Introducing

Rethinking IP Communication

matrix:

A federated open-source VoIP and IM ecosystem

matrix

In practice....

- Pragmatic and lightweight open spec
- Open source reference client and server implementations
- Not-for-profit neutral custodian

What matrix changes:

- Anyone can build and host their own IP-comm service
- Users can choose who they trust with their data
- Users can use their favorite service to reach anyone as all services federate

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Why is now the right time?

2000– SIP Open standard for VoIP

But technology was not mature (firewall traversal, quality-of-experience, codecs etc)

➔ **Limited take-off**

Industry builds proprietary closed ecosystems instead

For example Skype, Viber, WhatsApp…

➔ **Now stuck in this state of fragmentation**

2005 – RCS initiative

GSMA tries to launch a standard for interoperability between SPs

➔ **But RCS is flawed and has very questionable success**

As of the last ~1 year, the tech is finally available

WebRTC appeared; VoIP development is finally mainstream.

➔ **The industry is ready.**

So, what is it?

- Open spec
- Open source reference servers
  - **matrix** Home Server (**synapse**, written in Python/Twisted)
  - **matrix** Identity Server (**sydent**, written in Python/Twisted)
- Open source reference clients
  - Command Line Client (Python/Twisted)
  - Web Client (AngularJS)
- Third party **matrix** compliant servers, clients, gateways (in progress), app platforms (in progress), SDKs (in progress)...

What can it do?

- Federated rich instant messaging (1:1, public & private chat rooms, group chat, file sharing)
- Federated Presence, profiles, avatars
- End-to-end encryption (if desired; in progress)
- Federated VoIP calls and conferences
- Full multi-screen synchronisation of all state

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Guiding Principles

- Be web-friendly, and trivial for web developers to use.
- Baseline transport is JSON + RESTful APIs (HTTP + SPDY)
  - more efficient transports are allowed as extensions
- All functionality is federated - no single points of control
- Group communication is the 1st class citizen
  - 1:1 is just a degenerate case of group

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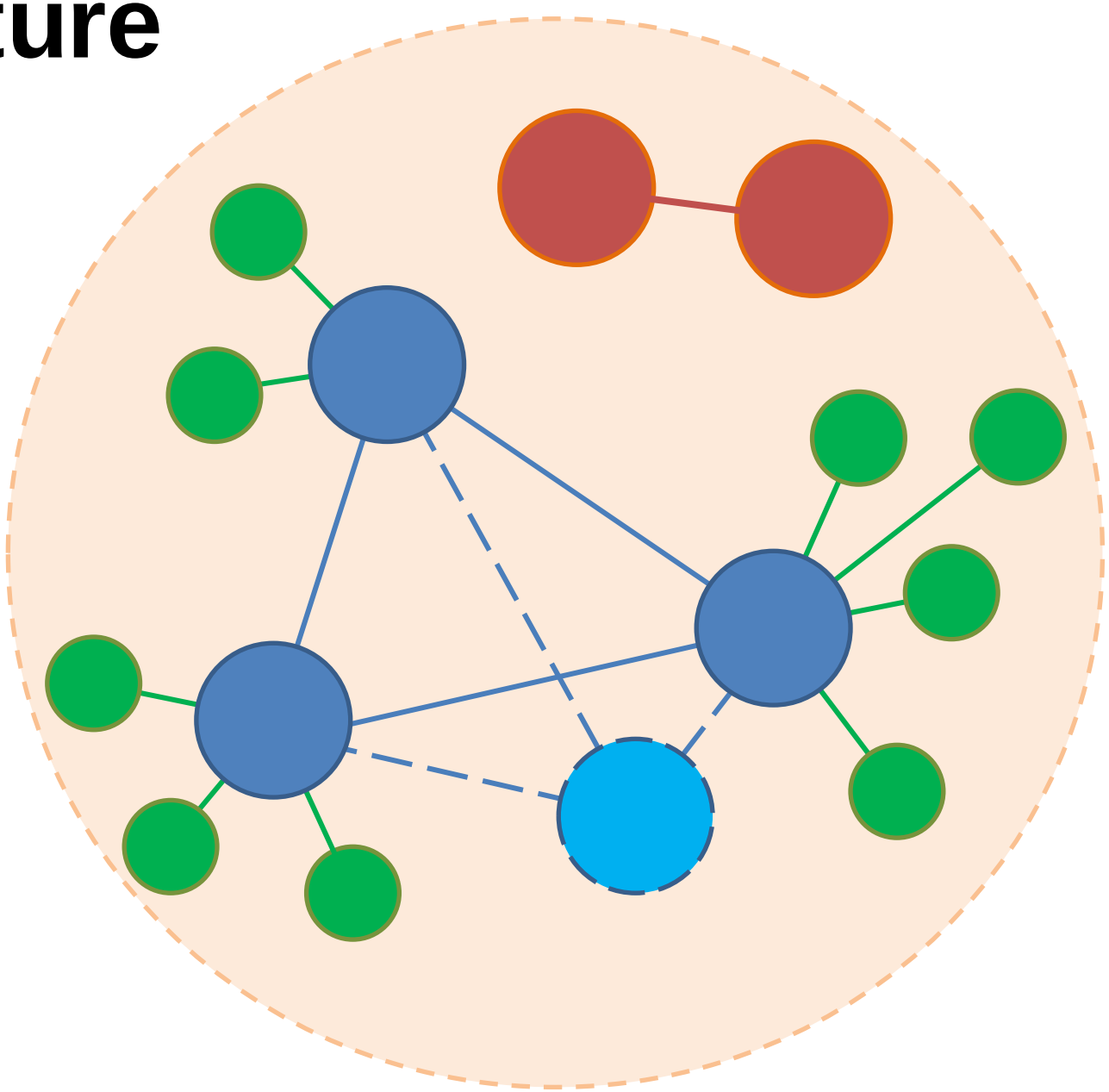
Architecture

Clients

Home Servers

Identity Servers

Policy Servers



Functional Responsibility

- **Clients**: Talks simple HTTP APIs to homeservers to push and pull messages and metadata. May be as thin or thick a client as desired.
- **Homeservers**: Stores all the data for a user - the history of the rooms in which they participate; their public profile data.
- **Identity Servers**: Trusted clique of servers (think DNS root servers): global repository of public keys for clients and servers. Also maps 3rd party IDs to **matrix** IDs.
- **Policy Server:** Optional; Acts as the focal point for all messages in a room which requires a single point of control (e.g. moderation) (in progress)

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Federation Design #1

- No single point of control for chat rooms.
- Any homeserver can publish a reference to a chat room (although typically the address is the homeserver of the user who created the room).
- Room addresses look like:

#matrix:matrix.org

(pronounced hash-matrix-on-matrix-dot-org)

- The IP of the matrix.org homeserver is discovered through DNS (SRV _matrix record if available, otherwise looks for port 443 of the A record).

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Federation Design #2

- When a user joins a room, his HS queries the HS specified in the room name to find a list of participating homeservers via a simple GET
- Messages form a directed acyclic graph (DAG) of chronologicity, each crypto-signed by the origin HS
- The user's HS pulls in messages via GETs from participating HSs by attempting to walk the DAG
- Each HS caches as much history as its users (or admin) desires
- When sending a message, the HS PUTs to participating homeservers (currently full mesh, but fan-out semantics using cyclical hashing in development)

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Identity Design

- We don't want to be yet another identity system (e.g. JIDs)
- So we aggregate existing 3rd party IDs (3PID) and map them to **matrix** IDs (MXIDs), whose use in public is strictly optional.
- And so login and user discovery is typically done entirely with 3rd party IDs.
- ID servers validate 3rd party IDs (e.g. email, MSISDN*, Facebook*, G+*) and map them to MXIDs. MXIDs look like:

@matthew:matrix.org

* In progress

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Security Design #1

- Server-server traffic is mandatorily TLS from the outset
- Can use official CA certs, but automagically self-sign and submit certs to **matrix** ID servers as a free but secure alternative
- Server-client traffic mandates transport layer encryption other than for tinkering
- Clients that support PKI publish their public keys to ID servers, and may encrypt and sign their messages* for E2E security.
- "Well behaved" clients should participate in key escrow servers to allow private key submission for law enforcement.
- End-to-end encryption* for group chat is supported through a per-room encryption key which is shared 1:1 between participating members

* In progress

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Security Design #2

- SPAM is contained by mandating invite handshake before communication
- Invite handshakes are throttled per user
- Homeservers may be blacklisted on identity servers
- ID servers authenticating 3PIDs are obligated to mitigate bulk registration of users via CAPTCHAs or domain-specific techniques (e.g. 2FA SMS for MSISDNs)

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What about VoIP?

- Simple JSON-based offer-answer over the **matrix** messaging channel
- Basic support in the reference web client
- See the specs for details

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Where are we at now?

- Matrix is still very much evolving. Main pending features:
  - E2E security
  - Policy servers
  - Mobile clients
  - Improved security

- Goal: mirror WHATWG's Living Standard approach except right now Matrix is more in the process of being born than actually being living!

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Why not XMPP?

- We used to use XMPP (ejabberd, OpenFire, Spectrum, psyced, Psi, Pidgin, ASmack, Spark, XMPP.Framework)
- We built an alternative because:
  - Single server per MUC is single point of control
  - Synchronised history is a very 2nd class citizen
  - Stanzas aren't framed or reliably delivered
  - XMPP stacks are not easy to implement in a web environment
  - Jingle is complicated and exotic
  - XML is needlessly verbose and unwieldy
  - The baseline feature-set is too minimal
  - JIDs haven't taken off like Email or MSISDNs
  - Not designed for mobile use cases (e.g. push; low bw)
  - Well documented spam and identity/security issues
  - ejabberd

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Why not psyc?

- psyc is an interesting early instance of better-than-XMPP federated chat
- psyc v1 has limitations:
  - Minimal spec
  - Few implementations
  - Security issues
  - Not web-friendly
- psyc v2 has become part of GNUnet, providing end-to-end secure group chat on top of the censorship-resistant GNUnet overlay network.
  - Dependent on the complexities and usability challenges of the GNUnet ecosystem
  - Not web-friendly
  - But does provide anti-censorship guaranties that Matrix doesn't

Get involved!

Support a promising new ecosystem

Be a Thought Leader and play an active role

Support a promising new ecosystem

- Validate and sanity-check the spec
- Help guide how **matrix** grows

Be a Thought Leader and play an active role

- Expose **matrix** APIs and act as a gateway to any existing community
  ➔ add a whole **new ecosystem to your community**
- Build your own customized **matrix** clients
  ➔ participate in **matrix**'s diversity and growth while **keeping your identity and maintaining your level of service**
- Host your own **matrix** homeservers
  ➔ be a **trusted provider for your customers** like you are today
- Provide self-hosted **matrix** compliant platforms
  ➔ allow your customers to host their own platform to **give them control over their data**

THANK YOU!

http://matrix.org

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