

# ASSO - Design the Internet (Part 2)

Homework 2

## Team 33

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Masters in Informatics and Computing Engineering

18/02/2024

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# 1 Introduction

This paper evaluates the design choices made in the paper "Extracting The Essential Simplicity of the Internet" [2] against our group's attempt to design the Internet [1]. The paper compares the essential design elements, service models, architectural layers, and critical mechanisms like routing, reliability, and resolution. We will then focus on two significant design choices that have contributed to the success of the Internet. Ultimately, this analysis aims to focus on the alignment and the disparities between our design and the established Internet infrastructure and critically think about what could have been done differently.

## 2 Design choices that contributed to the Internet's success

### 2.1 Flexible Service Model

We believe the decision to **make the Internet modest** was crucial to its evolution. The modesty of the Internet refers to the adoption of a very general service model that makes no guarantees. By making this decision, the Internet could be improved without the need for major changes because it was not tailored to any specific application requirements.

Having that said, the Internet provided a platform for a wide range of applications to develop and thrive. This flexibility allowed for the emergence of innovative services and technologies that may not have been anticipated at the time of its creation as well as preventing the Internet from becoming quickly outdated. Instead, it relied on smart hosts and unintelligent networks, enabling new applications to flourish and leveraging the ability of hosts to adapt to various conditions. This approach also facilitated a rapid increase in network speeds, since the service model was relatively simple.

### 2.2 Embracing Failure

Another crucial decision made by the Internet creators was the **assumption of failure as being the normal case**. As the authors mention in the article, as systems grow in size and complexity, the probability of component failures increases. Therefore, rather than treating failure as an exceptional event, the Internet regards failure as a common occurrence and incorporates mechanisms to handle it efficiently. An example of this can be observed in the design choices of common transport protocols such as TCP: in the event of packet losses the protocol ensures re-transmission of those same packets, contributing to the reliability expected of communications supported by this network.

This approach contrasts with one that expects a system to operate normally and, when failure occurs, measures must be taken to fix the system.

### 3 The 'why' behind the scenes

The article [2] focuses on exploring the "why" behind a decision instead of the "how".

#### 3.1 DNS (Domain Name System)

One example where this decision-making rationale provides additional insight into the internet is the **hierarchical structure of the Domain Name System (DNS)**.

The hierarchical structure of DNS was not arbitrarily chosen; it was designed to address specific challenges faced by the internet, namely administrative control and scalability. By breaking the namespace into regions called domains, which are further subdivided into smaller domains, DNS allows for the delegation of administrative control over specific sections of the naming system. This means that different organizations or entities can manage their own domains and make decisions about how names within those domains are resolved to IP addresses.

Without this hierarchical structure, managing the vast number of names and resolution requests on the internet would be much more challenging.

Moreover, this insight highlights the decentralized nature of the Internet's administrative control, which is essential for its resilience and adaptability. Each naming domain has its own set of name servers, allowing for local management and updates without requiring centralized coordination.

#### 3.2 Decentralized Network Governance

Another "why" that, while being rather obvious, expanded our knowledge about the Internet and aided us in understanding its core design principles is the choice behind implementing a **naïve network with smart hosts**, in which, by giving control to organizational systems and only enforcing a small set of standards in network communications, these organizations are free to scale as they wish, adhering to standards where they make sense and keeping their systems where it doesn't.

## 4 Deciphering the intent behind the article's title

The title of the article, "Extracting the Essential Simplicity of the Internet", suggests that the authors aim to uncover and emphasize the foundational principles and core design choices that define the Internet's functionality and success.

The internet appears more complicated than it truly is. While it comprises numerous protocols, its architecture is surprisingly straightforward and logical if we overlook these intricacies. This approach facilitates a clearer understanding of the Internet's design choices.

The term "essential simplicity" implies that there are key aspects of the Internet's design that are crucial to its operation and success. The writers mention that they wrote this paper due to a long-standing frustration: they find the internet both interesting and inspiring, while other researchers do not. Therefore, they aimed to share their fascination with the Internet by extracting its simplicity: the core concepts that make it such an intriguing and revolutionary infrastructure.

## 5 Design’s comparison

Understanding the nuances of our design in comparison to the approach behind the article is essential for identifying strengths and weaknesses and, mostly, to learn from the different thinking methods and the various approaches. In this small analysis, we reflect on key aspects that delineate our approach from established standards, mentioning some of the differences and areas for improvement.

### 5.1 Name Resolution

One important aspect that the authors of ”Extracting The Essential Simplicity of the Internet” mentioned that we thought was unnecessary to approach in our paper was *name resolution*, that is, the translation of human-readable host names into routing-friendly IP addresses. While we believe this to be an application-level service (both in the TCP/IP tech stack and in the OSI model), the truth is that it is a crucial aspect of the correct functioning of the Internet today and as such should have received some form of mention due to its intricate relationship with the Internet’s service model, as described in the aforementioned article.

### 5.2 Routing Protocols

Another thing that we failed to mention was **how large-scale networks discover new routing information**, mainly performed by the Border Gateway Protocol. We described the hypothesis of establishing several redundant links between networks but the lack of a route discovery process implicitly hints at this routing information having to be manually configured, which does not grow according to the scale at which the Internet is deployed today.

## 6 Conclusion

Overall, while our design closely resembles the architectural summary described in "Extracting The Essential Simplicity of the Internet", there are some minor differences that could affect our design's success in a production environment, namely **how to propagate routing information between networks** and **the use of a name resolution service**, which, while not being directly a network service, goes hand-in-hand with the Internet's service model.



## References

- [1] Guilherme Almeida, João Moreira, Jorge Sousa, Lia Vieira, and Nuno Pereira. Asso - design the internet. 2024.
- [2] Ames Mccauley, Scott Shenker, and George Varghese. Extracting the essential simplicity of the internet. *Communications of the ACM*, 66:64–74, 2023.