[matrix]

Introducing Matrix

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http://www.matrix.org

Matrix is an…

Open

Decentralised

Persistent

Eventually Consistent

Cryptographically Secure

JSON-over-HTTP

Messaging Fabric

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Matrix is for:

- Group Chat (and 1:1)
- WebRTC Signalling
- Bridging Comms Silos
- Internet of Things Data

…and anything else which needs to pubsub persistent data to the world.

Why are you re-inventing XMPP!?!?

WE ARE NOT.

Matrix is essentially a distributed EC persistent messaging database with an HTTP API.

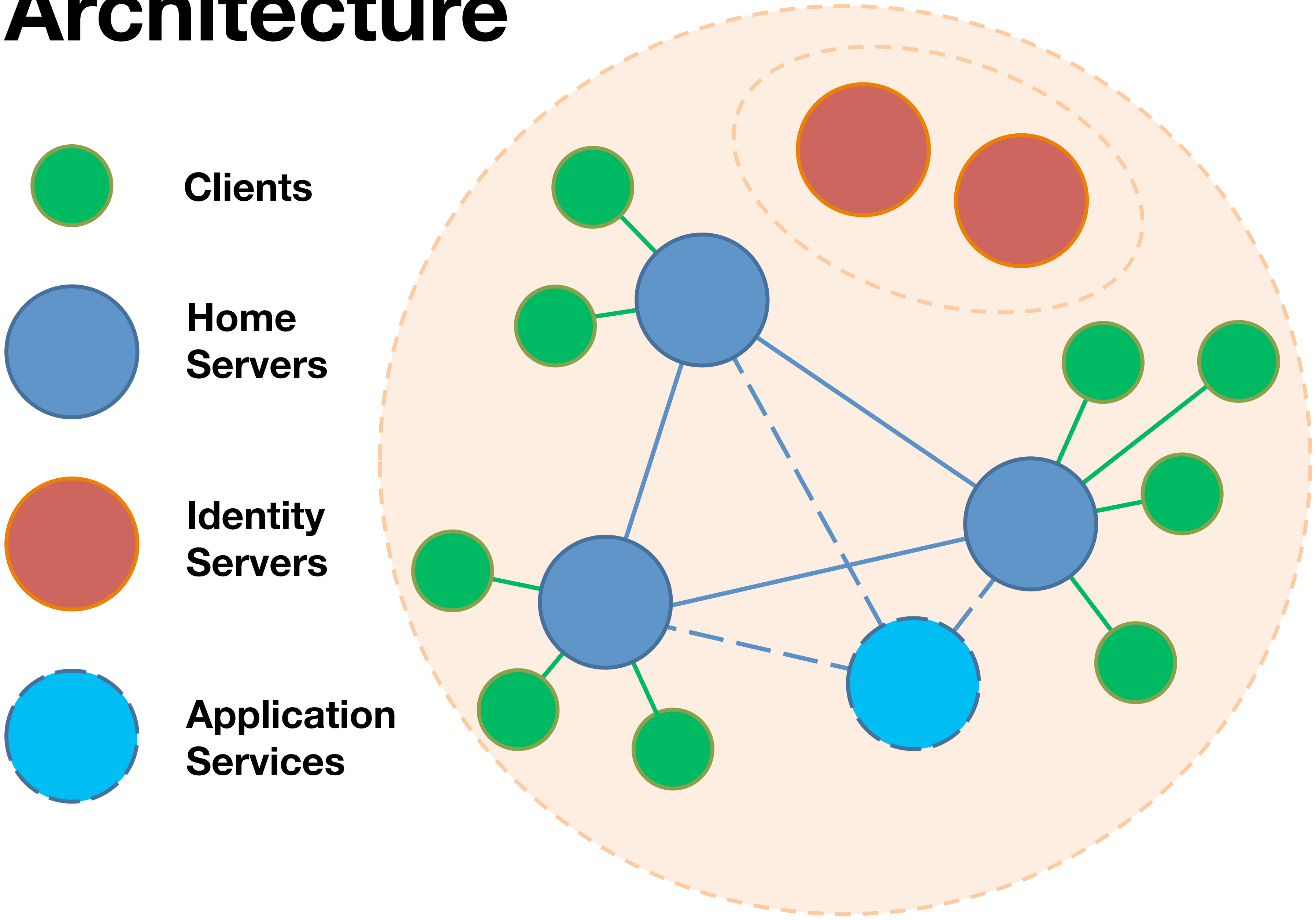
History and Group comms are 1st class citizens.

What does it look like?

Demo time!

http://matrix.org/beta

Architecture



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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): maps 3rd party IDs to **matrix** IDs.
- **Application Services:** Optional; delivers application layer logic on top of Matrix (Gateways, Conferencing, Archiving, Search etc). Can actively intercept messages if required.

What do you get?

- **Open Standard HTTP APIs (WIP)**
  - Client-Server API (v2)
  - Server-Server API
  - Application Service API
  - Identity Server API
- **Open Source Reference Implementations**
  - Synapse Homeserver (Python/Twisted)
  - SDKs for AngularJS, iOS, Android, Perl, Python
  - Clients for AngularJS, iOS, Android
- **Third Party Implementations**
  - Pallium Homeserver (Go)

How does it work?

http://matrix.org/matrix-graph.html

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The client-server API

To send a message:

```
curl -XPOST -d '{"msgtype":"m.text", "body":"hello"}'
"https://alice.com:8448/_matrix/client/api/v1/rooms/
ROOM_ID/send/m.room.message?access_token=ACCESS_TOKEN"
```

```
{
    "event_id": "YUwRidLecu"
}
```

The client-server API

To set up a WebRTC call:

```
curl -XPOST -d '{\
  "version": 0, \
  "call_id": "12345”, \
  "offer": {
    "type" : "offer”,
    "sdp" : "v=0\r\no=- 658458 2 IN IP4 127.0.0.1…"
  }
}' "https://alice.com:8448/_matrix/client/api/v1/rooms/
ROOM_ID/send/m.call.invite?access_token=ACCESS_TOKEN"

{ "event_id": "ZruiCZBu” }
```

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The client-server API

To persist some MIDI:

```
curl -XPOST -d '{\
    "note": "71",\
    "velocity": 68,\
    "state": "on",\
    "channel": 1,\
    "midi_ts": 374023441\
}' "https://alice.com:8448/_matrix/client/api/v1/rooms/
ROOM_ID/send/org.matrix.midi?access_token=ACCESS_TOKEN"

{ "event_id": “ORzcZn2” }
```

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The client-server API

…or to persist some tap gestures for animating an Avatar…

```
curl -XPOST -d '{
    "thumbnail": "http://matrix.org:8080/_matrix/content/
QGtlZ2FuOm1hdHJpeC5vcmcvNupjfhmFhjxDPquSZGaGlYj.aW1hZ2UvcG5n.png",
    "actions": [
        {"x": "0.5521607", "y": "6.224353", "t": "0.9479785"},
        {"x": "0.5511537", "y": "6.220354", "t": "0.9701037"},
        {"x": "0.5510949", "y": "6.214756", "t": "0.9804187"},
        {"x": "0.5499267", "y": "6.213634", "t": "0.9972034"},
        {"x": "0.5492241", "y": "6.210211", "t": "1.013744"},
        {"x": "0.5486694", "y": "6.206304", "t": "1.030284"},
        {"x": "0.5482137", "y": "6.201648", "t": "1.046764"},
...
        {"x": "0.9997056", "y": "4.022976", "t": "8.970592"},
        {"x": "0.9995697", "y": "4.043199", "t": "8.987072"}
    ]
}' "https://alice.com:8448/_matrix/client/api/v1/rooms/ROOM_ID/send/
org.matrix.demos.unity.stickmen?access_token=ACCESS_TOKEN"

{ "event_id": “ORzcZn2” }
```

The server-server API

```
curl -XPOST -H ‘Authorization: X-Matrix origin=matrix.org,key=”898be4…”,sig=“j7JXfIcPFDWl1pdJz…”’ -d ‘{
    "ts": 1413414391521,
    "origin": "matrix.org",
    "destination": "alice.com",
    "prev_ids": ["e1da392e61898be4d2009b9fecce5325"],
    "pdus": [{
        "age": 314,
        "content": {
            "body": "hello world",
            "msgtype": "m.text"
        },
        "context": "!fkILCTRBTHhftNYgkP:matrix.org",
        "depth": 26,
        "hashes": {
            "sha256": "MqVORjmjauxBDBzSyN2+Yu+KJxw0oxrrJyuPW8NpELs"
        },
        "is_state": false,
        "origin": "matrix.org",
        "pdu_id": "rKQFuZQawa",
        "pdu_type": "m.room.message",
        "prev_pdus": [
            ["PaBNREEuZj", "matrix.org"]
        ],
        "signatures": {
            "matrix.org": {
                "ed25519:auto": "jZXTwAH/7EZbjHFhIFg8Xj6HGoSI+j7JXfIcPFDWl1pdJz+JJPMHTDIZRha75oJ7lg7UM+CnhNAayHWZsUY3Ag"
            }
        },
        "origin_server_ts": 1413414391521,
        "user_id": "@matthew:matrix.org"
    }]
}’ https://alice.com:8448/_matrix/federation/v1/send/916d630ea616342b42e98a3be0b74113
```

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Current Progress

- Funded May 2014
- First public release in Sept 2014
- Crypto and iOS/Android landed Oct 2014
- Exited alpha Nov 2014
- Dec: 40 federated homeservers; 500 end users.
- Next up:
  - Spec overhaul
  - Finalise Application Server APIs
  - v2 Client-Server API
  - UX polish for the reference clients
  - End-to-End Encryption

We need help!!

- **We need people to try running their own servers and join the federation.**
- **We need feedback on the APIs.**
- **We need more people to actually use it!**

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http://matrix.org

THANK YOU!

matrix: @matthew:matrix.org
mail: matthew@matrix.org
twitter: @matrixdotorg

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 8448 of the A record).

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)

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) by **Identity Servers**, 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

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, 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

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Security Design #2

- SPAM is contained by mandating invite handshake before communication
- Invite handshakes are throttled per user
- Homeservers and users 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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Application Services: Spec & API

- Still in development; some early prototypes
- "Passive AS-API" Builds on the client-server API
  - Service registers a URL for inbound events to be PUT to
  - Allows a service to register for traffic on behalf of a namespace of virtual users and virtual rooms
  - Adds "superuser" permissions to subscribe to arbitrary filters of events on the homeserver, and inject arbitrary events
  - Modeled loosely after IRC Services
- Also: Active AS API for intercepting inbound events on a HS, and Storage API for exposing existing conversation DBs to Matrix via a HS.

AS Example: Matrix/SMS Gateway

- matrix.org runs a homeserver.
- Matrix/SMS gw AS is registered to the homeserver, masquerading for the 'sms.matrix.org' domain.
- @447968722968:sms.matrix.org routes to the homeserver from anywhere in Matrix, which passes events for *:sms.matrix.org through to the AS
- Matrix/SMS Gateway then relays via SMS aggregators to send SMS to +447968722968
- The reverse path is symmetrical, with the Matrix/ SMS AS injecting events into the HS on behalf of @447968722968:sms.matrix.org

AS Example: Matrix/SIP Gateway

- Similarly, AS can implement a SIP gateway, posing as a range of virtual matrix users.
- Events such as 'm.call.invite' and 'm.call.candidates' are PUT to the AS by the HS
- AS converts directly into SIP signalling (reINVITEing to advertise new ICE candidates)
- Media flows out-of-band to Matrix as typical WebRTC SRTP.
- We've already written a basic Matrix/Verto gateway (using client-service API – see matrix.org/blog)

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