

Faculty of Engineering of the University of Porto



## Homework 02

### Design the Internet - Part 2

**M.EIC010 - Software Systems Architecture**

**1MEIC03 - T32**

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# 1. Introduction

In the article “Extracting the Essential Simplicity of the Internet,” James McCauley, Scott Shenker and George Varghese, delve into the core principles that underpin the remarkable success of the Internet, shedding light on its essential design elements and, most importantly, its philosophies.

The article unveils the design and architectural decisions that shaped the Internet into the universal and resilient network it is today, prompts to reconsider its fundamental simplicity. Through this exploration, we come to appreciate the delicate balance between complexity and simplicity that defines the Internet's resilience and adaptability.

## 2. Message of the Title

Inspired in the work of David Clark, the authors endeavor a basic concept about the nature of the Internet and the difficulties in comprehending and navigating its complexity is captured in the title.

The Internet is a vastly intricate network of interconnected devices, protocols, networks, and people. It has developed naturally throughout time, giving rise to an abundance of standards, methods, and technologies that can be difficult to understand. Effective Internet management, design, and security may be hampered by this complexity.

In the article, the authors make the case that, despite all of the Internet's complexity, it is crucial to recognize and pay attention to the fundamental simplicity that lies at its foundation. This entails condensing the basic ideas, structures, and protocols that support how the Internet operates. By doing this, one can learn more about how it functions, manage its complexity more effectively, and create solutions that are more reliable and scalable.

The title's historical context most likely alludes to the early stages of the Internet's development, when openness, decentralization, and interoperability were the main design tenets. The fundamental ideas that continue to direct the development and functioning of the Internet maintain a fundamental simplicity despite its expansion and progress.

All in all, the article's title essentially implies that we may better grasp the Internet's operation and successfully tackle the problems it presents by isolating and comprehending this fundamental simplicity.

## 3. Secrets to the Internet's Success

The success of the Internet derives from deliberate decisions upon its design by defying the structure of the rising telephone network. In fact, by examining the reasons behind these decisions, it is possible to retain valuable insights regarding the fundamental principles that shaped the Internet into what it is to this date, defined by the “secrets to the Internet’s success”, as mentioned in the article. Two pivotal factors of the Internet's design highlighted are its modesty and the assumption that failure is normal.

### 3.1. Modesty

Architects of the Internet opted for a modest approach, offering a broadly applicable model without any promises, rather than overcomplicating its design with features made for specific applications. This allowed for a broader range of applications to evolve using this technology, without requiring constant modifications to the Internet architecture - demonstrating that the architecture envisioned to be future-proof.

This modesty in design has been a key factor in the Internet’s success, as it allowed for innovation and creativity without constraints, leading to an explosion of diverse applications that we see today.

### 3.2. Assuming failure is the normal case

Providing a failure-free design for the Internet was considered not viable, because “as systems scale in size it becomes increasingly likely that, at any point in time, some components of the system have failed”. This way of thinking modified the development approach towards failures, in the sense that rather than treating failures as exceptional events requiring special handling, the system was already built considering their inevitable presence, by dynamically changing conditions and rerouting traffic.

The assumption that failure is the norm has contributed to a more robust and reliable system, as it led to the development of mechanisms to handle these failures effectively.

## 4. Comparison with the Real Design of the Internet

Our first homework was to imagine we were in the 1970s, the Internet didn’t exist, and we would be coming up with its design. Now, in this section, we will compare ours with the real design of the Internet using the paper "Extracting the Essential Simplicity of the Internet".

When making this comparison, it is clear that both try to focus on modularity through the use of layers. Modularity allows for both a structured design with ease of implementation, while

also providing flexibility. Even though the layers themselves were slightly different, both had the main objective of separating the goals of the systems into smaller tasks.

The paper previously mentioned focuses a lot on the routing mechanism by addressing some details regarding valid routing states and multiple ways of avoiding loops when routing. In our design, we didn't focus on the specifics too much, only mentioning a simple flooding mechanism to disseminate messages throughout the network, enabling routers to exchange information with their neighbors. After examining the real design, it is clear that our routing process needed more details regarding the possibility of loops as well as some more consideration to create a more efficient and reliable routing. On the other hand, the mechanism of flooding we choose could be a great starting point with some improvements.

The paper also delved into the concepts of reliability through protocols such as TCP, while we didn't create any specific mechanism for dealing with errors and packet loss. Upon reflection, it is evident that reliability is important for seamless communication over the Internet.

The last mechanism mentioned in the paper is resolution, which was an oversight when creating our design, but in hindsight, name resolution is a key mechanism for the Internet since it provides a user-friendly way of accessing resources in the Internet by translating human-readable domains into IP addresses, among other reasons.

In the end, after attempting to design the Internet and reading about how the real one was designed, it is clear to us that designing the Internet needs a lot of careful consideration so that the entire system stays simple yet effective. Though this is not easily achieved, focusing on the reason why certain design elements were created the way they were gave us a better understanding of how the Internet was made by employing clever design decisions that defied the norms previously established.