BitVMX FORCE

A community-supported initiative to drive the establishment of **BitVMX** as the solution of choice in **Disputable Computing on Bitcoin**

October 2025

BitVMX

Getting Started with BitVMX

A Practical Approach

Fairgate | **Pedro Prete** | Blockchain Developer

bitcoin++ Berlin, OCT 2025

What is BitVMX?

- Disputable Computation on Bitcoin
- Allows defining UTXO spend conditions based on program results
- Any program compiled into a RISC-V binary
- For example, a ZKP Groth16 verifier (but could be others)
- If all agree off-chain → Happy path (99% of the time)
- If not → On-chain dispute

Applications using BitVMX

Union Bridge

○ Decentralized bridge

○ 1/n honest assumption

○ Bridge BTC → RBTC (on the Rootstock L2 blockchain)

Cardinal

○ Bitcoin NFT/Ordinal DeFi mode

○ 1/n honest assumption

○ Allows to lock an ordinal and trade it on Cardano Blockchain

○ Uses T.O.O.P to reduce the need for operator collateral

Hackathon

BitVMX FORCE

bitcoin++

Berlin | October 2-4, 2025

BitVMX track

The Lightning++ hackathon includes an optional BitVMX challenge with a **2,000,000 sats** prize!

Judges will primarily use the presentations to select winners with the following criteria:

- **Routine Difficulty**: Project idea, potential impact, ambition.
- **Routine Execution:** Achievement, what you actually built, does it work?.
- **General Effect**: Wow Factor, presentation, applicability to theme.

What can I do?

BitVMX lets you design **optimistic protocols** on Bitcoin. Perform computation off-chain and use Bitcoin L1 only for fraud proofs & settlement. For example:

- Trust-minimized **cross-chain bridges,** BitVMX verifies bridging logic between Bitcoin and another chain (e.g. RSK, ETH rollup).
- Bitcoin-native **stablecoins** or decentralized **derivatives** , BitVMX manages collateral, liquidation logic, and enforces mint/redeem rules.
- Verifiable **games** where moves occur off-chain but disputes are resolved on-chain.
- **Tournaments** and **betting** systems settling in BTC without trusted intermediaries.

Example app

Check out our example repo https://github.com/FairgateLabs/bitvmx-hackathon-games

It includes:

- Visual frontend to help understand the concept
- BitVMX-powered backend
- Documentation

You can learn more at our Knowledge Hub

Or talk to us directly at BitVMX Devs Telegram

Using BitVMX

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Communication

Message Broker (using Tarpc)

- Sends messages between internal and external BitVMX components
- TLS Encrypted
- Pinned Certificates for Client and Server
- Allow list
- Routing

Communication - Code example

```rust
pub fn init_broker(role: &str) -> Result<DualChannel> {
    let config = Config::new(Some(format!("config/{}.yaml", role)))?;
    let broker_config = BrokerConfig::new(config.broker_port, None);
    let bitvmx_client = DualChannel::new(&broker_config, L2_ID);
    Ok(bitvmx_client)
}

let msg = IncomingBitVMXApiMessages::GetPubKey(funding_public_id, true)?;
bitvmx_client.send(BITVMX_ID, msg.to_string())?;
```

BitVMX Client

- It’s where the **Protocols** live, and where you need to add new ones.
- Uses BitVMX CPU to verify **Program**’s execution through the BitVMX Job Dispatcher
- Connect with other **Operators** BitVMX Clients to setup the protocols
- Tracks and dispatch **TXs** from the protocols
- Automatically reacts to specific TXs
    - Collaborate with valid flux
    - Challenge malicious activity

Setting up program and protocol - Code example

```
let program_id = Uuid::new_v4();
let program_path = "../BitVMX-CPU/docker-riscv32/riscv32/build/hello-world.yaml";

let msg = IncomingBitVMXApiMessages::SetVar(program_id, "program_definition",
VariableTypes::String(program_path.to_string()))?;
bitvmx_client.send(BITVMX_ID, msg.to_string())?;

let msg = IncomingBitVMXApiMessages::Setup(program_id,
PROGRAM_TYPE_DRP.to_string(), vec![p2p_address_1, p2p_address_2], 1)?;
bitvmx_client.send(BITVMX_ID, msg.to_string())?;
```

BitVMX CPU

- Maps every RISC-V instruction into Bitcoin Script
- Off-chain evaluation of the **Program**
- Dispute logic to identify the faulty instruction in case of a challenge
- The CPU runs as a separate process inside **BitVMX Job Dispatcher**

to allow potential multiple parallel executions.

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Program - Code example

```c
#include <stdint.h>
#include "emulator.h"

int main(int x)
{
    unsigned int *a = (unsigned *)INPUT_ADDRESS;
    unsigned *b = a + 1;
    unsigned *c = a + 2;
    if (*a + *b == *c) { return 0;}
    else {return 1;}
}
```

Program - Build

- We need to build our program into ***RISCV32*** compatible **.elf** files
- Repo with helpers to build the program

https://github.com/FairgateLabs/bitvmx-docker-riscv32

- build the images run the corresponding script for Win,Linux,Mac (`docker-build.bat`, `docker-build.sh` or `docker-build-mac.sh`)
- Compile a program example `docker-run.bat riscv32 riscv32/build.sh src/hello-world.c --with-mul`
- Compile a ZKP groth16 verifier `docker-run.bat verifier verifier/build.sh --with-mul`

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Program - Yaml

```yaml
elf: add-test.elf
nary_search: 8
max_steps: 50
input_section_name: .input
inputs:
 - size: 8
   owner: const
 - size: 4
   owner: prove
```

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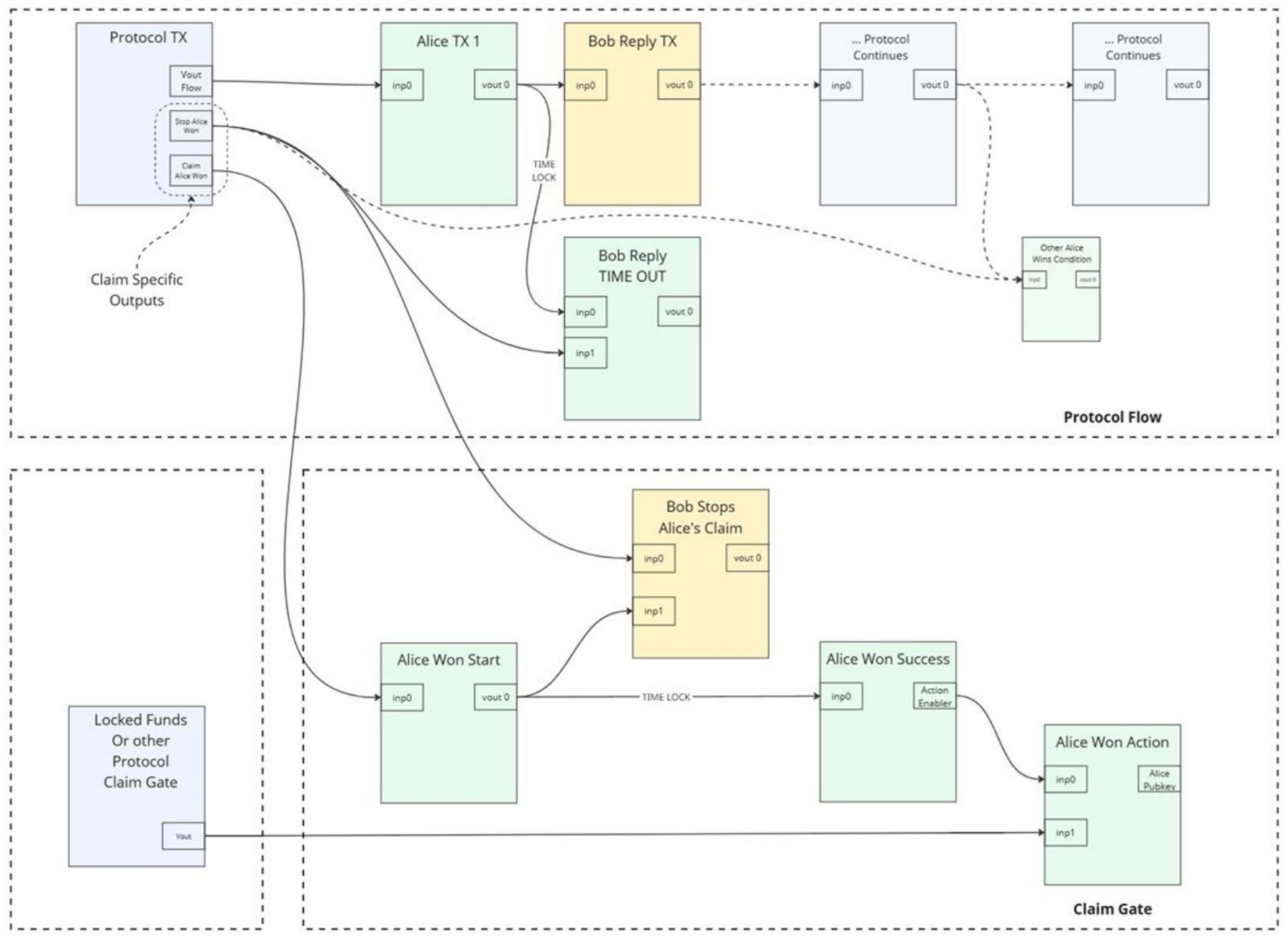
BitVMX Client - Protocols

Protocols are like plugins for BitVMX, adding extra functionality. They can:

- Set flows using Directed Acyclic Graphs (**DAGs**) of pre-signed Bitcoin transactions
- Store and read information
- Send transactions and receive updates about them
- Sign with aggregate keys (MuSig2 multisig)
- Sign using Winternitz keys
- Hold the program definition

Protocols


Protocol TX
Vout Flow
Stop Alice Won
Claim Alice Won
Claim Specific Outputs
Alice TX 1
inp0
vout 0
TIME LOCK
Bob Reply TX
inp0
vout 0
... Protocol Continues
inp0
vout 0
... Protocol Continues
inp0
vout 0
Bob Reply TIME OUT
inp0
inp1
vout 0
Other Alice Wins Condition
inp0
vout 0
Protocol Flow
Bob Stops Alice's Claim
inp0
inp1
vout 0
Alice Won Start
inp0
vout 0
TIME LOCK
Alice Won Success
inp0
Action Enabler
Alice Won Action
inp0
inp1
Alice Pubkey
Locked Funds Or other Protocol Claim Gate
Vout
Claim Gate

Oh, dear. Oh, dear.

Creating a Protocol - Protocol Handler

To add a protocol in BitVMX we need to create it at src/program/protocols and implement ProtocolHandler, where you can add functionality like:

- Generate keys
- Define Protocol Setup
- Receive transactions news
- Trigger transactions on finish

BitVMX Protocol Builder

Creates complex protocols DAGs using Bitcoin transactions

- Creates and stores different types of transactions (Segwit, Taproot)
- Stores metadata to know the inputs, outputs, spending paths, and signatures
- Speed-ups using Child-Pays-for-Parent (CPFP) transactions
- Dust and TxFee calculation
- Graph visualization

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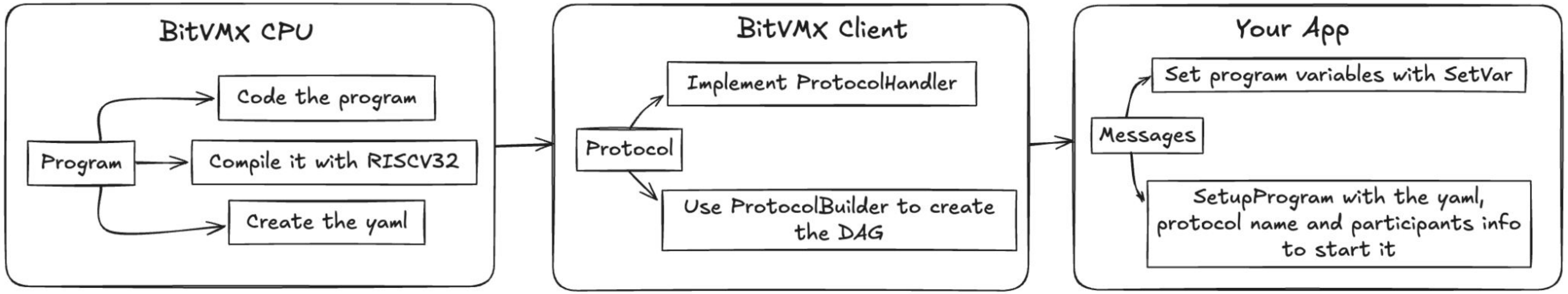
BitVMX Protocol Builder - Code example

```rust
// Add the output to the claim transaction that contains two leaves:
// 1. The aggregated signature for the stoppers
// 2. The timelock script that will be used by the claimer if he succeeds the claim
let verify_aggregated = scripts::check_aggregated_signature(&aggregated,
SignMode::Aggregate);
let timeout = scripts::timelock(timelock_blocks, &aggregated, SignMode::Aggregate);

let start_tx_output = OutputType::taproot(
    amount_fee + ((1 + actions.len() as u64) * amount_dust),
    aggregated,
    &vec![verify_aggregated.clone(), timeout],
)?;
protocol.add_transaction_output(&stx, &start_tx_output)?;
```

Summary


BitVMX CPU
Program
Code the program
Compile it with RISCV32
Create the yaml
BitVMX Client
Protocol
Implement ProtocolHandler
Use ProtocolBuilder to create the DAG
Your App
Messages
Set program variables with SetVar
SetupProgram with the yaml, protocol name and participants info to start it

MAY THE

BITVMX

FORCE

BE WITH YOU

Thank you!

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https://bitvmx.org/

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https://www.fairgate.io/

https://github.com/FairgateLabs