

FIArch

# Internet Architecture & Design Principles

Principles that should be augmented

Paul Mueller

University Kaiserslautern / Germany

# Content

- Internet Architecture Design Principles
- Principles that should be preserved
- Principles that should be adapted
- **Principles that should be augmented**
- Seeds of new design principles

# Principles that should be augmented

- In this section we highlight design principles that have been applied to the current Internet but we challenge that they should be augmented or extended:

- Modularity and layering



**Polymorphism**

- Naming and Addressing



**Unambiguous naming  
and addressing**

- where is the intelligence?



**End-to-End**

# Polymorphism principle

(as extension to the modularity principle)

- **In general:**

- having multiple phenotypes within a population;
- allowing program code to work with various types;
- ability of an interface to be realized in multiple ways.



- **The polymorphism principle is driven by the fact to make our architecture simpler; for example by layering. This promotes:**

- First, it manages complexity by limiting the scope of interaction between tasks.
- Second, limiting and predefining the ways that modules interact with one another allows independent actors to work
- Third, the intramodule flexibility provided by modularity accommodates uncertainty by making it easy to **incorporate subsequent improvements** into the system.

- **this allows**

- for objects of different classes to respond differently to the same function call, and
- for run-time (dynamic) instead of compile-time (static) binding.

# Polymorphism principle

(as extension to the modularity principle)

- **In general:**

- having multiple phenotypes within a population;
- allowing programs to be written in a way that is independent of the specific hardware or software environment;
- ability of an individual to perform tasks in different ways.



*polymorphism would enable the same abstract and autonomous loosely coupled components/objects to have different functional and non-functional behaviour under different environments or circumstances.*

- **The polymorphic architecture supports:**

- First, it manages the complexity of the system by limiting the number of components and their interactions.
- Second, limiting the number of components and their interactions makes the system more independent and easier to maintain.
- Third, the intramodular communication is made easy to understand and use.

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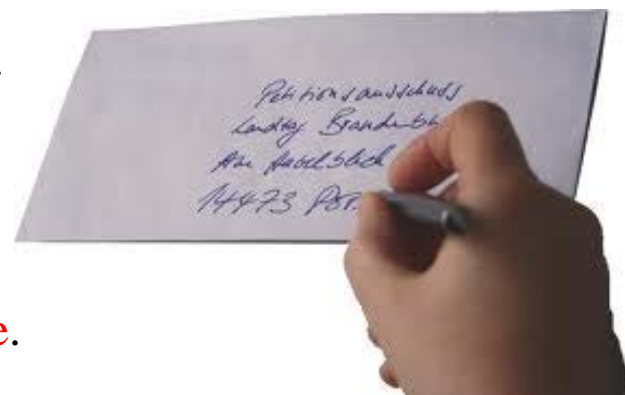
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- **this allows**

- for objects of different classes to respond differently to the same function call, and
- for run-time (dynamic) instead of compile-time (static) binding.

# Naming and Addressing

- **The naming and addressing principle:**
  - the Internet level protocols are and must be independent of the hardware medium and hardware addressing
  - This approach allows the Internet to exploit any new digital transmission technology of any kind, and to **decouple its addressing mechanisms from the hardware.**
- **The following augmentations are considered:**
  - Avoid any design that requires addresses to be hard coded or stored on non-volatile storage. In that respect the transport layer address should be decoupled from any locator and use space invariant identifiers associated to the communication endpoint.
    - In turn, this would facilitate dynamic multi-homing, TCP connection continuity (required for mobility) and more generally misuse of IP addresses.
  - A single and common naming structure should be used.
  - LOC/ID separation
    - In the future not only the end-points (ID) and their attachment points (LOC) need to be unambiguous and unique within the scope in which they appear and are used, but also the **data and the services.**



# Naming and Addressing

- **The naming and addressing principle:**

- the Internet level protocols are and must be independent of the hardware medium

- This approach decouples digital transmission from **decouple its address**

- **The following**

- Avoid any dependence on storage. In the future, the locator and user should be separated at the point.
- In turn, this would be more generally applicable

In Future Internet, naming and addressing as a design principle should be ***extended to unambiguously identify hosts, resources, data, and services.***

- A single and common naming structure should be used.

- LOC/ID separation

- In the future not only the end-points (ID) and their attachment points (LOC) need to be unambiguous and unique within the scope in which they appear and are used, but also the **data and the services**.



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...upled from any  
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# End-to-End

- **The End-to-End principle**

- Intelligence at the edges or in the network?
- Driven by the demands of ever emerging applications and the capabilities of new communication networks, the End-to-End principle eroded over time.



- **Augmentation of the End-to-End principle:**

- IP overlay applications such as IP multicast and mobile IP (MIP), require support from intermediate nodes (RP in ASM, and Home Agent in MIP).
- The Internet of Things/Smart objects communication, where the end-to-end communication may be significantly modified by intermediate gateways and sensor networks sink nodes.
- Many modern applications (e.g. mobile applications, distributed searching, ...) maintaining state information within the network.
  - To argue that the only stateful elements that may be active in the Internet should be located at the edges ignores the evolution of software/hardware.
- Finally support of congestion control cannot be realized as a pure end-to-end function:
  - congestion is an inherent network phenomenon which require some cooperation between end-systems and the net.



# End-to-End

- **The End-to-End principle**

- Intelligence at the edges
- Driven by the development of new capabilities of network devices, the principle erodes

- **Augmentation**

- IP overlay applications at intermediate nodes
- The Internet of Things may be significantly impacted
- Many modern applications require state information
  - To argue that this ignores the evolution of the network
- Finally support of congestion control function:
  - congestion is an inherent network phenomenon which require some cooperation between end-systems and the net.

*to “update” or augment this principle increase;*

*however*

*even if this principle is challenged, due to the heavy consequence in terms of scalability, survivability and robustness on the Internet at large departing from this principle remains open.*



support from

communication

sink nodes.

) maintaining

ated at the edges

and function:

# End of part four

# Announcement



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