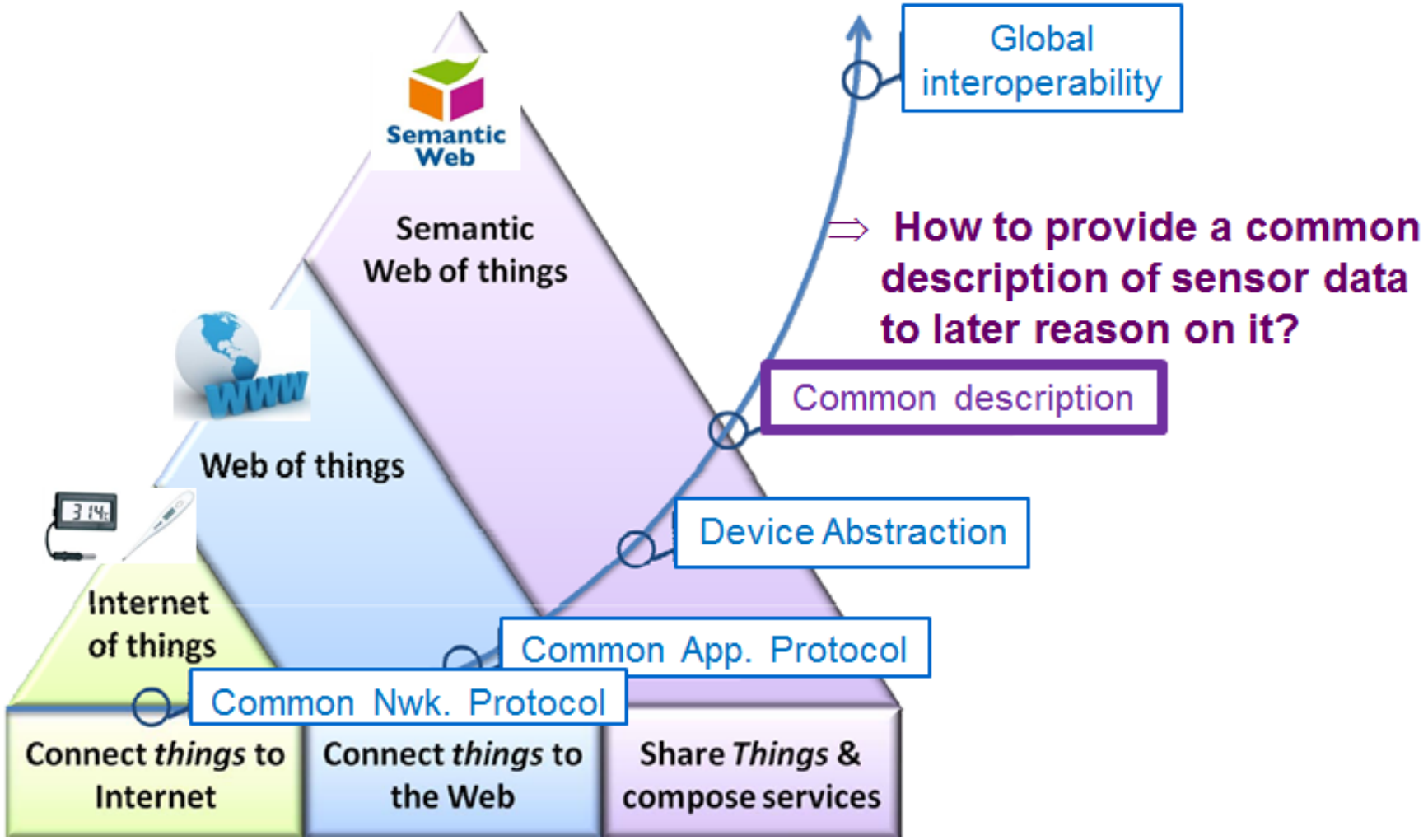
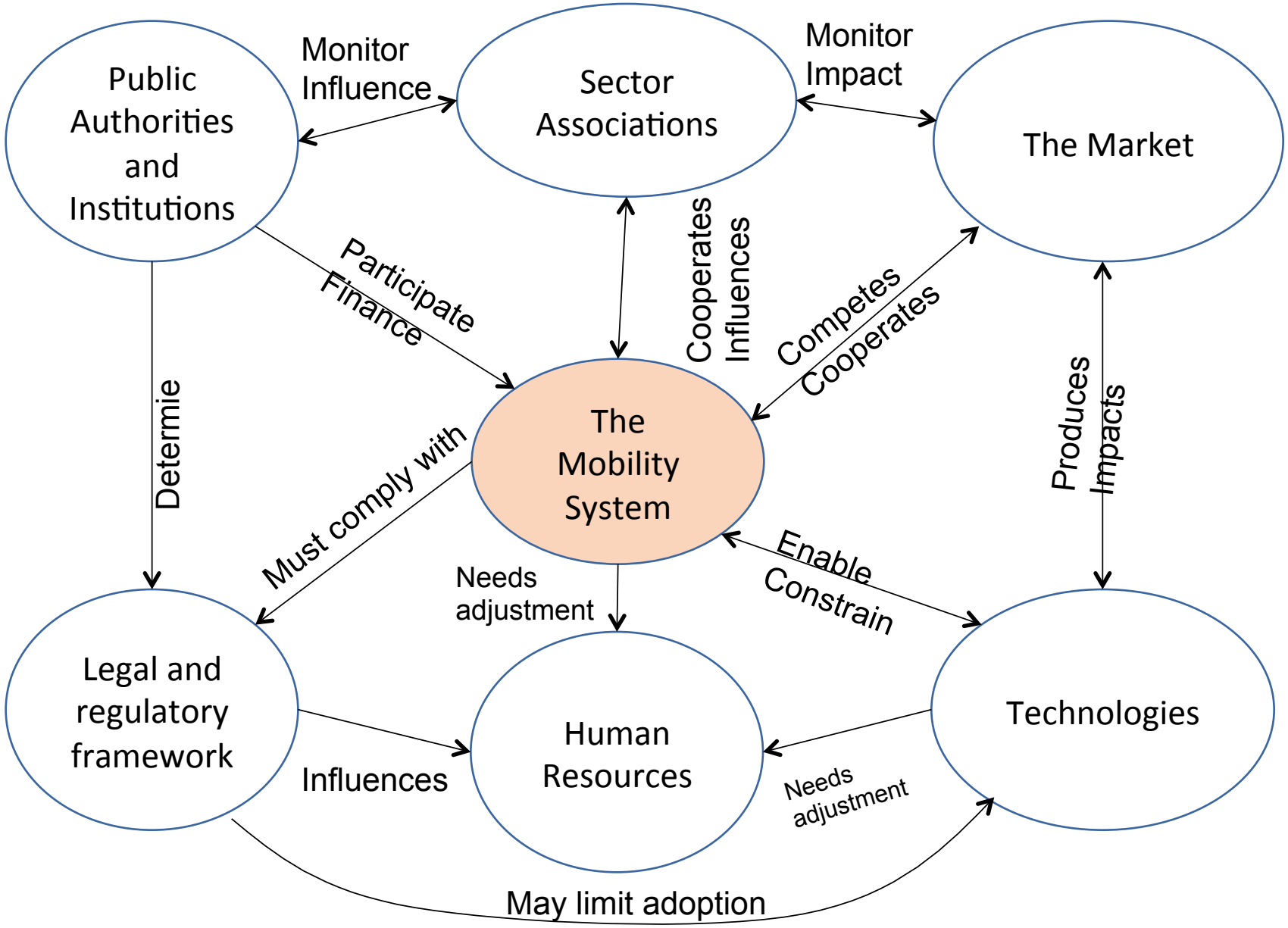
The obscure we see eventually,
the completely apparent takes longer

Edward R. Murrow

The Web of Everything



Effective innovation happens in a *context*



I thought I was engaging in HEP research
I couldn’t get any computer time, wandered into IT department
I discovered a fascinating subject and a group of «rebels»

Later at IBM designing large distributed computing systems
I couldn’t get to fit them into the SAA framework
Assisted in a spectacular turnaround

Oct 1972: first Flight Airbus A300

Apr 1979: first Ariane I launch

Feb 1982: first Flight Airbus A310

Feb 1986: first Flight Airbus A320

May 1986: first Ariane II launch

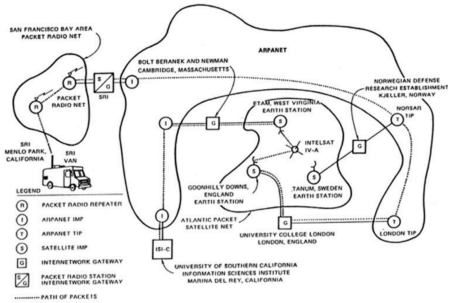
Mid 80s to 90s: Bosch Jetronic / Motronic electronic fuel injection

1990s Diesel common rail technology

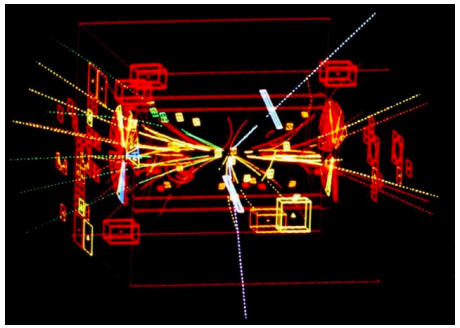
May 1976

Super proton synchroton startup

1975: ARPANET declared operational



Jan 1983



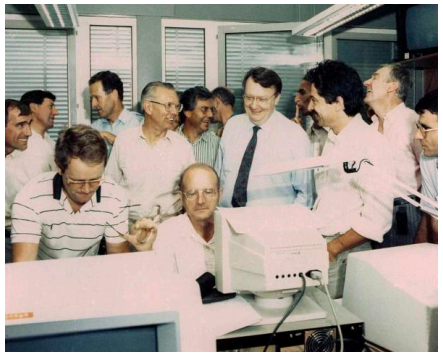
W and Z particles discovered

May 1983: ISO publishes “ISO 7498: The Basic Reference Model for Open Systems Interconnection” as an international standard.

1985: U.S. National Research Council recommends that the Department of Defense migrate gradually from TCP/IP to OSI

June 1986: Réseaux Associés pour la Recherche Européenne (RARE) «Constitution»

Jul 1989

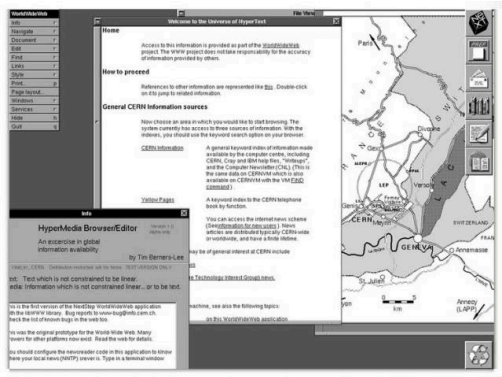


LEP collider first injection

1988: U.S. Department of Commerce mandates that government agencies buy OSI compliant products.

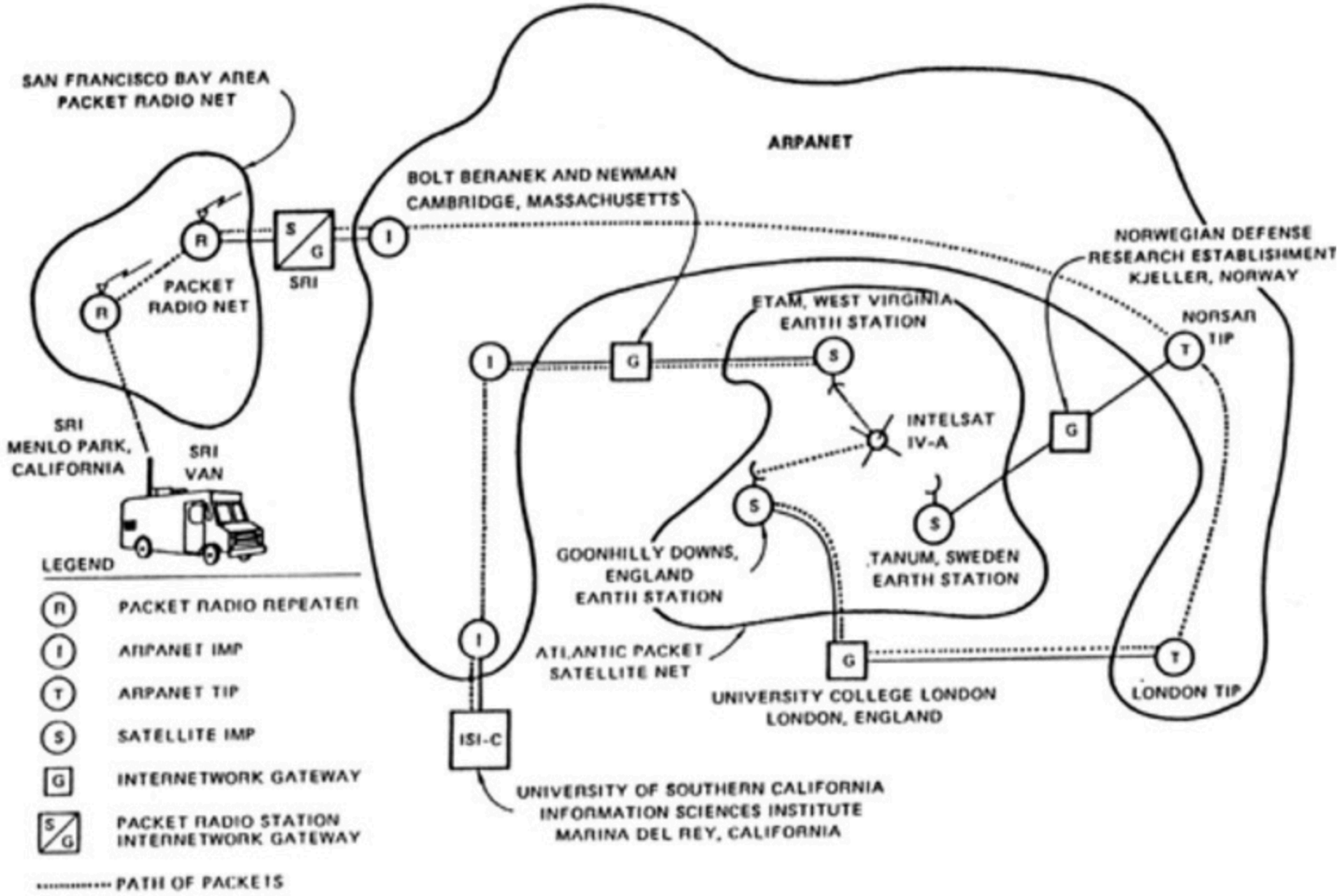
1988: CERN’s B. Carpenter «COSINE implementation: the view from a major site.» COSINE could regain its credibility […] by endorsing immediate actions that are not hampered by insistence on pure OSI products

Dec 1990



First website and server

1989: CERN’s B. Carpenter «Is OSI too late?»


SAN FRANCISCO BAY AREA
PACKET RADIO NET
ARPANET
BOLT BERANEK AND NEWMAN
CAMBRIDGE, MASSACHUSETTS
NORWEGIAN DEFENSE
RESEARCH ESTABLISHMENT
KJELLER, NORWAY
PACKET
RADIO NET
SRI
ETAM, WEST VIRGINIA
EARTH STATION
NORSAR
TIP
INTELSAT
IV-A
SRI
MENLO PARK,
CALIFORNIA
SRI
VAN
GOONHILLY DOWNS,
ENGLAND
EARTH STATION
TANUM, SWEDEN
EARTH STATION
ATLANTIC PACKET
SATELLITE NET
UNIVERSITY COLLEGE LONDON
LONDON, ENGLAND
LONDON TIP
ISI-C
UNIVERSITY OF SOUTHERN CALIFORNIA
INFORMATION SCIENCES INSTITUTE
MARINA DEL REY, CALIFORNIA
LEGEND
PACKET RADIO REPEATER
ARPANET IMP
ARPANET TIP
SATELLITE IMP
INTERNETWORK GATEWAY
PACKET RADIO STATION
INTERNETWORK GATEWAY
PATH OF PACKETS

"The formal establishment of RARE was activated by signing of the constitution by the new officers in Amsterdam on June 13th 1986.

[…] After some 22 international meetings to agree the details of the organization, the final signing was over in an hour, and was followed by a pleasant social lunch. […]

The constitution allowed only one member per country, and limited eligibility for full membership to: Austria, Belgium, Denmark, Finland, France, Germany (Federal Republic), Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom of Great Britain and Northern Ireland, and Yugoslavia.

The document signed that day in Amsterdam was in Dutch and ran to 11 pages.

[…] Just after 18 months after its first planning meeting, RARE was now an established organization with a constitution, a permanent secretariat and enough resources to support its activity"

RARE Constitution: Objectives - Article 4

1. The objectives of RARE are to promote and participate in the creation of a high-quality European computer-communications infrastructure for the support of research endevour. It will take whatever steps are required to ensure that this infrastructure adopts the most advanced technology available, according to the principles of Open Systems Interconnection as defined by the International Standards Organisation (ISO), in order to ensure open international interconnection. It will wherever possible use the data carrier services of the European Postal, Telephone and Telegraph services.
2. In order to attain the above objectives, RARE shall, inter alia:
   - remove technical and organisational barriers between national networks, by harmonizing their technical facilities;
   - provide for the exchange of operational, directory and technical information;
   - protect and serve the interests of RARE with respect to other organizations, in particular governmental, standardization, PTT and industrial bodies;
   - where appropriate, set up and run common services and technical facilities;
   - establish working groups to perform technical activities in line with the objectives of RARE;
   - assist identified international user groups in the definition and provision of computer communications facilities;
   - support and organize conferences.
3. RARE may negotiate and secure rights in the name of its members but has no authority to undertake obligations or liabilities in their name, unless so instructed by an express authorization from the members concerned.
4. Generating profits for the purpose of distributing the same among the members shall not be permitted.
5. RARE shall take an independent attitude towards political groups, whether national or international.
6. The language of communication within RARE shall be the English language, entirely without prejudice however to Article 22, paragraph 4, last sentence.

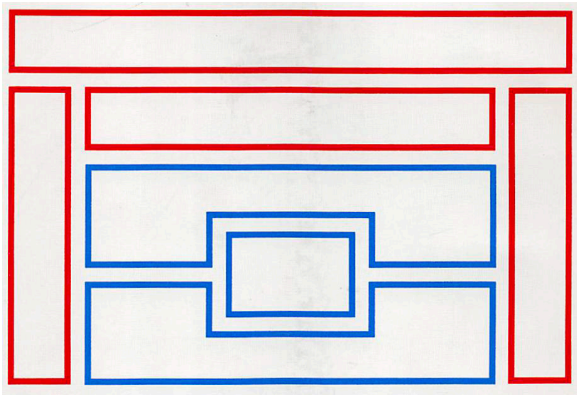
IBM

Systems Application Architecture

GC26-4341-2

Third Edition
(February 1988)

An Overview



Systems Application Architecture is a collection of selected software interfaces, conventions, and protocols that are being published. Systems Application Architecture will be the framework for developing consistent, integrated applications across the future offerings of the major IBM computing environments.

The interfaces, conventions, and protocols of Systems Application Architecture are designed to provide an enhanced level of consistency and connectivity in the following areas:

- Programming interface — the languages and services that application developers use in building their software
- User access — the design and use of screen panels and user interaction techniques
- Communications support — the connectivity of systems and programs
- Applications — the software built and supplied by IBM and other vendors.

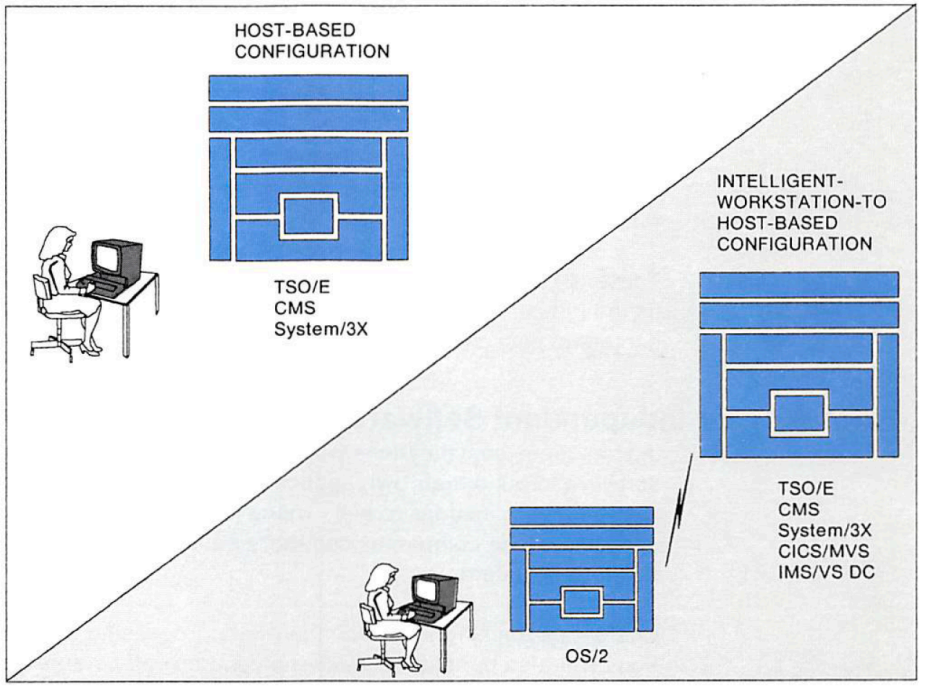


Figure 3. Two Possible Configurations

«a common user interface for the entire IBM product line. A user who sits down at a PC should see the same menus, keyboards and procedures that he would at a 3270 terminal».

Session D010 - SAA Strategy Update: Application Software Support
SHARE 70 February 29 - March 4, 1988

4.1.4 European Internet

One of the most surprising developments in the past three years has been the explosive growth in use of the Transmission Control Protocol / Internet Protocol (TCP/IP) protocol suite, as used in the American Internet, to create what can only reasonably be called a European Internet. There are now some 160,000 computers and workstations connected to this European Internet, making it by far the largest grouping of European data networks for academia and research. The availability of TCP/IP on a very wide range of systems, the quality and reasonable cost of the software, and the immense efforts going into developments have influenced this rapid growth.

4.3.5 Protocol issues

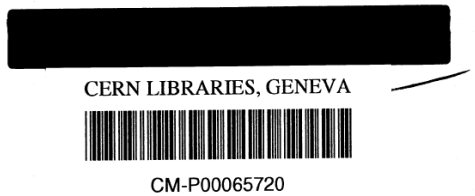
Network protocols are technically very complex, and they need to evolve continually in order to keep up with advances in technology, such as higher speeds. Ten years ago many people, including the authors, held high hopes that Open Systems Interconnection (OSI) protcols would become available quickly and provide for Open Networking between different computers. For good reasons, including the general wish to be independent of any single computer vendor and a more specific hope that a commitment to OSI protocols would revitalise Europe's local computer industry, the European Commission's Directorate-General XIII has been a strong supporter of OSI protocols. Indeed, many of Europe's officially funded data networking initiatives have based their whole strategy on the assumption that commercial OSI products would become available quickly and widely, and that they would offer full functionality.

Unfortunately OSI products have taken much longer to arrive than expected, and they still only offer limited functionality and performance. Furthermore, products based on another set of Open Networking protocols, the Internet TCP/IP suite, have become widely available on computers and workstations from all vendors. So while OSI undoubtedly will still have an important role to play, it is no longer realistic to use it as the sole basis for Europe's data networking strategy.

4.4 What happens if we do nothing?

However, if we do nothing the authors are convinced that European data networking will remain underdeveloped in the short term and will then quickly be colonised by companies based in the USA who have understood the developments needed in this market full of opportunity for progress and profit. Put bluntly, we will have abandoned European data networking to some combination of American computing and networking companies. We fear that the undoubted industrial strength of some of Europe's suppliers of voice networking services will not be sufficient to stand up to the American wave, unless they move very quickly to emphasise data networking in the context of the whole of Europe. But, as we have argued, the lack of European common carriers and scientfic computing suppliers is likely to make that difficult.

CERN / Computing and Networks Division
CN/92/4
(Ex:CN/91/10)
June 1992



Data Networking for the European Academic an Research Community: Is it important?

B. E. Carpenter and D.O. Williams

“The TCP/IP versus OSI dispute was just a battle which formed a part, albeit an important part, of a longer-lasting conflict between two groups which persists today: rebels versus the establishment, radicals versus conservatives. If the OSI war had never taken place, the two groups would have found some other vehicle for carrying on their conflict”.

“The radicals believe in opportunism […] minimizing or even eliminating management overhead and bureaucracy […]. For the radicals, personal glory is there to be won, at least amongst one’s peer-group […]. The conservatives are more concerned with long-term stability and making careful preparations to minimize the risk of problems. The people concerned may be ambitious but, in most cases, get statisfaction from working as members of a team with defined positions in the hierarchy.”

“In the particular context of research networking, and despite declaring that they have the same objectives, the two sides have different technical interests. For the radicals, for example, a system failure provides an opportunity to explore the technology at a detailed level and to demonstrate their competence by quickly finding and correcting the source of the problem. Conservatives, in contrast, prefer avoiding failures in the first place, in other words, to create an environment in which failures never happen, and which in consequence, is very tedious for the technical staff involved»

H. Davies, B. Bressan (editors). “A History of International Research Networking: the People who Made it Happen”, Wiley-Blackwel 2010, pag 134

COSINE

Project ID: 1647

Funded under: FP1-ESPRIT 1

Cooperation for Open Systems Interconnection Networking in Europe

From 1990-01-01 **to** 1993-01-01

Project details

Total cost:

Not available

EU contribution:

Not available

Coordinated in:

Netherlands

Objective

COSINE's aims are to:
establish a pan-European computer-based network infrastructure that enables research workers to communicate with each other using Open Systems
facilitate the introduction of and contribute to the market pull for Open Systems Interconnection (OSI)
ensure that the infrastructure established becomes financially self-supporting.

The project began with a specification phase undertaken by RARE (Rseaux Associs pour la Recherche Europenne) which concluded in autumn 1988. During 1989, work began on the implementation phase, again undertaken by RARE, which has established the COSINE Project Management Unit (CPMU) to carry out the work on its behalf. COSINE includes a number of subprojects and pilot services. The first pilot service to be available was the IXI X.25 backbone network. Several more are now underway, expanding on the ser vices already used at local and national level to bring Europe-wide connectivity in electronic mail, directories and information services. Further sub-projects and services are being established. The aim is that the complete infrastructure should be self-sustaining by the end of the COSINE implementation phase.
The sub-projects being implemented are:
ftam north american gateway
international x.500 directory services (paradise)
support and information service (concise)
activities to support typical international user groups
osi connectionless-mode network service trials.
Contracts for ftam interoperability testing and full-screen terminal services sub-projects are under negotiation, and one on security mechanisms is being prepared. The pilot services provided to the user community are ixi and x.400 mhs message-handling services (interworking of national R&D management domains and US gateway).

Coordinator

RARE — Netherlands

Netherlands

A. Tannembaum, D. Wetherall, «Computer Networks» 5° editon, Prentice Hall 2011

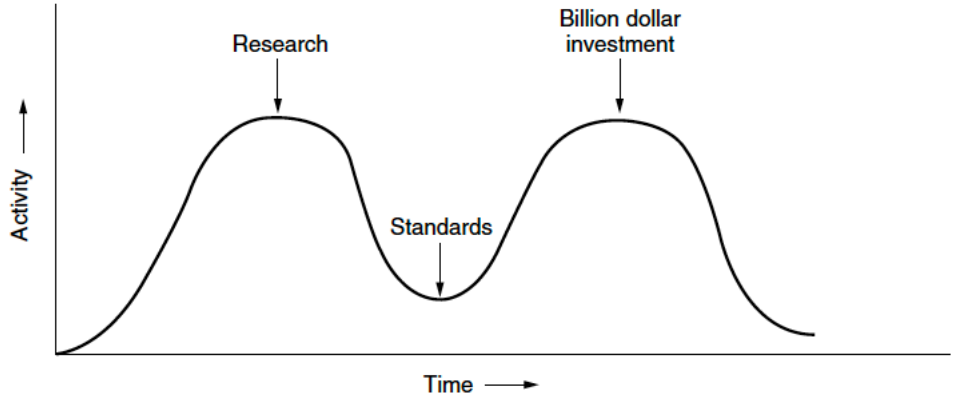
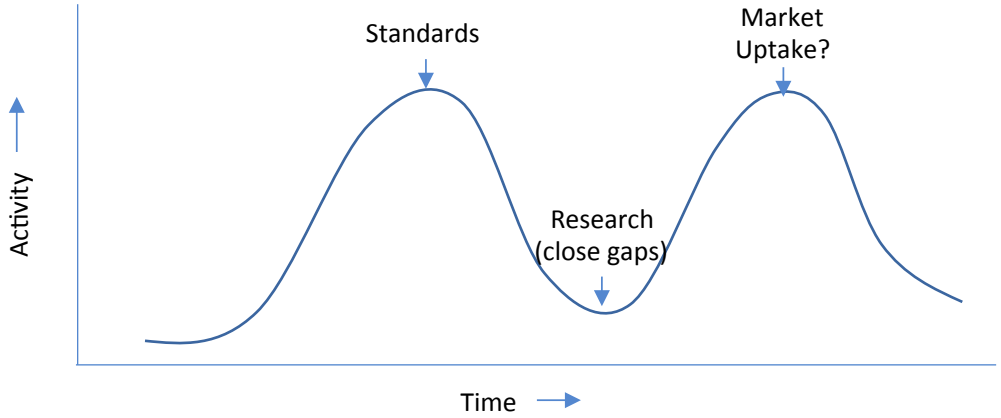


Figure 1-24. The apocalypse of the two elephants.



IS OSI TOO LATE?

(Presented at the RARE European Networking Conference, Trieste, May 1989)

IS OSI TOO LATE?

Brian E. Carpenter

CERN, European Laboratory for Particle Physics
CH-1211 Geneva 23

Despite a decade's work, it is readily demonstrated that OSI is not yet complete, and indeed probably never will be. The question arises whether it is too late to realise its major goals of universal service and improved competitivity. Due to the multiple facets of OSI, there is no general answer to this question. This paper sketches answers for a number of domains of application of OSI, and concludes that promoters of OSI should concentrate on areas in which OSI solutions have the greatest chance of being in time. Effort should not be wasted on applications for which there are well-established non-OSI open solutions.

The last force on us -- us

The standards elephant of yesterday -- OSI.

The standards elephant of today -- it's right here.

As the Internet and its community grows, how do we manage the process of change and growth?

- **Open process -- let all voices be heard.**
- **Closed process -- make progress.**
- **Quick process -- keep up with reality.**
- **Slow process -- leave time to think.**
- **Market driven process -- the future is commercial.**
- **Scaling driven process -- the future is the Internet.**

We reject: kings, presidents and voting.

We believe in: rough consensus and running code.

END-TO-END ARGUMENTS IN SYSTEM DESIGN

J.H. Saltzer, D.P. Reed and D.D. Clark*

M.I.T. Laboratory for Computer Science

This paper presents a design principle that helps guide placement of functions among the modules of a distributed computer system. The principle, called the end-to-end argument, suggests that functions placed at low levels of a system may be redundant or of little value when compared with the cost of providing them at that low level. Examples discussed in the paper include bit error recovery, security using encryption, duplicate message suppression, recovery from system crashes, and delivery acknowledgement. Low level mechanisms to support these functions are justified only as performance enhancements.

Published in ACM Transactions in Computer Systems 2, 4, November, 1984, pages 277-288

Rise of the Stupid Network

Why the Intelligent Network was once a good idea, but isn't anymore. One telephone company nerd's odd perspective on the changing value proposition

by
David Isenberg - isen@isen.com - www.isen.com

Computer Telephony, Aug 1997, pages 16-26

An outgrowth of substantial experience with TCP/IP networking, the end-to-end principle held that the Internet's complex functions should be performed at the endpoints, leaving only the (relatively) simple tasks of interconnection and data transport to the network.

The end-to-end design allows new innovations to be added at the edges and on top of the "stupid network."

The network is "stupid" in that it is *not* designed to application-level "end-user requirements"(*)

(*) at the start researchers where looking for remote login (telnet) and file transfer (ftp) applications,
but the real «killer application» that started the snowball turned out to be e-mail, which nobody had anticipated

IETF RFC 1958 Architectural principles of the Internet

The principle of constant change is perhaps the only principle of the Internet that should survive indefinitely.

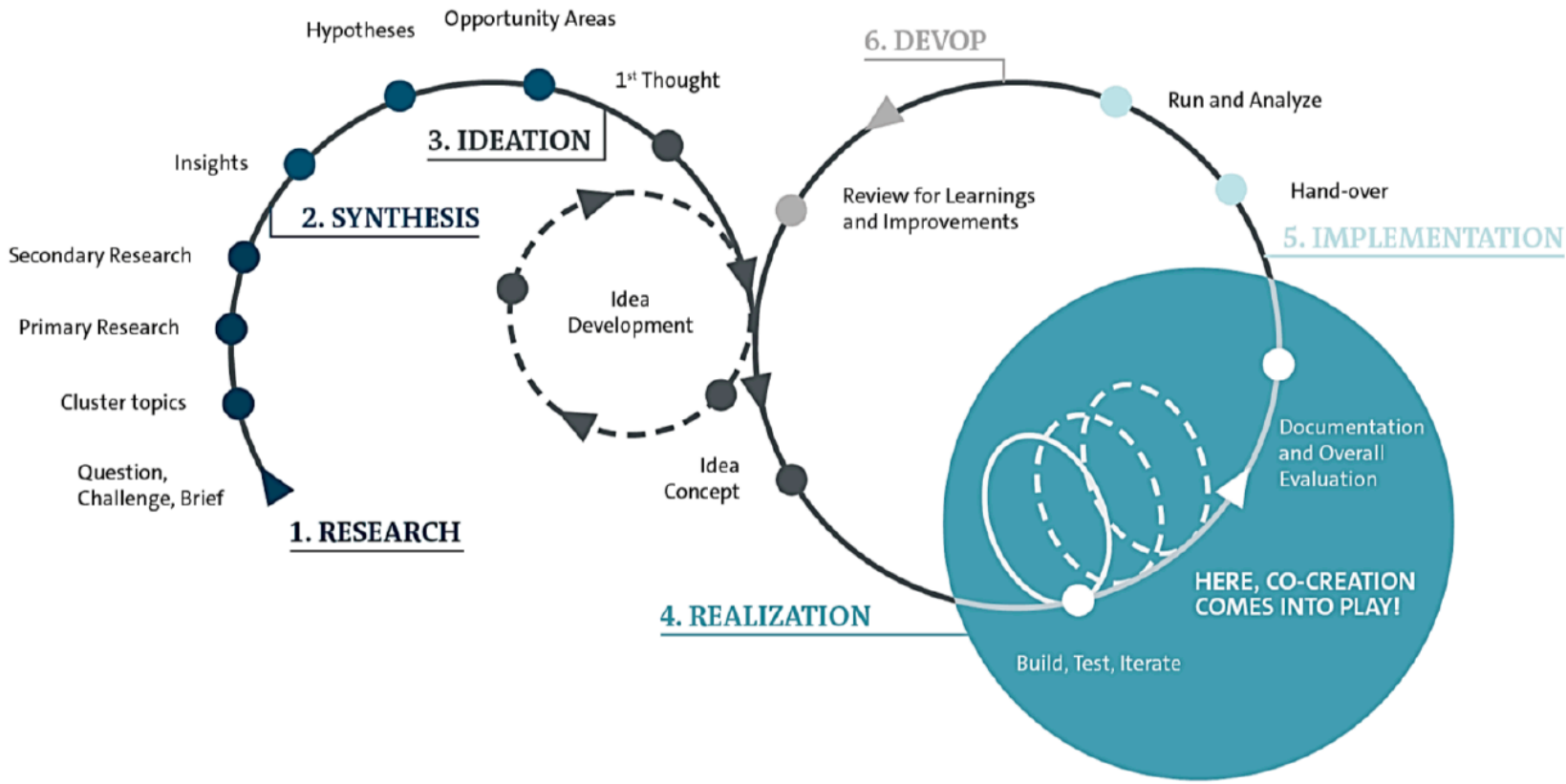
The architectural principles [...] aim to provide a framework for creating cooperation and standards, *as a small "spanning set" of rules that generates a large, varied and evolving space of technology.*

[...] In very general terms, the community believes that the goal is connectivity, the tool is the Internet Protocol, and the *intelligence is end-to-end rather than hidden in the network*

Heterogeneity is inevitable and must be supported by design. [...]. *Multiple types of application protocol must be allowed for*, ranging from the simplest such as remote login up to the most complex such as distributed databases.

And perhaps most important: *Nothing gets standardised until there are multiple instances of running code*

AGILE DEVELOPMENT WITH USER TESTING & CO-CREATION



Tussle in Cyberspace: Defining Tomorrow's Internet

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John Wroclawski
MIT Lab for Computer Science
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Karen R. Sollins
MIT Lab for Computer Science
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braden@isi.edu

- Design for variation in outcome, so that the outcome can be different in different places, and the tussle takes place within the design, not by distorting or violating it. Do not design so as to dictate the outcome. Rigid designs will be broken; designs that permit variation will flex under pressure and survive.

Within this guiding principle, we identify two more specific principles:

- Modularize the design along tussle boundaries, so that one tussle does not spill over and distort unrelated issues.

- Design for choice, to permit the different players to express their preferences.

Conservative's design principles

1. Heterogeneity is a degenerative moral disease created by undisciplined rebels
2. It must be cured by 'interoperability', i.e. disciplined homogeneity
3. Collect all possible user-requirements first (and possibly 'harmonize' them)
4. Design a proper governance structure, i.e. for representatives from accredited bodies only
5. Write down standards with a design based on central control and ignore what goes on at the edges. Sell the standards and price them for 'serious' people
6. Set up a decades-long 'deployment roadmap' and yearly reports
7. When that doesn't happen conclude that a little more governance is needed, write more reports, commission research to 'close gaps' and then repeat the process
8. "running code" is a 'technical issue' of no import to standardization or governance bodies
9. Marvel at lack of market uptake and blame 'academical day-dreaming'
10. (No matter what) complain that funding is insufficient

«With the adoption of the new Delegated Regulation on the provision of EU-wide multimodal travel information services, “suggesting” the user of NeTEx and SIRI protocols, an important challenge emerged, that is to make all the existing applications compatible with the new orientations».

«An overview of the NAPs across Europe shows that the NAPs vary in system architecture, organisation, monitoring of data users, accessibility, etc. Thus, there is a need for a more coordinated approach and exchange of ideas and best practices».

«From an architectural point of view, it is a fact that the various NAPs currently in operation at first sight seem to be providing their services using quite different technical solutions»

EU EIP SA46
Annual NAP report - 2018

Monitoring and Harmonisation of National Access Points in Europe

FRAME NEXT is a project that extends the European ITS Framework Architecture, now normally known as the FRAME Architecture, with the activities of the different member states in Europe, within the priority areas of the ITS directive (Directive 2010/40/EU) and with the methodologies and tools that make a modern ITS architecture attractive and appealing for its.

FRAME NEXT goals are to:

- create a Common Pan-European ITS Architecture
- extend and enhance the existing FRAME Architecture users.

Digitization: econding of information in numerical base-2 ’digits’, tractable by computers

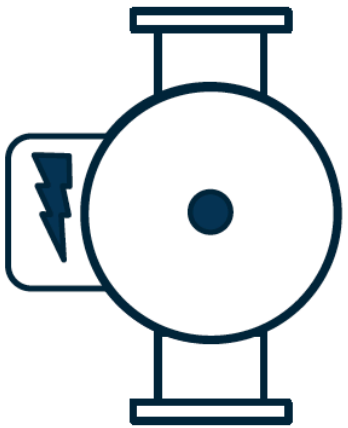
Digitalization: a transformational process that leverages digitization to do «something different»

Servitization: a business model whereby products (value) are delivered as a (possibly subscription-based) service.

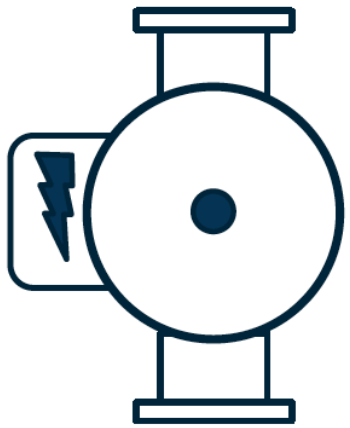
application of end-to-end principle to digitalization:

intelligence at the edge of multiple ‘stupid’ infrastructures (internet being one of them)

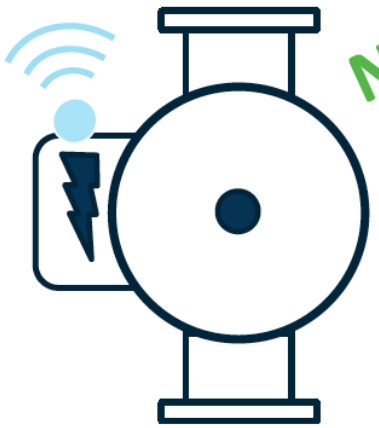
Moving from Products to Services



Pump



Pump
+Service



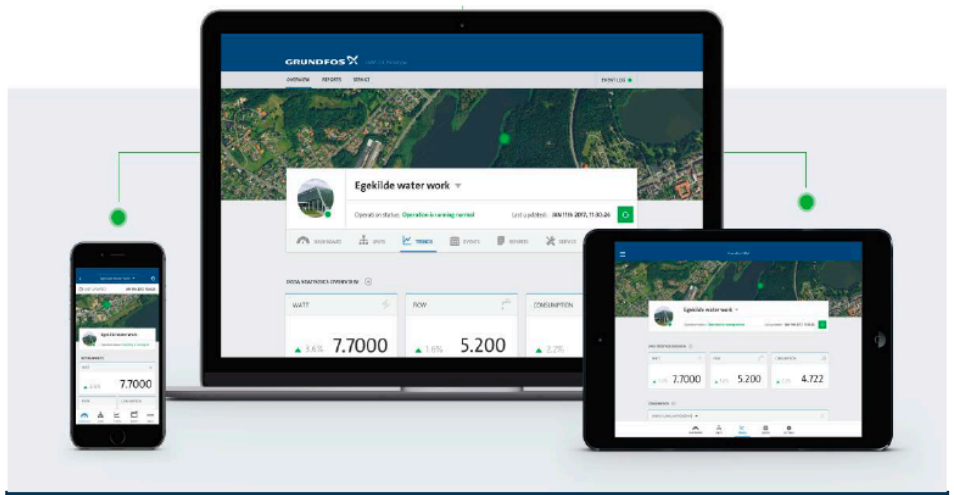
New!

Pump
as-a-service

New!

Water
as-a-service

Digital Offerings will bring new value to our customers



Grundfos Digital Platform

Tools for our customers

New revenues

Tools for ourselves

New business models

Digitization: econding of information in numerical base-2 'digits', tractable by computers

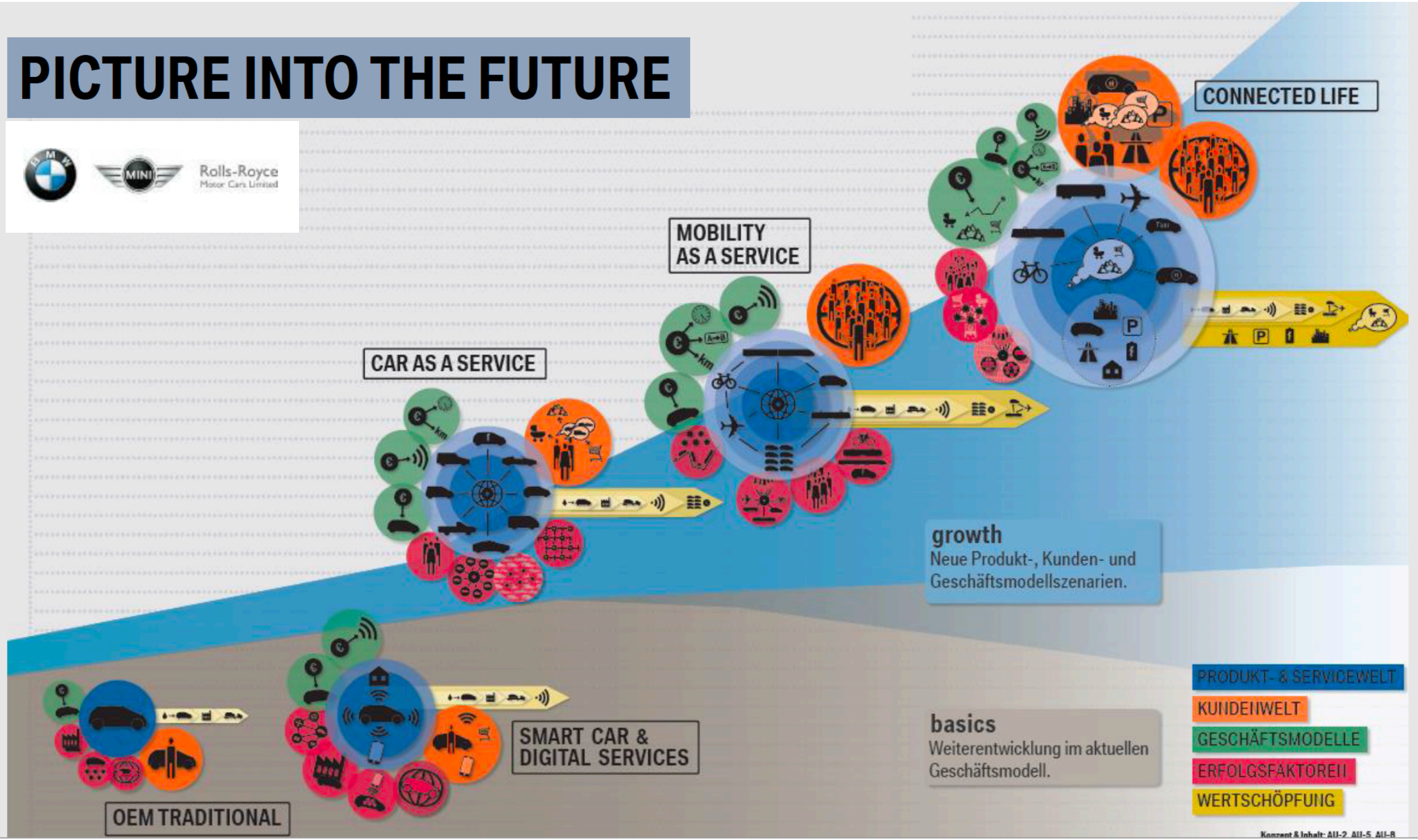
Digitalization: a transformational process that leverages digitization to do «something different»

Servitization: a business model whereby products (value) are delivered as a (possibly subscription-based) service.
application of end-to-end principle to digitalization:
intelligence at the edge of multiple 'stupid' infrastructures (internet being one of them)

MaaS: Value (mobility) is delivered as a (possibly subscription-based) service.
application of end-to-end principle to digitalization
intelligence (people) at the edge of 'stupid' infrastructures: rail, road, air, credit, gps, etc.. + internet

NOTHING to do with «one-stop-shopping», «ticketing», etc.
(that would be dumb (people) at the edge of «intelligent» infrastructure!)

PICTURE INTO THE FUTURE

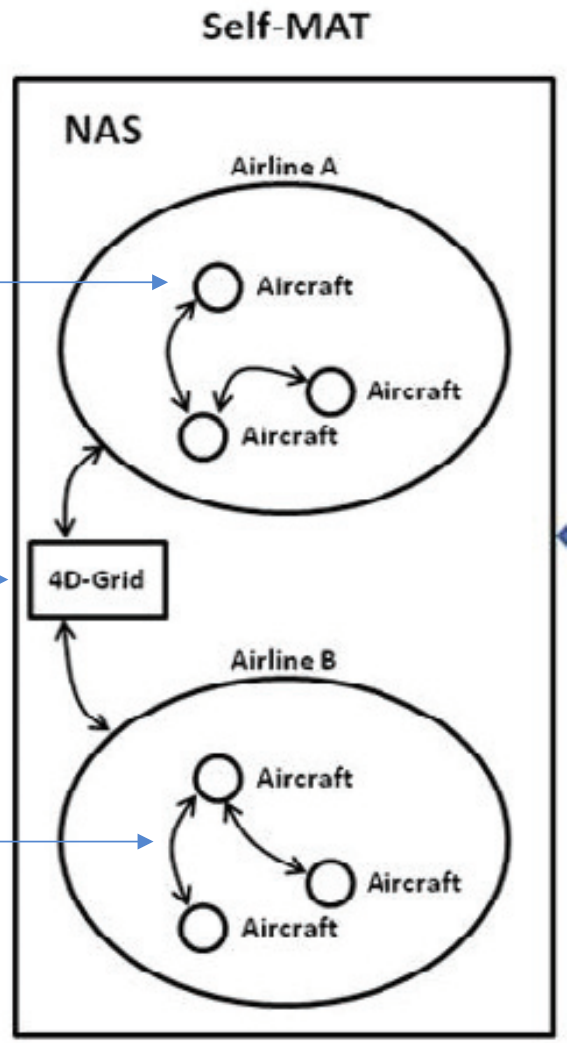


Self-managed air traffic management

Intelligent edge

«stupid infrastructure»

«stupid communications infrastructure»



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Procedia Computer Science 12 (2012) 463 – 470

Procedia Computer Science

Complex Adaptive Systems, Publication 2
Cihan H. Dagli, Editor in Chief
Conference Organized by Missouri University of Science and Technology
2012- Washington D.C.

Swarm theory applied to air traffic flow management

Sergio Torres*

Lockheed Martin, 9211 Corporate Blvd, Rockville, MD, USA