System

- Principles
  - A Unified Formalism for Complex Systems Architecture
  - Section 1.3
    - http://www.lix.polytechnique.fr/~golden/systems_architecture.html
    - http://www.lix.polytechnique.fr/~golden/research/phd.pdf
  -

System

- From wikipedia
  - A system is a set of interacting or interdependent components forming an integrated whole.
  - Delineated by its spatial and temporal boundaries,
  - Surrounded and influenced by its environment
  - Described by its structure and purpose
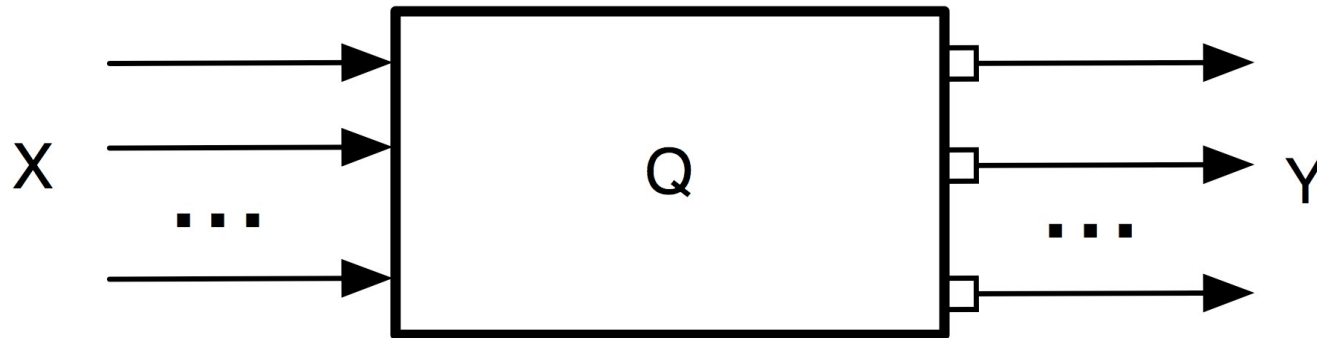 - Expressed in its functioning.

Principles
Thinking with a systemic approach

- # Thinking with a systemic approach

  -

  - system can be broken down into a set of smaller subsystems

  - system must be considered in interaction with other systems

  - a system must be considered through its whole life cycle

Principles
Thinking with a systemic approach

- **the objects of the reality are modeled as systems**
  - – i.e. a box performing a function and defined by its perimeter, inputs, outputs and an internal state

-

X   Q   Y
...   ...

Principles
Thinking with a systemic approach

- **the objects of the reality are modeled as systems**

- Ex: a mobile phone is a system which takes in input a voice & keystrokes and outputs voices & displays.
  - Moreover, it can be on, off or in standby.
  - Overall, the phone allows to make phone calls (among other functions).

Principles
Thinking with a systemic approach

- **a system can be broken down into a set of smaller subsystems,**
  - which is less than the whole system
 - Composition emerges new behavious
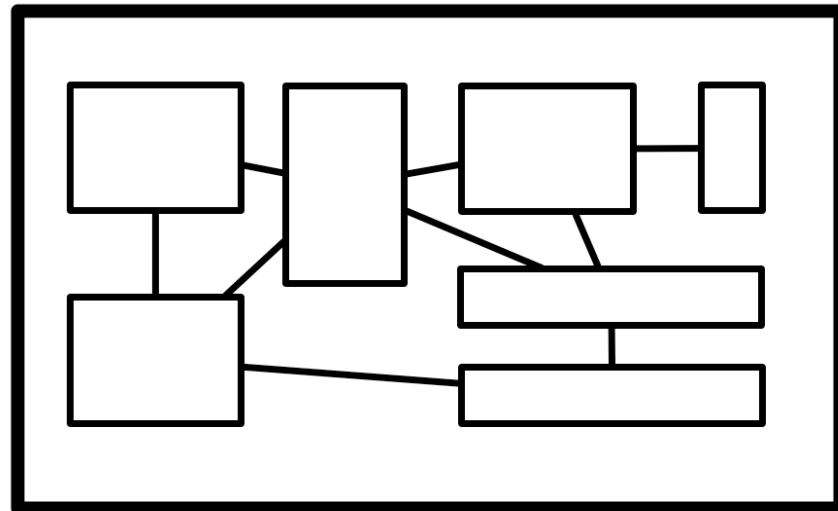
Principles
Thinking with a systemic approach

- **a system can be broken down into a set of smaller subsystems,**

- Ex: a mobile phone is in fact a screen, a keyboard, a body, a microphone, a speaker, and electronics.
    - But the phone is the integration of all those elements and cannot be understood completely from this set of elements.

Principles
Thinking with a systemic approach

- **a system must be considered in interaction with other systems**,
 - – i.e. its environment
  - – Other systems
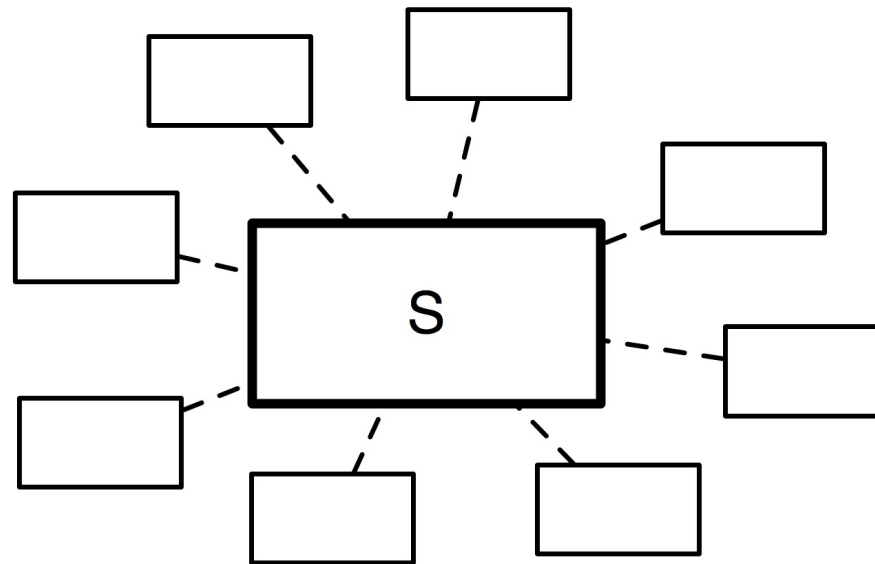
Principles
Thinking with a systemic approach

- **a system must be considered in interaction with other systems**,

- Ex: a mobile phone is in interaction with users, antennas (to transmit the signal), reparators (when broken), the ground (when falling), software, etc.
  - All these systems constitute its environment and shall be considered during its design.

Principles
Thinking with a systemic approach

- **a system must be considered through its whole lifecycle**
  - From the moment it starts being produced
  - Sold to consumer
  - Switched on
  - Switched off
  - Malfunction...
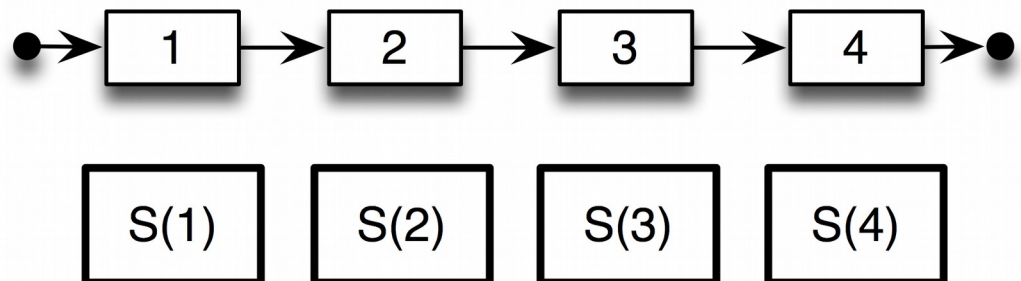
Principles
Thinking with a systemic approach

- a system must be considered through its whole lifecycle

- Ex: a mobile phone will be designed, prototyped, tested, approved, manufactured, distributed, selled, used, repaired, and finally recycled.

    – All these steps are important (and not only the moment when it is used).
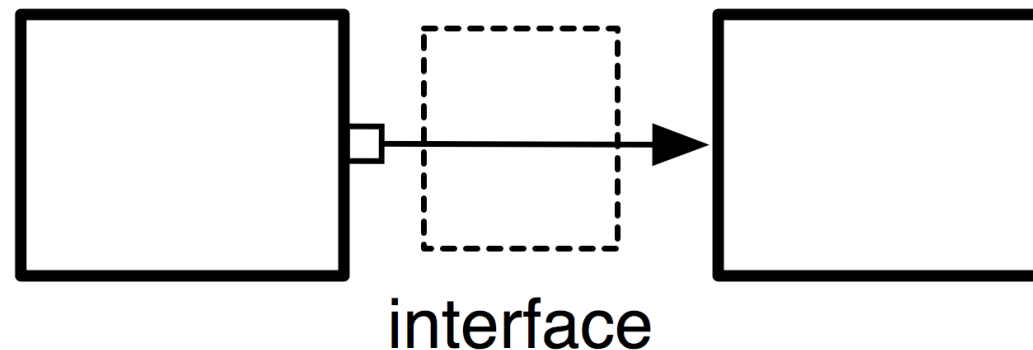
Principles
Reasoning according to an architecture paradigm

- Reasoning according to an architecture paradigm
  - system can be linked to another through an interface
  - a system can be considered at various abstraction levels
  - system can be viewed according to several layers
  - a system can be described through interrelated models with given semantics
  - a system can be described through different viewpoints

Principles
Reasoning according to an architecture paradigm

- **a system can be linked to another through an interface**,
    - which will model the properties of the link
    - The link requirements will model the provided interfaces


interface

Principles
Reasoning according to an architecture paradigm

- **a system can be linked to another through an interface,**

- Ex: when phoning, our ear is in direct contact with the phone, and there is therefore a link between the two systems -the ear and the phone
  - However, there is a hidden interface : the air! The properties of the air may influence the link between the ear and the phone (imagine for example if there is a lot of noise).

Principles
Reasoning according to an architecture paradigm

- a system can be considered at various abstraction levels,
  - allowing to consider only relevant properties and behaviors
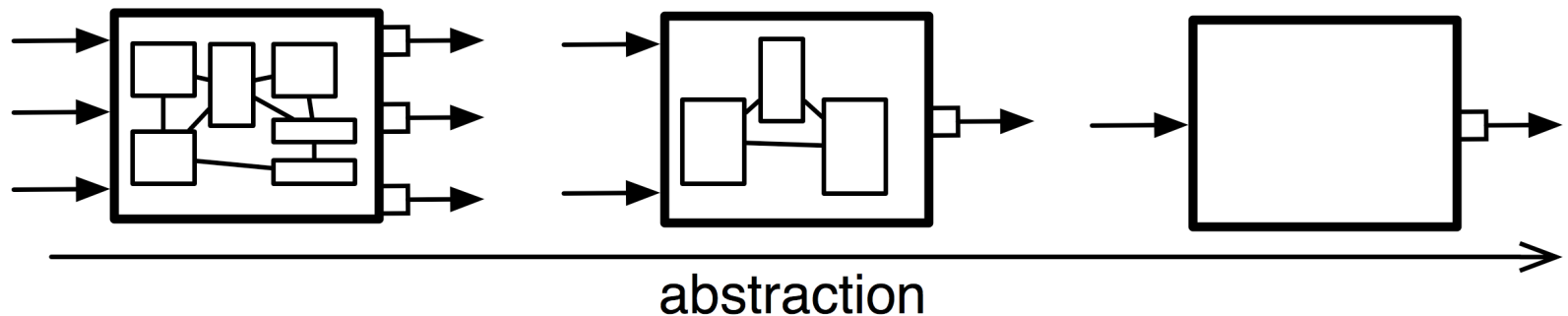
abstraction

Principles
Reasoning according to an architecture paradigm

- a system can be considered at various abstraction levels,

- Ex: do you consider your phone as a device to make phone calls (and other functions of modern phones), a set of material and electronics components manufactured together, or a huge set of atoms ?
  - All these visions are realistic, but they are just at different abstraction levels, whose relevancy will depend on the context.
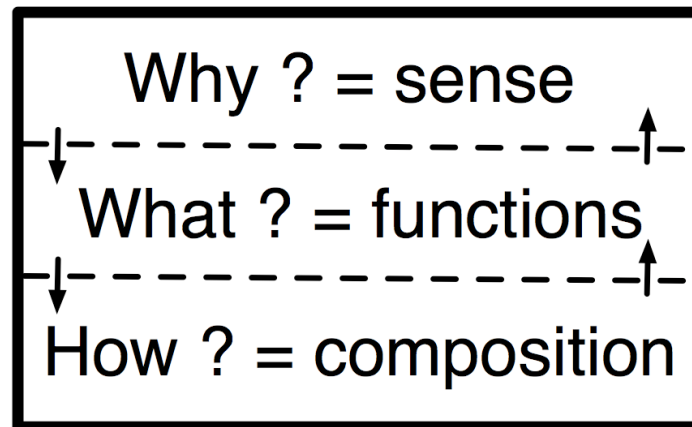
Principles
Reasoning according to an architecture paradigm

- a system can be viewed according to several layers
    - its sense – why is it being produced (offered functionality)
    - Functions – operation to fulfill offered functionality
    - Composition – definition of components ;ary to implement the functior

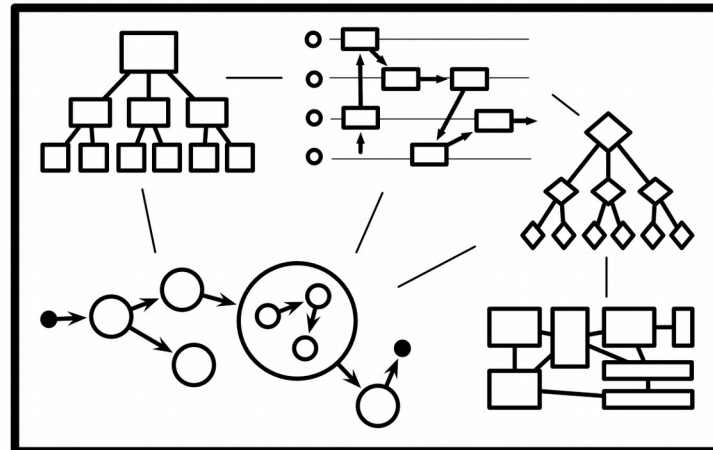 | Why ? = sense |
        | What ? = functions |
        | How ? = composition |

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Principles
Reasoning according to an architecture paradigm

- **a system can be viewed according to several layers**

- A phone is an object whose sense is to accomplish several missions for its environment
  - making phone calls, being a fashionable object, offering various features of personal digital assistants, etc.
- Is a set of functions organized to accomplish these missions
  - displaying on the screen, transmitting signal, delivering power supply, looking for user inputs, making noise if necessary, etc).
- Finally, all these functions are implemented by physical components:
  - Antenna, communication co-processor, network stack

Principles
Reasoning according to an architecture paradigm

- **a system can be described through interrelated models with given semantics**

  - Properties that the system should provide (requirements)

  - Structure of the various components (how they interact)

  - States of the system

  - Behaviors of the system

  - Manipulated data, etc

- This will typically be described with diagrams inSysML

Principles
Reasoning according to an architecture paradigm

- **a system can be described through interrelated models with given semantics**

- From the point of view of properties, the phone is a device expected to meet requirements like
  - "a phone must resist to falls from a height of one meter".
- But a phone will also change state :
  - when a phone is off and that the power button is pressed, the phone shall turn on.
- Function dynamics of the phone are also relevant:
  - when receiving a call, the screen will display the name and the speaker will buzz, but if the user presses no button the phone will stop after 30 seconds..

Principles
Reasoning according to an architecture paradigm

- **a system can be described through different viewpoints**
    - corresponding to various actors concerned by the system.
    - All these visions are important and define the
      system in multiple and complementary ways.

- Ex: commercials, designers, engineers (in charge of software, electronics, acoustics, materials, etc) users, repairers...
- All these people will have different visions of the phone.
    - When the designer will see the phone as an easy-to-use object centered on the user, the engineer will see it as a technological device which has to be efficient and robust.
    - A commercial may rather see it as a product which must meet clients' needs and market trends to be sold.