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What is an intelligent transmitter?

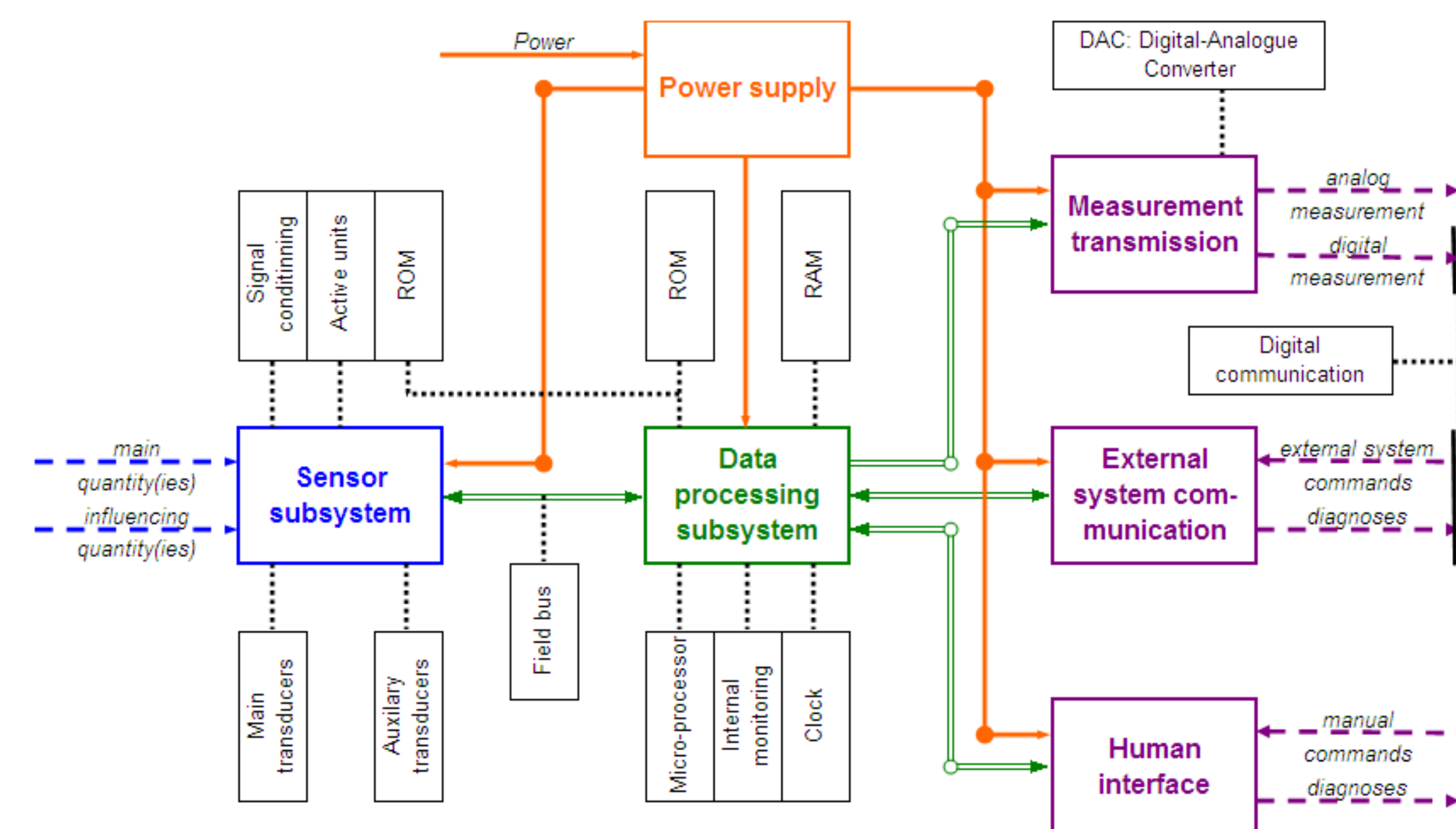
First, a transmitter is **smart** if it provides functions beyond those necessary for generating a correct representation of a sensed or controlled quantity (IEEE 1451, 2007).

In addition, a transmitter is **intelligent** depending on functionalities involved in the host system functions:

- the ability to modify its internal behaviour to optimize data collection and communicate them in a response manner (J.E. Brignell, 1996)
- the bi-directional communication for sending measurement and status information, and receiving and processing external commands (IEC 60770-3, 2006)

Material architecture:

New functionalities:



- **error measurement correction** by the monitoring of influencing factors, digital correction and compensation
- **self-adjustment** of the off-set, gain drift, linearity, temperature, etc.
- **self-diagnosis** by the monitoring of internal and external parameters, and **validation**
- **on-line reconfiguration** for metrological requirements and functional purposes (accommodation, restructuring)
- **digital and bi-directional communication** to send measurement and status information, and to receive external commands

Dependability issues

Reliability:

- ⊗ the high amount of electronics, programmable units and software aspects implies new failure causes and modes which are usually not well known and difficult to predict
- ⊗ each fault or failure may affect a lot of transmitted information (measurements, diagnoses, etc.)
- ⊙ faults and failures may be partly compensated for by fault tolerant strategies (reconfiguration)
- ⊙ self-adjustments may prevent drifts or other failures which appear with ageing

Maintainability:

- ⊗ a specific expertise is required to maintain complex systems
- ⊙ information about drifts, influencing factors, charge exceeding, etc. may be monitored over time
- ⊙ field buses and on-line reconfiguration can make corrective maintenance easier

Safety:

- ⊗ the transmitters are getting more and more "black box" systems
- ⊙ self-diagnoses allow a better fault and failure coverage, and safe states can be defined in more details
- ⊙ centralized data processing and digital communication may improve the risk management efficiency

Reliability modelling of intelligent transmitters

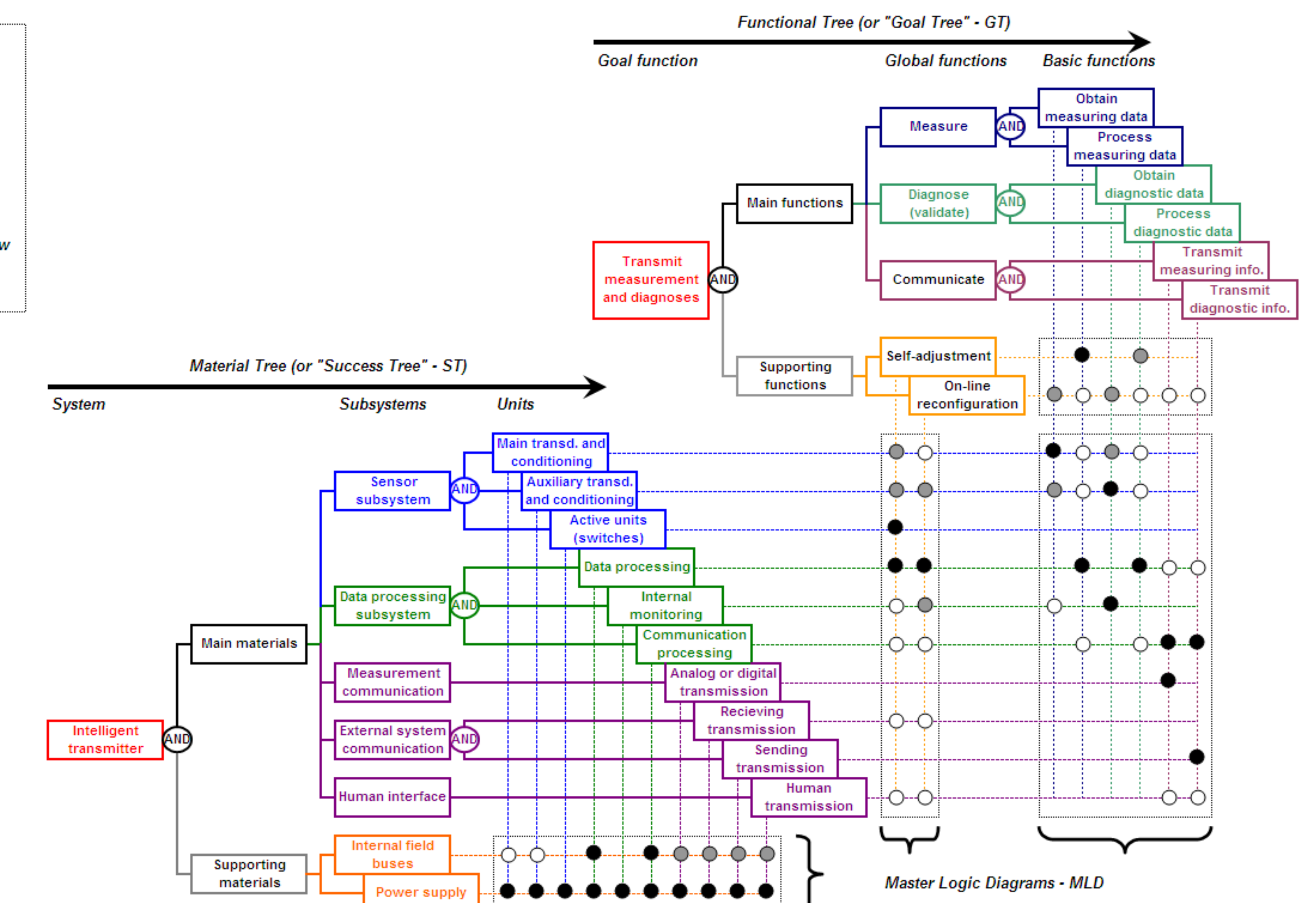
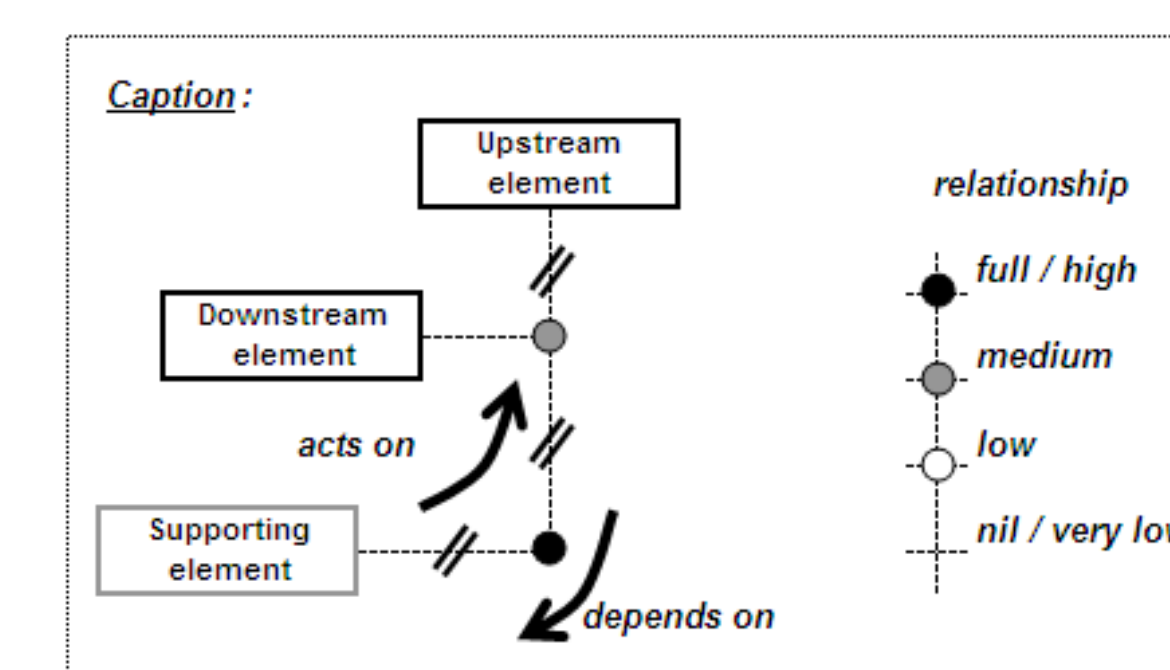
The reliability modelling of an intelligent transmitter has to deal with several issues:

- the system complexity i.e. numerous interactions between both material elements and functions
- the system behaviour under fault conditions which is difficult to determine, especially due to programmable units and software
- several transmitted data may fail (measurement, status information), including combinations
- few reliability feedback are available due to quite new technologies

The **Goal Tree–Success Tree & Master Logic Diagrams** i.e. GTST–MLD model (M. Modarres *et al.*, 1999):

- both functional analysis and system breaking up using GTST
- material–material, material–function, and function–function relationships represented by MLD
- to identify complex system failures (A. Jalashgar, 1998), to evaluate system behaviour (Y. Hu *et al.*, 1999), and to quantify probability of functions fulfilment and failure modes (F. Brissaud *et al.*, 2008)

Reliability model proposal for an intelligent transmitter pattern:



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