

## *SoftCOM 2004*

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# A Historical Perspective on the Evolution of Software Architecture

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**Abstract:** The evolution of software architecture, including operating systems and applications, spans from batch systems on big iron to today's hand-held devices, and is now reaching into ubiquitous computing objects as evident in efforts such as JINI and Bluetooth. In digital telecommunication, the origins came from PCM and Ethernet, via OSI's X.25 to fast packet-switching realized in Frame Relay and ATM and now culminate in the exploding Internet environment.

## 1. INTRODUCTION

This paper is an essay that tries to identify and explain the overarching concepts, principles, and approaches in the field of software architecture as it evolved during the first half century of its lifetime. It is inspired by the approach taken by eighteenth century historians and philosophers (Dilthey, Hegel) called "history of ideas" (Ideengeschichte).

We start out by giving our definition of architecture which leads to the first basic concept of the operating system as a metaphor of an interface transformation between hardware and software.

## 2. ARCHITECTURE

### 2.1 Scheduling

What do we mean by software architecture? We actually give two complementary meanings. In analogy to the approach of the architect involved in construction of buildings, we separate the architecture into exo-architecture which looks at the system from the "outer" side, i.e. the appearance of the system to their users, and into endo-architecture which looks at the "inner" side, i.e. the internal structure as seen by the builders [1].

## 3. DISTRIBUTED SYSTEMS

We consider a "distributed system" to be a set of programs running on separate physical systems (not necessarily in a

geographically spread network) which communicate and/or cooperate with one another. In our view, the deciding characteristic is that communications can fail in an unpredictable manner, and the distributed system has to be prepared for such failures [2]. Such systems show therefore non-deterministic behavior.

## 4. NETWORKING

How does a network differ from a distributed system? We view the boundaries between them as floating.

The most important distinction in our view is the network's necessity to deal with change, with change being a mandatory phenomenon in networks, but not necessarily in distributed systems.

*Table 1 - xxxxxxx*

$$e_i = E_i(o_i, a_i) \quad (1)$$

*Figure 1 - xxxxxxx*

## 5. CONCLUSION

Finally, if over the first fifty years of its life the computing/communication environment merely reflected the culture in which it grew, the next fifty years may very well see a development where the converging electronic technologies will dominate the culture; in that sense the new millennium we are about to begin could become the era of electronic culture or in current parlance of "e-culture".

## REFERENCES

- [1] Ralf Steinmetz: "Analyzing the Multimedia Operating System", IEEE Multimedia, Spring 1995, p.p. 68-84.
- [2] Abraham Silberschatz: "Operating System Concepts", Addison-Wesley Publishing Company, 4<sup>th</sup> ed., 1994.