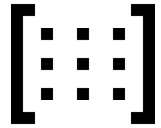


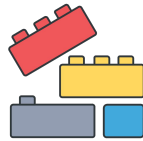
Element Call...

World's first decentralised and federated
video conferencing solution

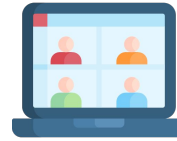
Agenda



Intro to Matrix



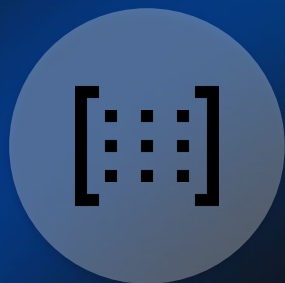
(Why) MatrixRTC



Element Call



Guest Access



Recap | Matrix

Matrix is an open network for secure, decentralised real-time communication.



Interoperable chat



Interoperable VoIP



Open comms for
VR/AR



Real-time IoT
data fabric

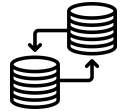
What Matrix is really good at



Open Standard



Decentral & Federated



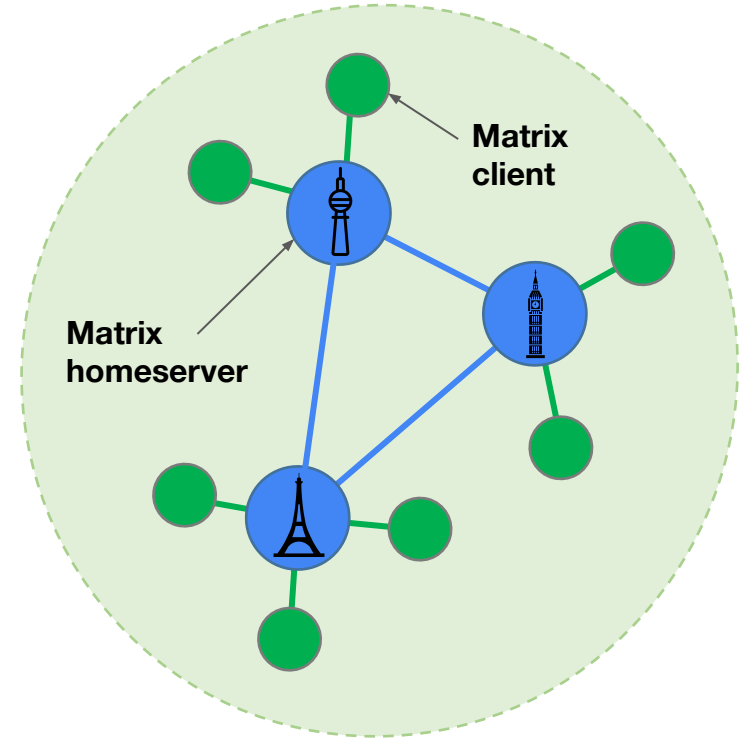
Replicated / Persistent



End-2-End Encryption

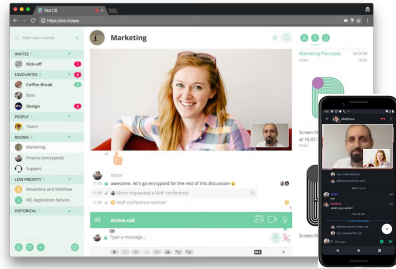


Verified Identities

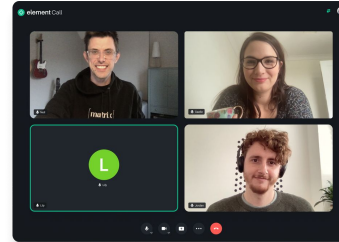


Does it Fit Calling Requirements?

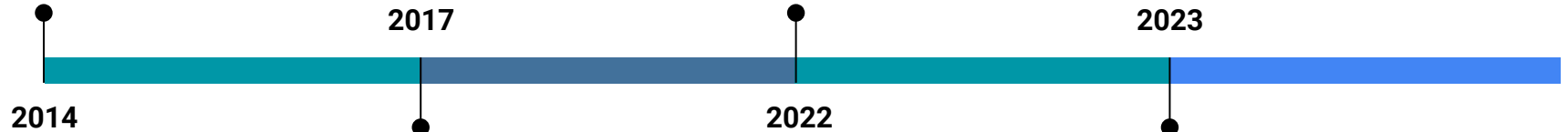
Brief History of Matrix Calling



Native 1:1 Calling [MSC2746](#)



Native P2P Group Calling [MSC3401](#)



2014

2017

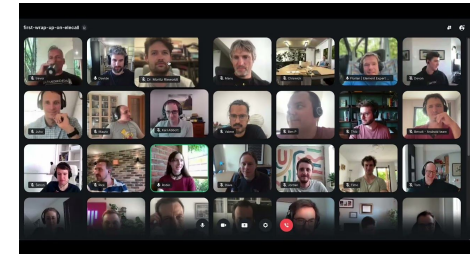
2022

2023

Jitsi via Widget (iFrame)



Group Calling Using SFU Backend for Scaling



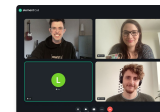
Does it Fit Matrix DNA



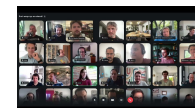
Jitsi



1:1 Calling



P2P Calling

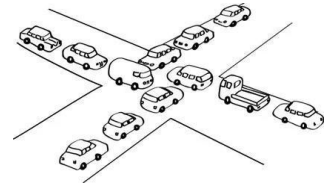


Backend

	Jitsi	1:1 Calling	P2P Calling	Backend
Federation	X	✓	✓	✓
(Large) group calls	✓	X	~ 5-8	✓
E2EE / Verified Identities	(✓) / X	✓	✓	✓
Interoperable	X	✓	✓	✓
Matrix compatible permissions and roles	X	✓	✓	✓
Open Standard	X	✓	✓	✓

Interim Status

- Getting calls right is hard due to Matrix distributed nature
 - Eventual consistency & race conditions
- Typical symptoms in the past
 - Neverending call ringing on your second device
 - **Ghosts** / Split brains / partitions / multiple parallel calls
 - Glare causing a conflict in state machines
 - Similar to two people speaking at the same time
 - Unlike humans, computers are unable to recover gracefully
- Findings
 - Face “eventual consistency” by adapting to emerging state
 - Improve clear ownership of events & separation of concerns
 - Prevents a class of race conditions

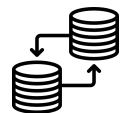


It is all about reliable room state

Does Matrix Fit Calling Requirements Yet?



Decentral & Federated



Replicated / Persistent



End-2-End Encryption



Verified Identities

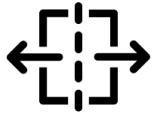


Reliable (RTC) Room State



Further Requirements for Matrix Calling

Tackling Typical Symptoms & Failures



Clear ownership of events



Separation of concerns



Adapting to emerging state





MatrixRTC



In depth talk MatrixRTC: The (not anymore) missing piece to enable great video conferences

Today, 16:00h, LAB4

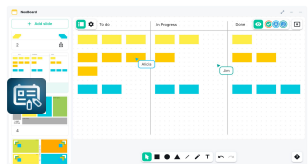
Make RTC a great and central part of [m]

Think beyond calls

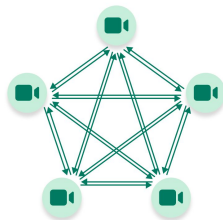
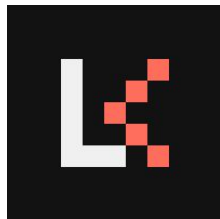
third room



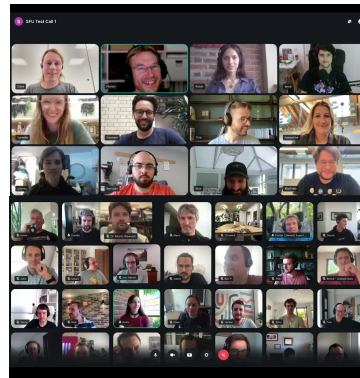
NeoBoard (Nordeck)



Pluggable
RTC backend



Large, interop.,
secure group calls



Support many
clients



+

Others?

(widget support EC)
Or any livekit sdk

NeoToolSuite: A productivity suite integrated with Matrix
Fr, 15.30h, LAB3

MatrixRTC at a Glance



Clear ownership [MSC4143](#) MatrixRTC



Separation of concerns

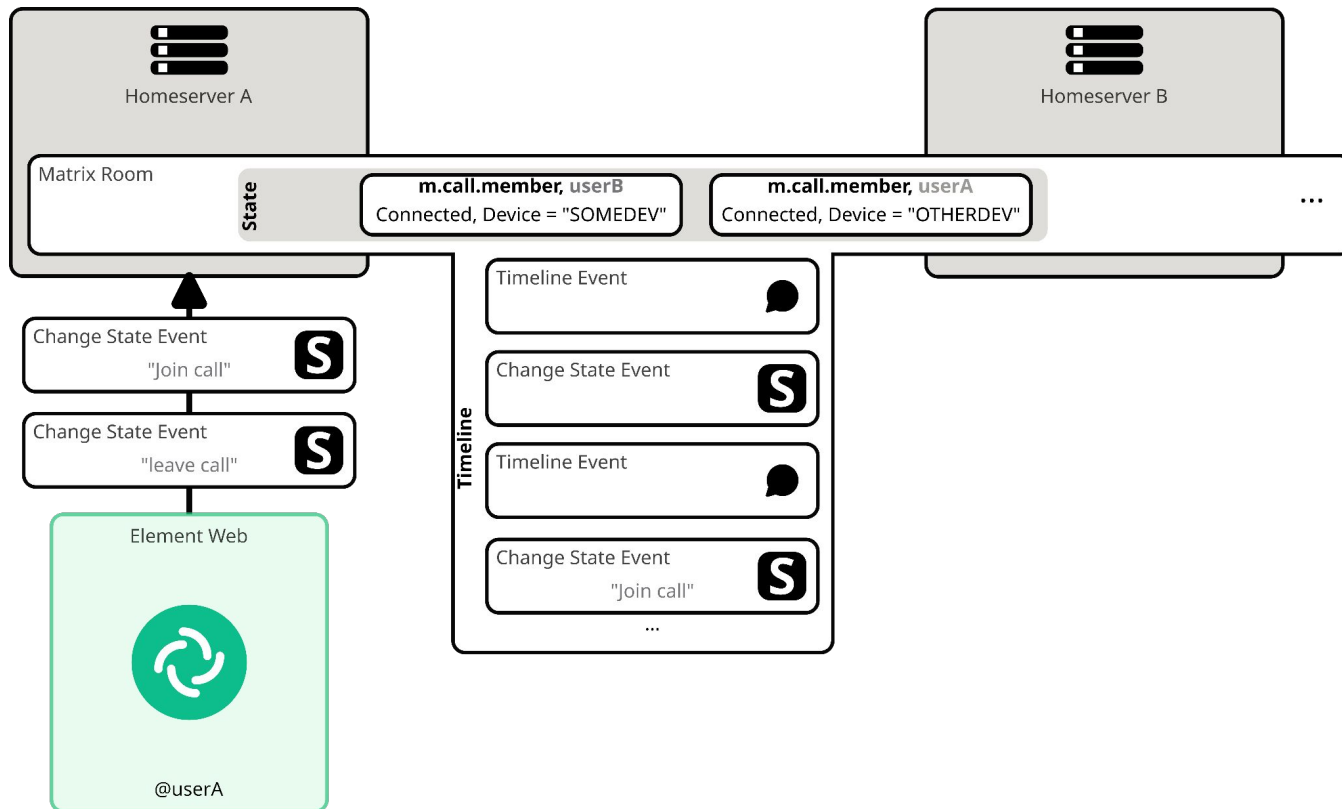
- Pluggable RTC backends
 - RTC backend discovery via homeserver's `.well-known/matrix/client`
 - [MSC4195](#) `livekit` - a backend using the [LiveKit](#) SFU
 - [MSC3401](#) `full_mesh` - a backend using a pure WebRTC full-mesh approach
- [MSC4196](#) MatrixRTC voice and video conferencing application
- [MSC4075](#) MatrixRTC Call Ringing



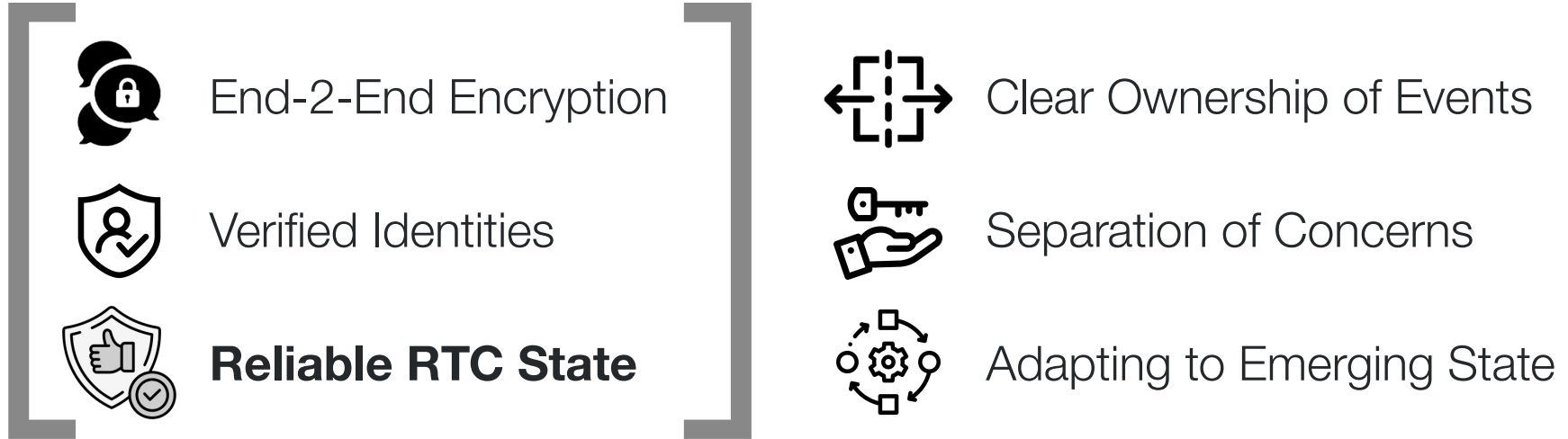
New: Reliable RTC state (implemented in Synapse)

- [MSC4140](#) Cancellable delayed events (aka Futures)
- [MSC3757](#) Restricting who can overwrite a state event

Example of MatrixRTC Session

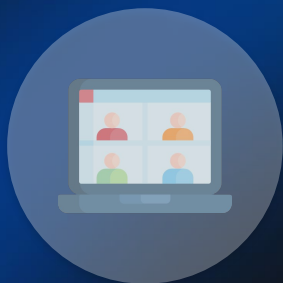


MatrixRTC is Ready for Matrix Calling



And it also supports net-splitted operation





Element Call

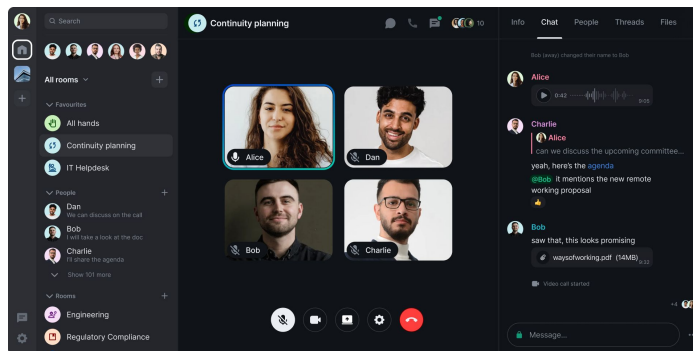
We Cover all Call & Video Scenarios

1:1



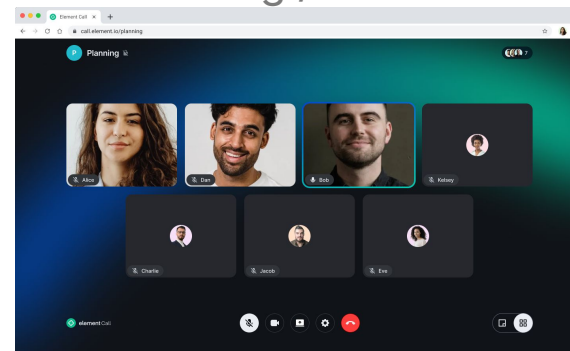
- Telephone call
- Ringing by default

Ad hoc in-chat



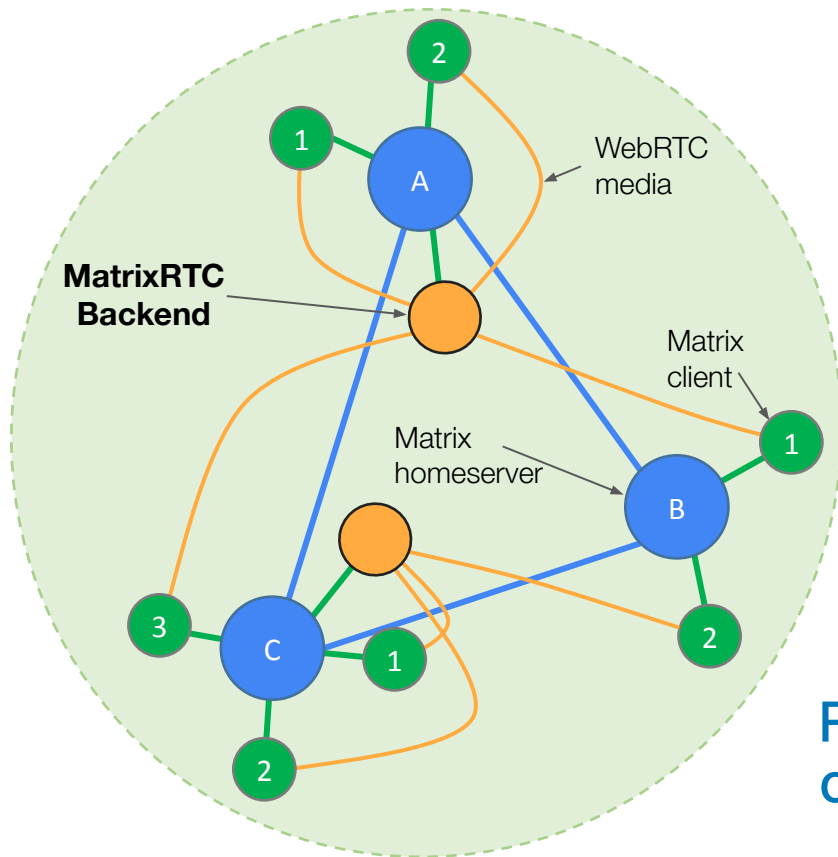
- Start a call in existing matrix room
- Ringing as part of notification settings

Conferencing / Standalone



- Easy to share
- Features **Guest Access**

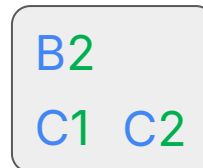
Federated Setup



Mental model for MatrixRTC backend

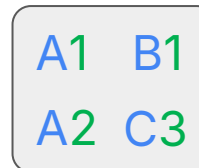
- SFU alongside each homeserver
- Serves all rooms of that server (also federated ones!)

RoomID: 456



SFU C

RoomID: 123

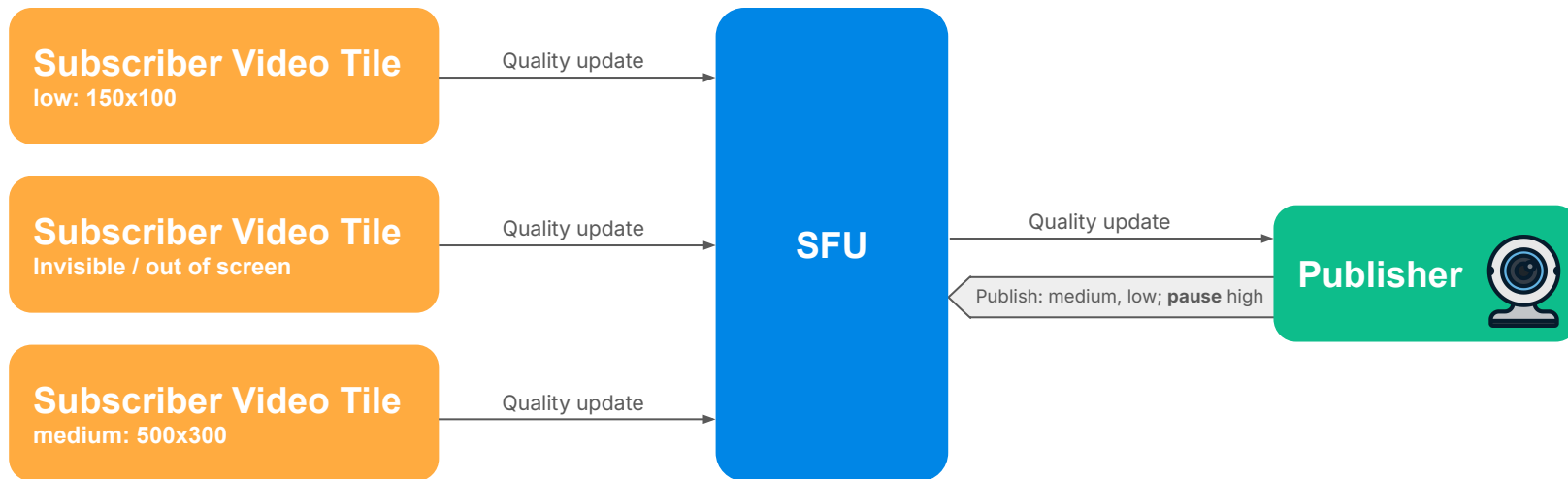


SFU A

Fair distribution of backend resources
on the statistical average

Smart Selective Forwarding Unit

Economical and efficient use of the available network bandwidth



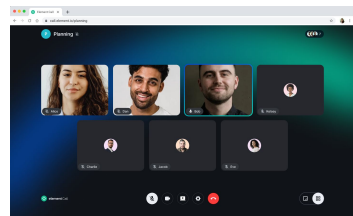
- Up to 500 participants per machine (e.g., AWS, ARM64, 4 Cores, 8GB RAM)
- Horizontal scaling using k8s

Element Call | Embedding

- How to embed Element Call into Matrix clients in general 🤔
 - Initially developed as a Single Page Application for web
- Options
 - Native implementation on each platform
 - 👍 Native look & feel
 - ⚠️ Reimplementing Element Call from scratch
 - ⚠️ Maintenance of multiple implementations
 - Widget API approach
 - 👍 One implementation fits all
 - 👍 Web browsers are using the most advanced WebRTC stack
 - 👍 Time to market
 - ⚠️ Requires Widget driver on each platform (👍 js-sdk/react-sdk, ⚠️ rust-sdk)
- Lets use a Widget

One Implementation Fits All

Standalone mode



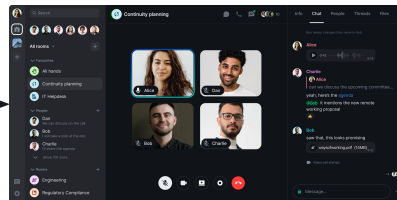
Client-server API

Homeserver

Widget mode

Element Call
Widget

Widget API



Client-server
API

Homeserver

Element Call
Widget

Widget API



Client-server API

Element Messenger Features

MSC4075 MatrixRTC Call Ringing

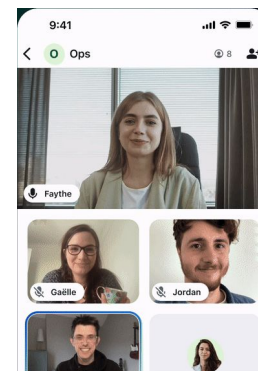
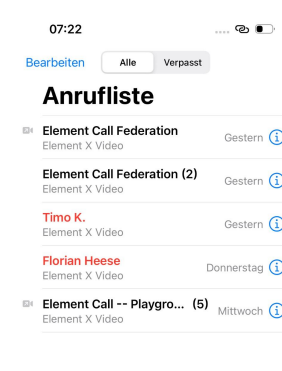
- Ringing in direct messages
- Notification Toast in rooms

Videorooms On Element Web / Desktop

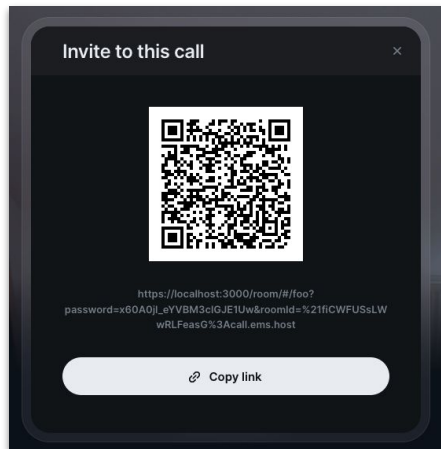
- Video first UX
- Conference meta space
- Each new Conference is a new Matrix room

Element X Mobile

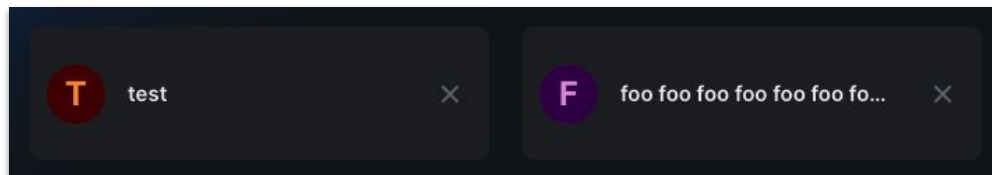
- Native CallKit Integration
- Call back from native dialer recents list
- Picture-in-picture mode



Community is Contributing 🚀🚀🚀

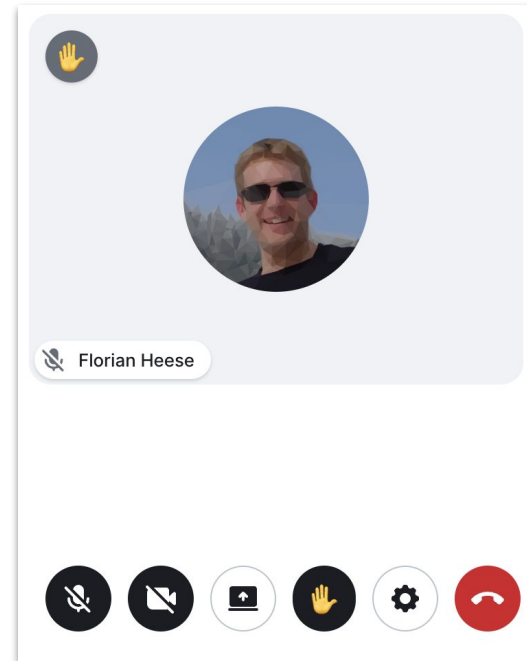


[Display QR code when sharing invite link](#) by [Johannes](#)



[Add button to remove call from recents](#) by [Johannes](#)

[Initial support for Raise Hand feature](#) by [mgcm](#)

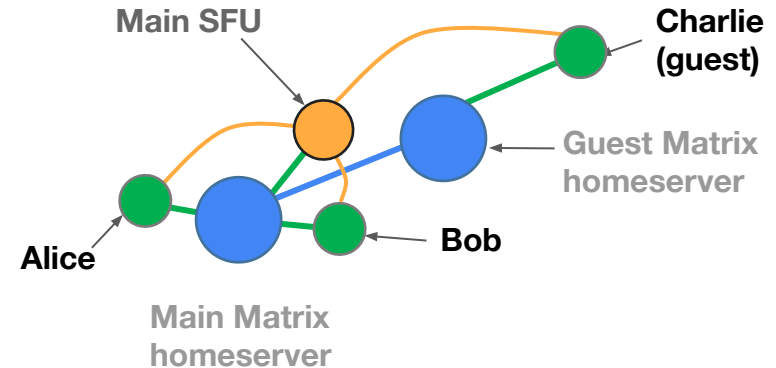




Guest Access

Matrix Allows Separation of Guest Users

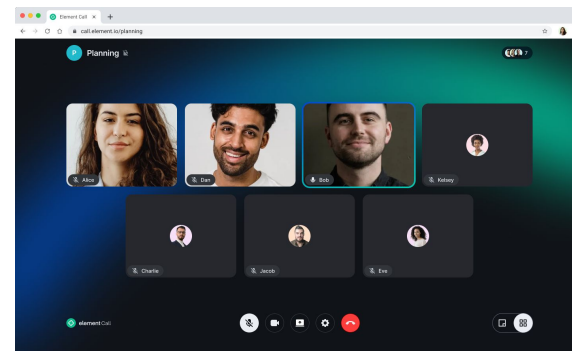
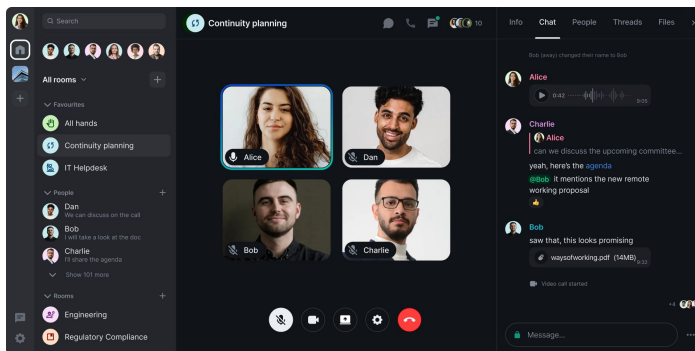
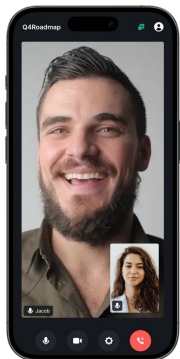
- A Call happens in a (new) Matrix room
 - No guest users on main homeserver
- Guests join via separate homeserver
 - Temporary accounts created on the fly
 - Account retention possible
 - User only required to provide a displayname
 - Main homeserver joined via federation
- Guest user access control is **secured**
 - Knocking request granted on the fly by call moderators / admins



Element Call Demo

Summary

Summary



- MatrixRTC is ready for Matrix calling 🎉🥳
 - Using Matrix primitives Client UX is just mapping state
- Element Call Widget implements
 - [MSC4196](#) MatrixRTC voice and video conferencing application
- Deep integration into Element X using CallKit and PiP
- Frictionless solution for Guest Access

Element Call...

World's first decentralised and federated
video conferencing solution