

The Development of Peer-to-Peer Matrix

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Abstract

as *the silo problem*.

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1 Introduction

In 1971, the first email was sent [12]. Email is currently implemented using decentralized protocols for sending simple messages between recipients, specified for example in the SMTP RFC [11]. One may register with an email provider, and write messages to any other provider implementing the same protocols, as long as they have the recipient's address, known as an email address. Mobile providers similarly allow people to contact others outside of their network. However, there's been a growing trend of *communication silos*, where users may only contact other users of the same service. Examples of such services are WhatsApp, which has announced that its userbase has now exceeded two billion users [10], and Facebook Messenger, which similarly reported having 1.3 billion users [5].

Communication Silos Although these services run over the internet, they are designed in isolation, and do not adhere to an external standard. In order to use such a service, a user must acquire a client designed for this private protocol. This approach does not scale well in terms of battery or network traffic, as each application separately performs similar routine actions, such as checking for and sending messages. We refer to the challenges of communication silos

Security In the typical client-server architecture, the client is forced to operate with some level of trust. In the case of email, the original architecture required that both participants be online, but has now adapted such that some server just needs to receive it and be able to pass it on to the recipient when possible [12]. Platforms which follow this architecture for messaging therefore store the messages of all conversation participants. The storage format and security depends on the software run on the server, which receives, stores and passes the messages on. For closed-source vendors, it is intractable to know whether the messages passed are done so securely, or whether third parties can access the data. Users are therefore forced to either rely on the word of the service providers, or use an alternative. In the cases of WhatsApp and Facebook Messenger, several such features are boasted, but regardless not verified [13].

Matrix The Matrix open standard [4] is a specification for a network similar in structure to email. It supports more recent features, such as live messaging, calls, and video conferencing. This standard is a potential solution to *the silo problem*, and has several strong points. It is designed for interoperability. It has multiple clients [2] and SDKs [8]. Through bridges, Matrix allows communicating with different protocols [1]. The reference implementation of the Matrix open standard is Synapse [9], which is writ-

ten mostly in Python.

1.1 Initial Problem Statement

We explore the current status of Matrix

We propose the following initial problem statement:

- What are the current priorities of the Matrix project?
- What technical challenges does it face?
- What are the properties

2 Analysis

We explore the different questions posed in the initial problem statement in section 1.1.

The Matrix Standard The Matrix standard defines the behavior of a *homeserver*, and a *client* [4]. Each homeserver needs to be registered with a DNS entry, by which they are currently identified. A user is registered under a homeserver, and identified thereby, e.g. `@user:homeserver.domain`. The specification is meant to change, i.e. it was not designed as final, and it has an established process for change. This process is defined in [7]. In order to account for a changing standard, a versioning system was established by the Matrix foundation. This standard is found in [4], and establishes the foundation for interoperability between clients and chat rooms of varying versions.

2.1 Use of the Matrix Standard

Matrix.org provide a free homeserver, from which the foundation reported the following statistics [3]:

- ~13.5 million users are visible from the Matrix.org homeserver.
- ~5 million messages are sent each day.

- France, Germany and the US are reported to use Matrix, potentially also the UK.

- ~100 companies reported using Matrix.

2.2 Matrix Specification Limitations

We consider some of the limitations of the Matrix Specification.

As described in Github issue [6], a fundamental limitation of the client-server architecture is that users require a separate homeserver, with a static IP address and a DNS entry. To clarify, homeservers do not support changing domain names, as it is an essential part of their identity. Not all users have the hardware or resources to host their own server, and the specification currently does not support peer-to-peer communication.

2.3 Matrix Reference Implementation Limitations

2.4 Properties of Solutions

2.5 Problem Statement

- Which technical challenges must be overcome in order to implement peer-to-peer Matrix?
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- How could one implement such a solution?

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