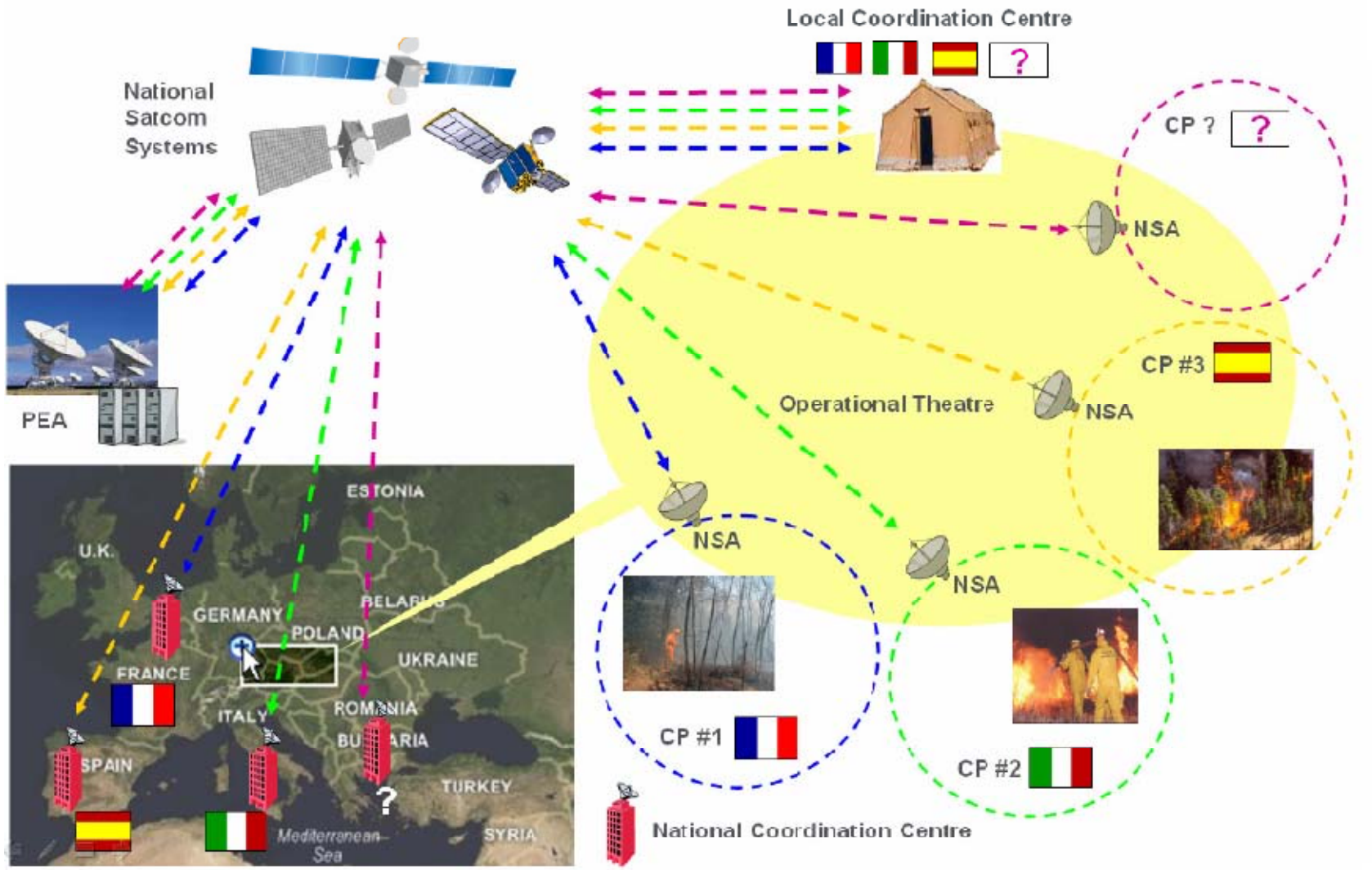

The GMES System of Systems

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- GMES (Global Monitoring for Environmental and Security) is a space and in-situ based Earth observation system, which will be the European contribution to the international Global Earth Observation System of Systems (GEOSS)
- The overall GMES architecture comprises five major elements:
  - space observations
  - in-situ observations
  - data integration
  - information management
  - services

SoSs Need an Overarching Information Infrastructure

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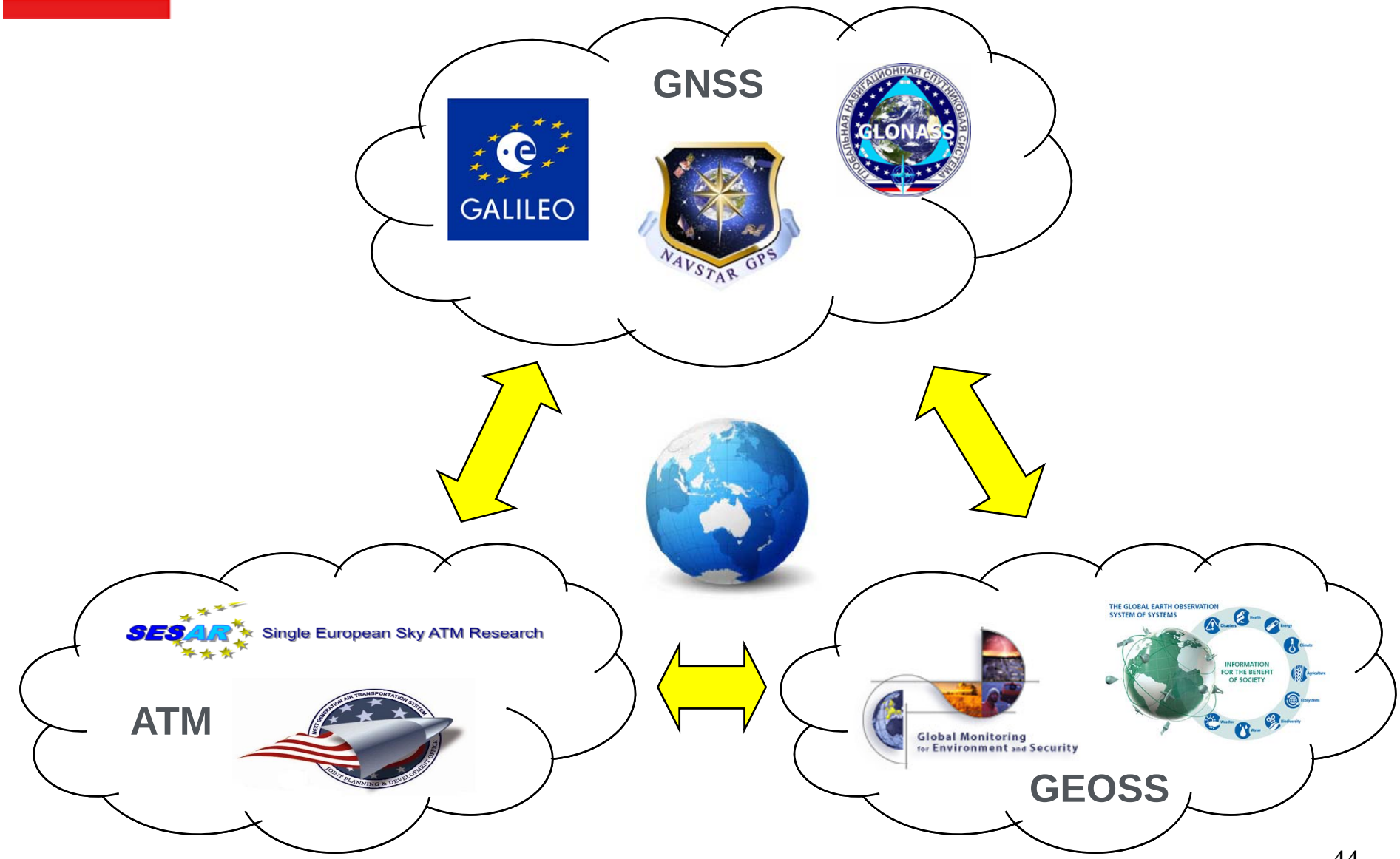

Global Information Grid Architectural Stack

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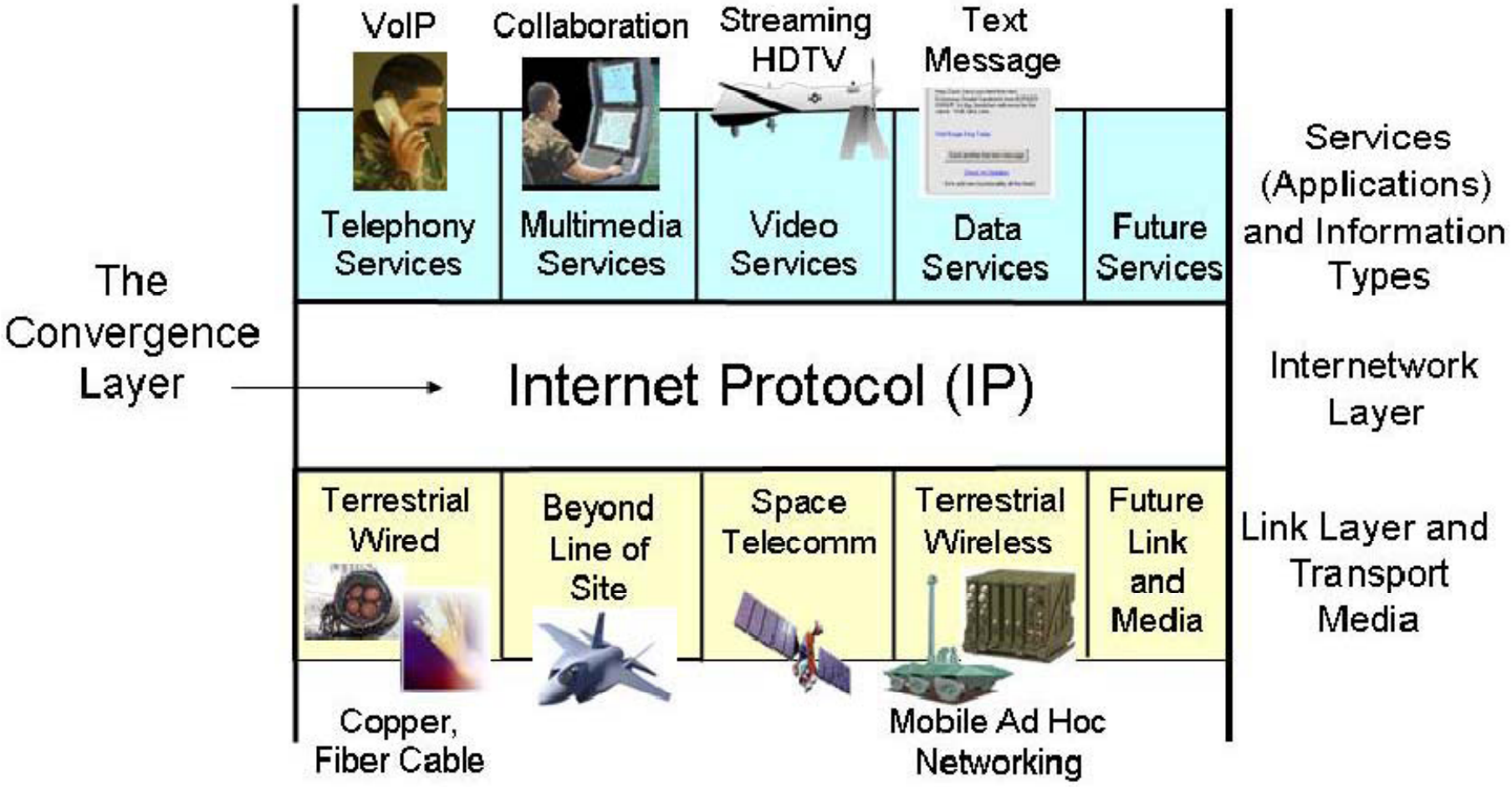

Worldwide Welfare Information Infrastructure (W2I2)

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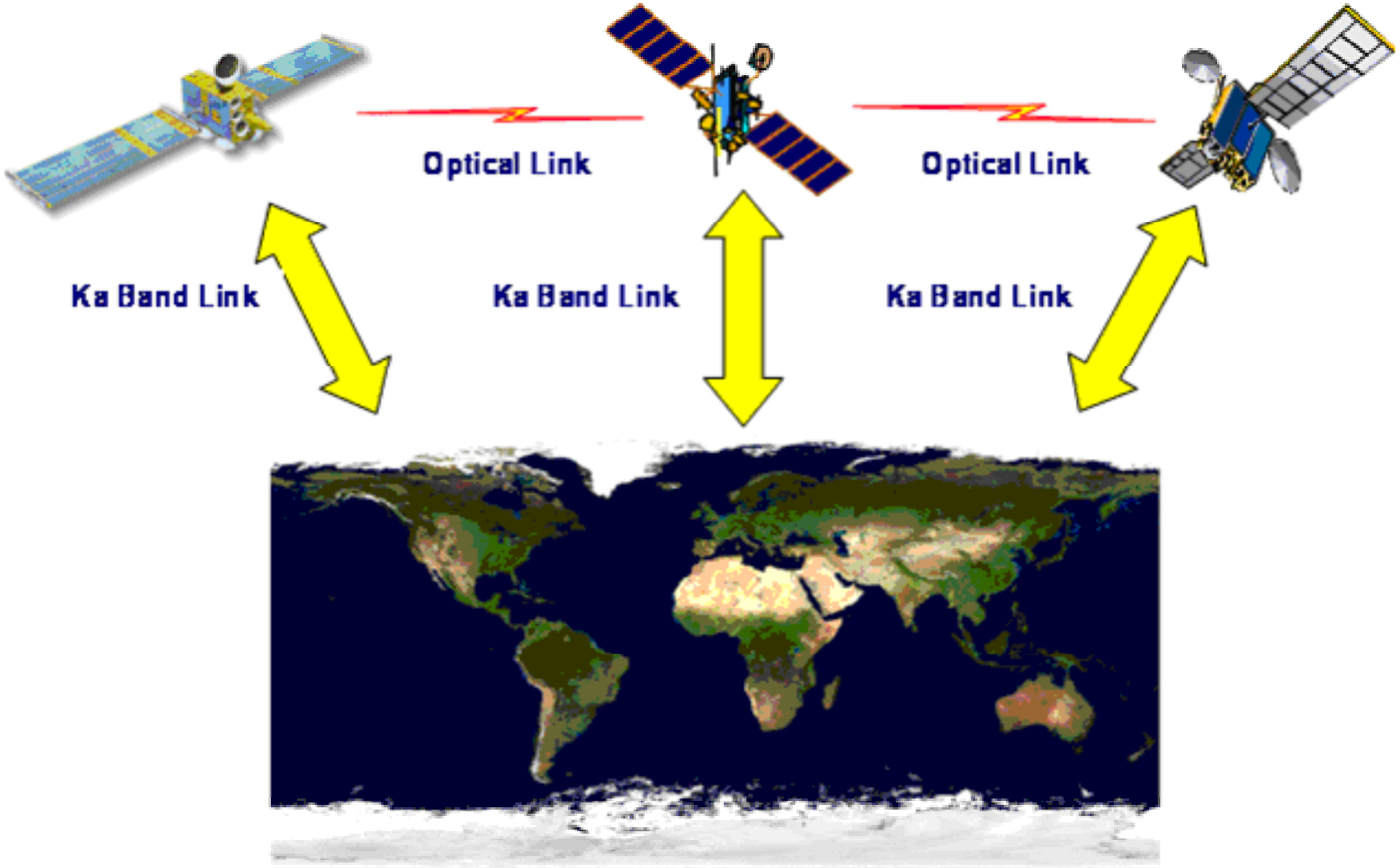

Satellite Systems and Information Security

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- In a network-centric perspective, satellite systems need to incorporate standardized and certifiable approaches to information security
- So far information security has been perceived as a customized add-on, leading to a variety of security requirements and to a number of proprietary solutions, adopted by space agencies and industries
- Certification standards and security solutions for network-centric military systems can be effectively applied to complex, network-centric satellite systems
- Information security features, including encryption, keys management and conditional access control, will have to be designed into the network from the beginning, as an integral part of it.

Conclusions

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- At the heart of an information sharing society there must be a global communications infrastructure, seamlessly integrating fixed and mobile terrestrial networks as well as satellites;
- Satellite communications can play a pivotal role in providing the interoperable, robust, ubiquitous, "network-centric" communications needed for the provision of worldwide value-added services;
- More generally, satellites will fit very well in future network centric scenarios as ideal means to observe, gather and transmit information;
- A drastic paradigm shift is needed: tomorrow's space-based systems must be "service-centered" rather than "technology-centered".