

When do we measure ?

❑ during the design phase

- ♦ preliminary measurements to validate a design idea
- ♦ investigations about the applicability of a new technology
- ♦ performance measurements of a new technology
- ♦ ...

❑ during the prototyping phase

- ♦ conformance checking
- ♦ checking of the robustness of the project to environmental conditions
- ♦ measurements of electromagnetic compatibility
- ♦ ...

continue ...

☐ during the production engineering

- ♦ tuning (by successive approximations) of the project
- ♦ reliability tests
- ♦ compatibility measurements (i.e. electromagnetic compatibility tests)
- ♦ ...

☐ while bringing new equipment and systems into service

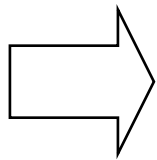
- ♦ checking of the vital system parameters
- ♦ checking about the compatibility with other apparatuses
- ♦ ...

continue ...

- ❑ **when operating the installation (in-service maintenance):**
 - ♦ **monitoring of the correct functioning**
 - ♦ **monitoring of the operating costs**
 - ♦ **pricing to third parties**
 - ♦ **...**
- ❑ **when maintaining the installation (out-service maintenance):**
 - ♦ **the live traffic is removed from the link**
 - ♦ **a known test signal can be used**

What do we measure ?

- ❑ measurements are always done to get well-defined benefits
- ❑ measuring is an experimental activity (see fundamentals of measurements) always involving costs made up, with different proportions, of investments and of operating costs

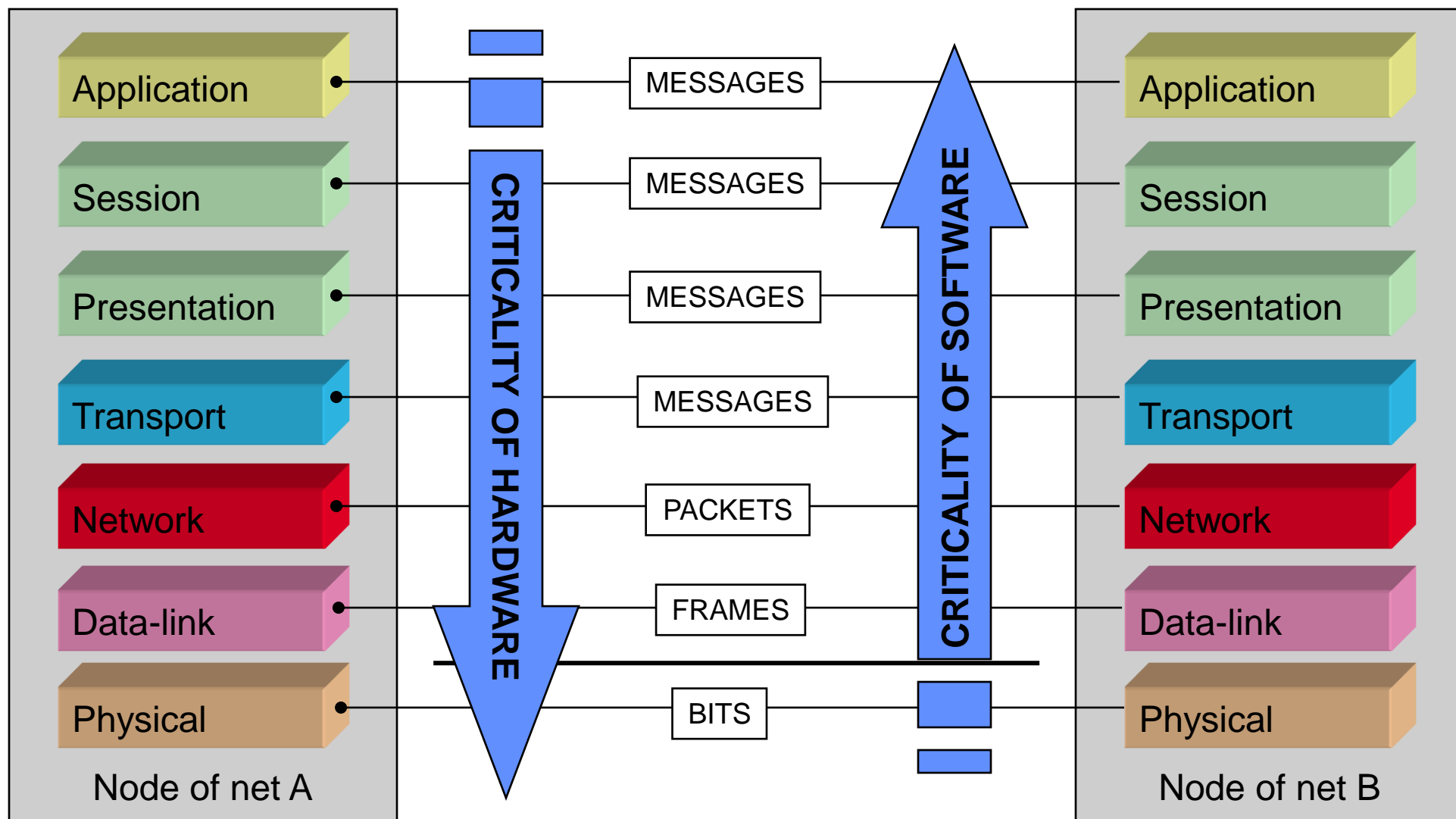


We must measure all and only the parameters that are indispensable to reach the goal

The case of TLCs

- ❑ a very large number of technologies, both hardware and software, are involved
 - ♦ electrical, optical, mechanical, ..., and thermal quantities
- ❑ very complex systems/installations
 - ♦ reliability is of vital importance
 - ♦ self-diagnosis of faults becomes a necessity
- ❑ installations may extend over distances from few centimeters up to thousands of kilometers
- ❑ very high-speed signals
- ❑ contribution of both analog and digital signals

Reference to the ISO/OSI model



Layer 1 (physical)

- ❑ **cabling technology**
 - ◆ **copper**
 - ◆ **optical fiber**
- ❑ **wireless technology**
 - ◆ **radio signals**
- ❑ **network topology**
 - ◆ **bus**
 - ◆ **ring**
 - ◆ **tree**
- ❑ **standards**
 - ◆ **802**
 - ◆ **...**

- **quantity to be measured**
- **methods of measurement**
- **measuring instruments**

Layers 2-7

- ❑ **2- 6: test procedures are aimed to prove the efficacy of the network. Mainly, although not exclusively, software technologies are involved**
 - ◆ **conformity tests**
 - ◆ **measurements of efficiency**
- ❑ **7 (application): application-oriented tests, usually based on functional specifications checking**
 - ◆ **transaction integrity**
 - ◆ **execution timing**
 - ◆ **latency timing**
 - ◆ **....**

Leveled conformance tests

- ☐ the complexity of the systems pushes towards modular and interconnected solutions
- ☐ the layered model simplify the design of sub-systems able to operate in an interconnected way
- ☐ for each layer, a suitable conformance test must be designed and then applied to the different implementations that will be operating together
- ☐ tests are applied to both protocols and interfaces

continue ...

- ❑ **test techniques must take into account for**
 - ♦ **the evolution rapidity of the involved technologies**
 - ♦ **the increasing complexity of the installations**
 - ♦ ...
- ❑ **necessary knowledge of**
 - ♦ **fundamentals of measurement theory**
 - ♦ **fundamentals of the main technologies applied into the installations**
 - ♦ **electronic instrumentation**
 - ♦ **application specs**
 - ♦ ...

Quality of service (1)

- ❑ **in the case of TLC systems, the quality of service coincides with the fruition of an efficient and reliable communication channel:**
 - ♦ **the application layer must rely on a communication channel having a predictable behavior**

- ❑ **the goal to operate a TLC system with a high-quality level can only be obtained through the application of tests and measurements**

Quality of service (2)

❑ user perception

- ♦ response time (to a message)
- ♦ clearness of a voice channel
- ♦ quality of the transmitted image
- ♦ guaranty of a transaction
- ♦ ...

❑ point of view of the operator

- ♦ definition of an adequate metric: finding of measurable quantities well correlated to the quality as perceived by the user
- ♦ continuous monitoring of the selected quantities