



InterPlanetary Atomic Swaps

as a Settlement Primitive for the Earth–Mars
Economy

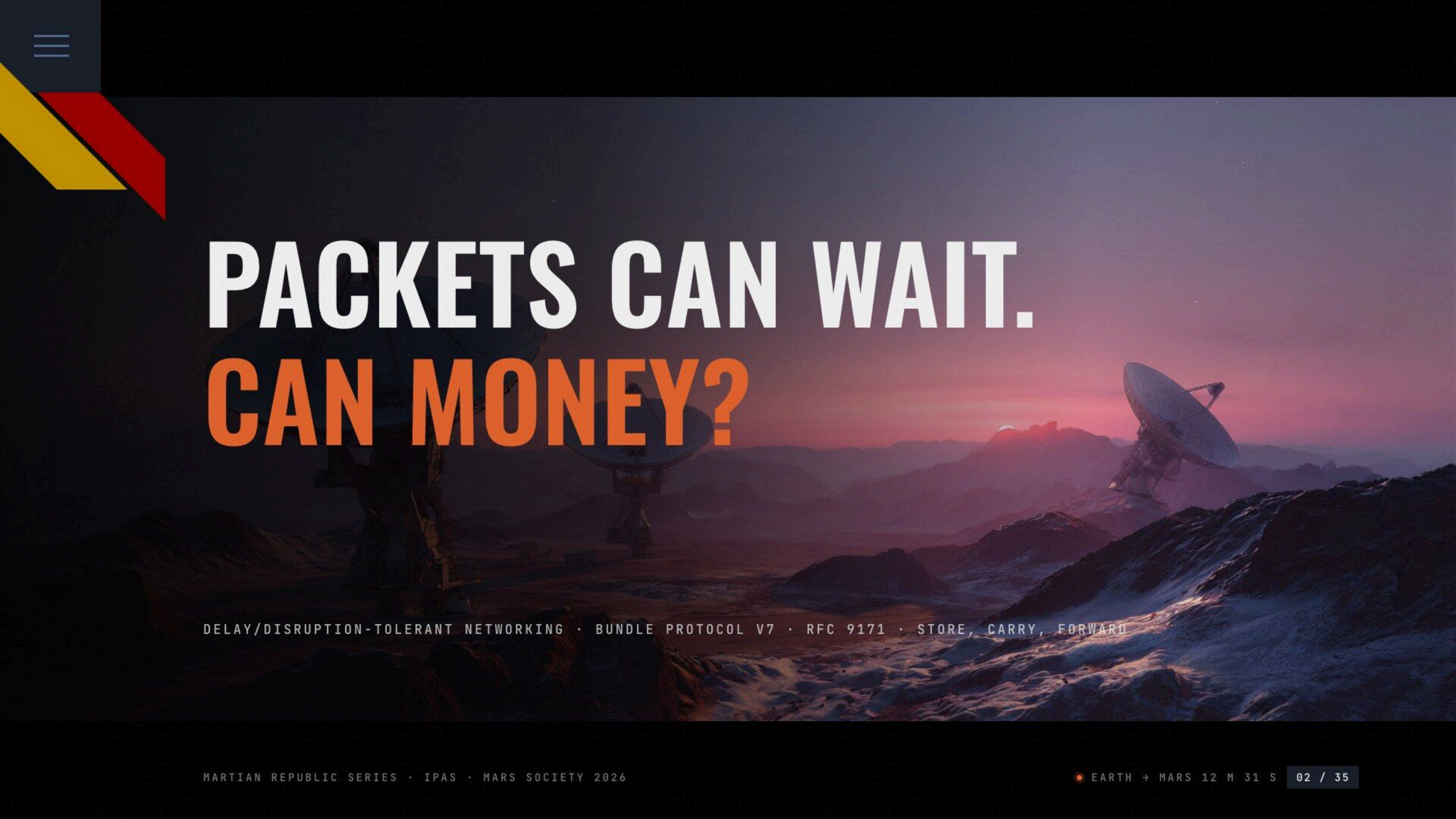
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RIGHT NOW MARS IS 225.2 MILLION KM AWAY
LIGHT FROM THIS ROOM ARRIVES IN 12 MIN 31 S

Martian Republic Series

MARS SOCIETY CONVENTION 2026 · USC · LOS ANGELES



PACKETS CAN WAIT. CAN MONEY?

DELAY/DISRUPTION-TOLERANT NETWORKING · BUNDLE PROTOCOL V7 · RFC 9171 · STORE, CARRY, FORWARD



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PART I

One light-speed boundary

Why Earth's financial stack cannot reach Mars



The bubble we have always lived in

01 **67 ms**

Light-time across the widest distance on Earth. **Every financial transaction in human history** has happened inside it.

02 **3 ms**

What Spread Networks spent **\$300 million** to cut from the Chicago ↔ New Jersey round trip, in 2010.

03 **1,320,000 ms**

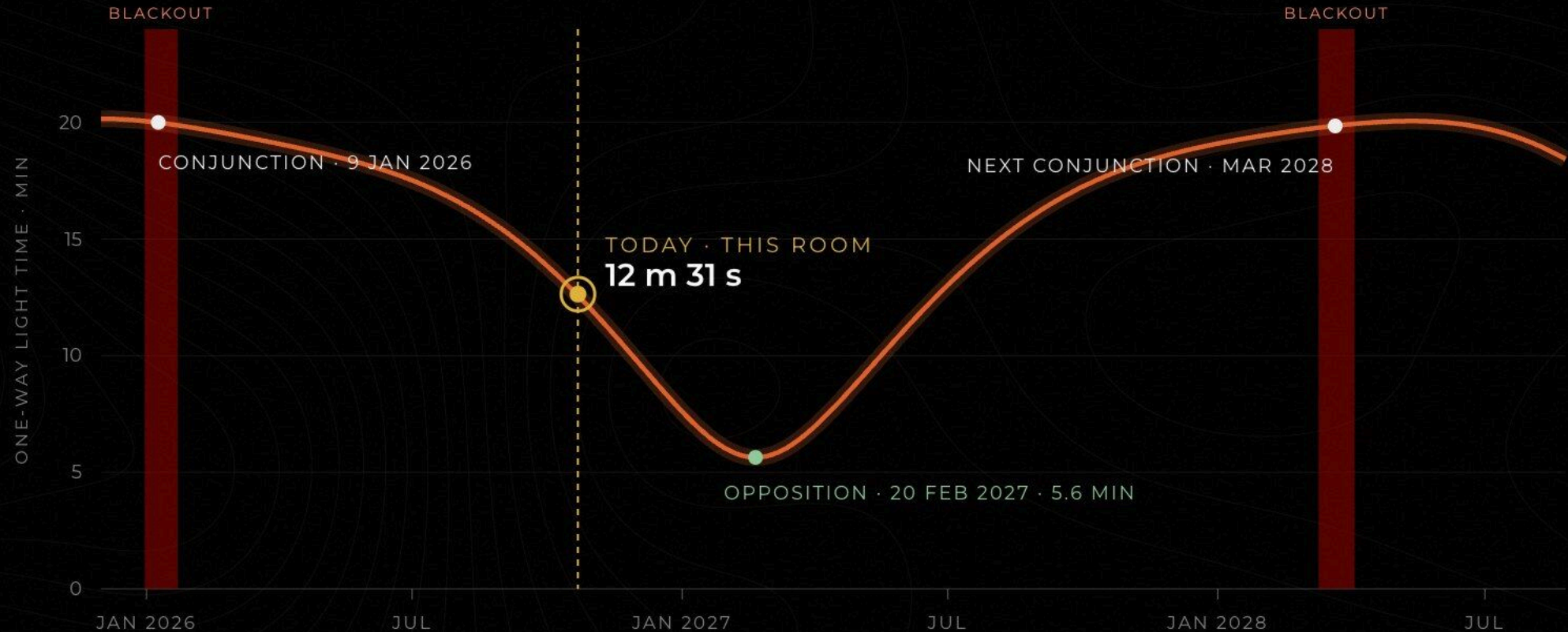
Earth → Mars, one way, at greatest distance.

The link is set by orbits, not by engineers

3-22 MIN ONE WAY

6-44 MIN ROUND TRIP

≈ 2 WEEKS DARK EVERY 26 MONTHS





A colonist needs a turbopump

The supplier is on Earth and wants bitcoin.
The colonist holds Marscoin.

- 01 ~~Wire transfer~~ — **no correspondent bank** on Mars
- 02 ~~Card network~~ — no issuer, no acquirer, **no chargeback desk**
- 03 ~~Exchange~~ — every order loop is longer than a **6–44 min round trip**
- 04 ~~Custodial bridge~~ — your money sits with a stranger **225 million km away**

EVERY PIECE OF THE TERRESTRIAL PAYMENT STACK FAILS.



TRUST DOES NOT SURVIVE A TWO-WEEK BLACKOUT

FTX hid an **\$8 billion hole** from customers who were milliseconds away. Now put the exchange 225 million km away — and switch the link off for **14 days**.

An atomic swap has no custodian, no reserves, and no third party's solvency on the critical path.

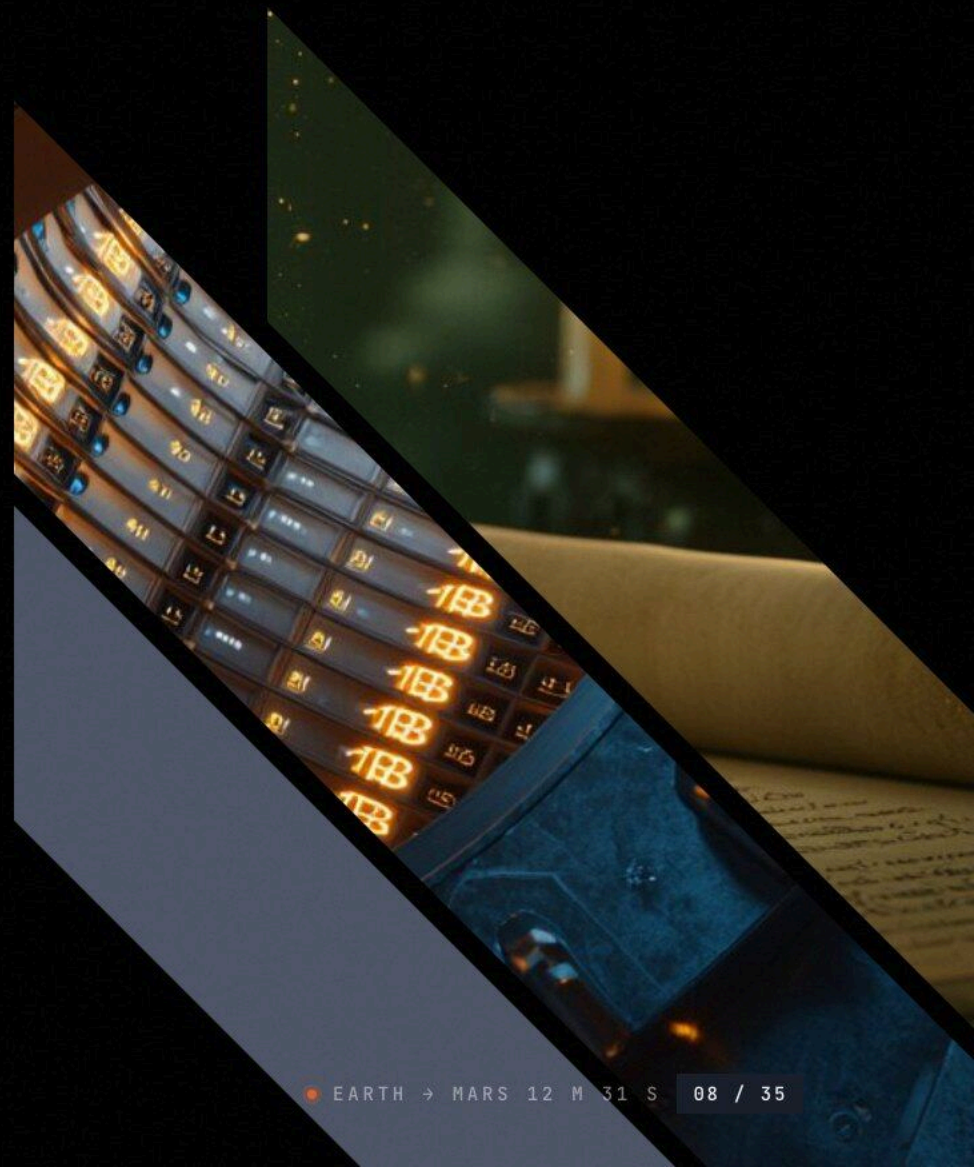


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PART II

Two lockboxes, one secret

The atomic swap — and why it is accidentally interplanetary



2013: two conversations, one community

BITCOINTALK • MAY 2013

Tier Nolan: “Alt chains and atomic transfers”

Two chains. One hash. Asymmetric timeouts. **Nobody in the middle.**

EARLY MARSCOIN CONTRIBUTORS • 2013

How will value ever move between planets?

One proposal: a third, deliberately slow “**Interplanetary Coin**” between an Earth chain and a Mars chain.

The third chain was the wrong answer to the right question. **Neither side knew it was holding half of an interplanetary financial architecture.**



Two lockboxes. One secret.

ALICE REVEALS THE SECRET



Mars · Marscoin chain

104 MARS

opens for **Bob** — with the secret

or returns to **Alice** — after 144 h



$h = \text{SHA-256}(\text{secret})$

9f2c 81d4 ... 07b3 e81a

BOB COPIES IT



Earth · Bitcoin chain

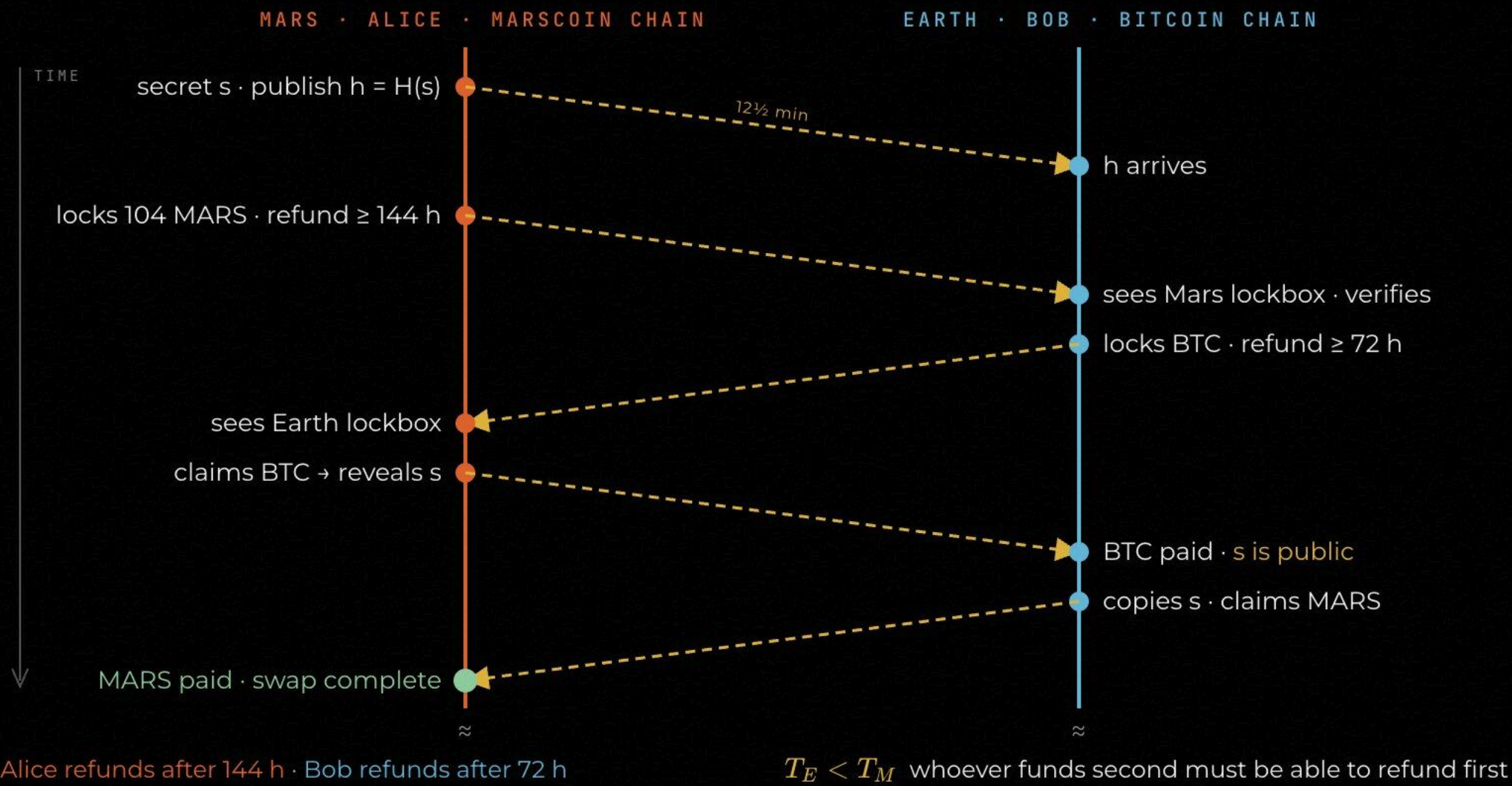
0.0000365 BTC

opens for **Alice** — with the secret

or returns to **Bob** — after 72 h

5 Bob copies it and opens the Mars box. **Both trades happen — or neither does.** That is “atomic”.

Read it like a light-cone



HTLCs are accidentally interplanetary

01

The hash doesn't know what planet it's on

SHA-256 of the secret either matches the fingerprint or it doesn't — whether it arrives after **22 milliseconds** or **22 minutes**.

02

The timelock counts blocks, not seconds

A refund opens when **that chain** reaches block height T. Each chain is its own clock. Nobody has to agree what time it is.

+477 μ s

per day: how much faster a clock runs on Mars than on Earth, swinging $\pm 226 \mu$ s over the Martian year (NIST, Dec 2025). **The planets will never agree on the time. IPAS never asks them to.**

This already works.
On Earth. With real
money.

104 MARS $\longleftrightarrow$
0.00003652 BTC

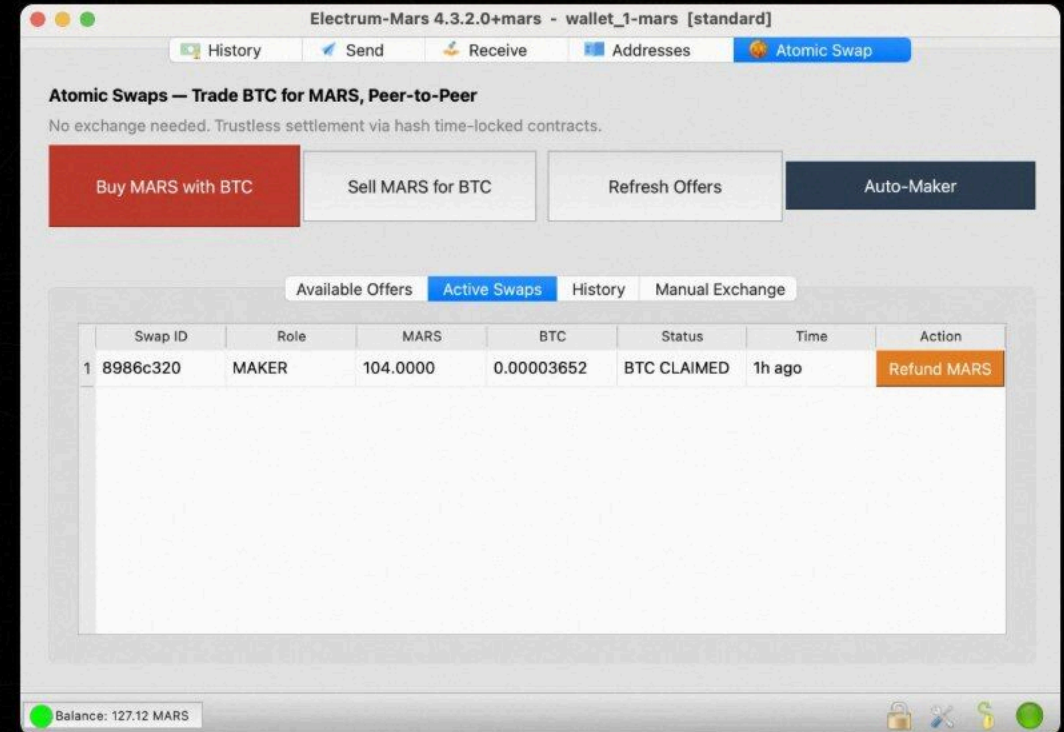
first mainnet atomic swap between Marscoin and Bitcoin

4 h / 8 h

timelocks

0

exchanges, custodians, accounts



Electrum-Mars · atomic-swap release v4.4.0-mars · open source ·
github.com/marscoin/electrum-mars

The failures were the best part

Electrum-Mars 4.3.2.0+mars - default_wallet [standard]

History Send Receive Addresses Console Atomic Swap

Atomic Swaps — Trade BTC for MARS, Peer-to-Peer
No exchange needed. Trustless settlement via hash time-locked contracts.

Buy MARS with BTC Sell MARS for BTC Refresh Offers Auto-Maker

Available Offers Active Swaps History Manual Exchange

	Swap ID	Role	MARS	BTC	Status	Date
1	1a06e0d1	TAKER	104.0000	0.00003652	COMPLETED	2026-04-12
2	3be63704	TAKER	103.0000	0.00004392	BTC REFUNDED	2026-04-11
3	e5879885	TAKER	100.0000	0.00004247	FAILED	2026-04-10
4	3ade54da	TAKER	20.0000	0.00001111	FAILED	2026-04-01
5	f0dea7eb	TAKER	20.0000	0.00001111	FAILED	2026-04-01
6	688cac3c	TAKER	20.0000	0.00001111	FAILED	2026-04-01

Balance: 103.999 MARS

real swap history from the wallet: four failures, one refund, one success

11 APRIL

A bug stalled the swap half-way. **Four hours later the bitcoin came home by itself.** The safety net is not theoretical.

12 APRIL

Miners produced **empty blocks for ~9 hours** — Mars-like delay, by accident. The engine mistook delay for expiry; we fixed it live; the swap completed.

WE HIT THE INTERPLANETARY FAILURE MODE ON EARTH — IN PUBLIC, WITH SMALL MONEY.

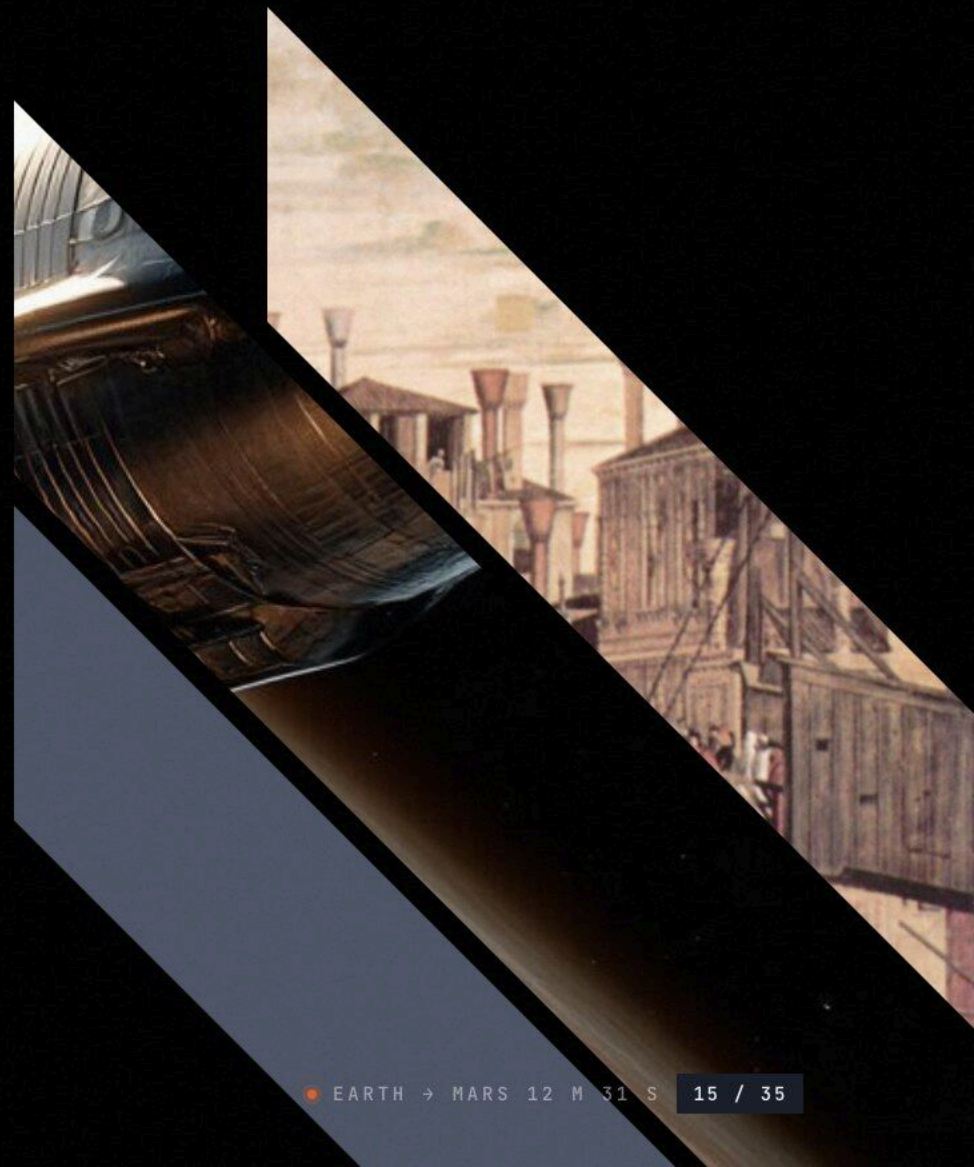


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PART III

Sizing the window

Timelocks, orbits — and a 600-year-old precedent



Not a new protocol. A wider window.

Same code, same math — **a configuration change, not a protocol change.**

Earth · mainnet, 12 April 2026

■ BTC refund 4 h
■ MARS refund 8 h

Earth ↔ Mars · average distance (today)



Across a solar conjunction



How wide is wide enough?

$$T_E < T_M$$

The party who funds second must be able to refund first.

Not a convention. A correctness condition.

$$\Delta \geq \underbrace{\tau_{\text{confirm},E}}_{\text{Earth confirmations}} + \underbrace{\tau_{\text{prop}}}_{\text{light delay 3-22 min}} + \underbrace{\tau_{\text{relay}}}_{\text{relay scheduling}} + \underbrace{\tau_{\text{obs}}}_{\text{watching}} + \underbrace{\tau_{\text{claim},M}}_{\text{building the claim}} + \underbrace{\tau_{\text{confirm},M}}_{\text{Mars confirmations}} + \underbrace{\tau_{\text{fee}}}_{\text{fee spikes}} + \underbrace{\varepsilon}_{\text{humility}}$$

One term is physics. Everything else is operations — engineering we control.

Evaluated at today's distance with conservative buffers: $\Delta = 72 \text{ h}$ → BTC refund 72 h, MARS refund 144 h.

Four orbital regimes. The wallet picks the row.



CONJUNCTION-SPANNING · LINK BLOCKED $\approx$ 2 WEEKS $\rightarrow$ 504 H / 672 H

BTC / MARS refund timelocks · Bitcoin 10-min blocks · Marscoin 123-s blocks

Usance: the Renaissance timelock

A bill of exchange matured after a fixed “**usance**” set by the route — **always longer than the courier.**

ROUTE, C. 1400	COURIER	USANCE
Venice → Florence	~6 days	20 days
Venice → Bruges	~26 days	2 months
Venice → London	~33 days	3 months

USANCE – COURIER TIME = Δ . WE ARE DOING THE SAME THING WITH LIGHT.

Vittore Carpaccio, *Miracle of the Relic of the Cross at the Ponte di Rialto*, 1496 – Gallerie dell'Accademia, Venice (public domain)

Usance: G. da Uzzano, *Pratica della mercatura* (1442) · courier times: Datini letters (Bettarini, Bradley & Moore)



FOR A CIVILIZATION WHERE CARGO
TAKES MONTHS, A SIX-DAY
SETTLEMENT IS **INSTANT**



Mars can watch Bitcoin through a straw

≈ **1 bit/s**

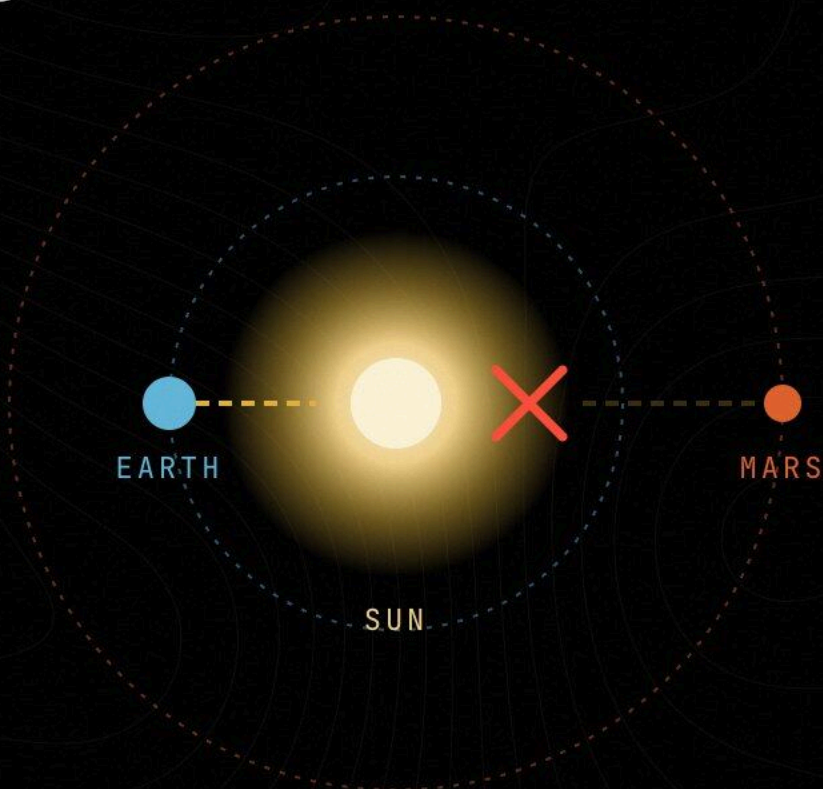
Every Bitcoin block header — 80 bytes, six per hour. With a Merkle proof, enough to verify a specific payment.

≈ **20 kbit/s**

Every full Bitcoin block — about 9 MB an hour. That's 4% of what NASA's 20-year-old MRO sends **even at maximum range**.

Marscoin → Earth, full blocks: ≈ 2 MB per day · MRO downlink ≥ 500 kbit/s at max range, up to 6 Mbit/s

Conjunction doesn't break IPAS. It changes its regime.



Mars within $\sim 2^\circ$ of the Sun · direct radio blocked $\approx$ 2 weeks · every 26 months

01

BEFORE

Wallets switch to conjunction timelocks (21 / 28 days) — or advise waiting it out.

02

DURING

Each side keeps watching its **own** chain. A revealed secret simply waits in the block data.

03

AFTER

Mirrors resync. Pending claims complete. **No refund opened in the dark.**

NEXT BLACKOUT $\approx$ 13 - 29 MARCH 2028



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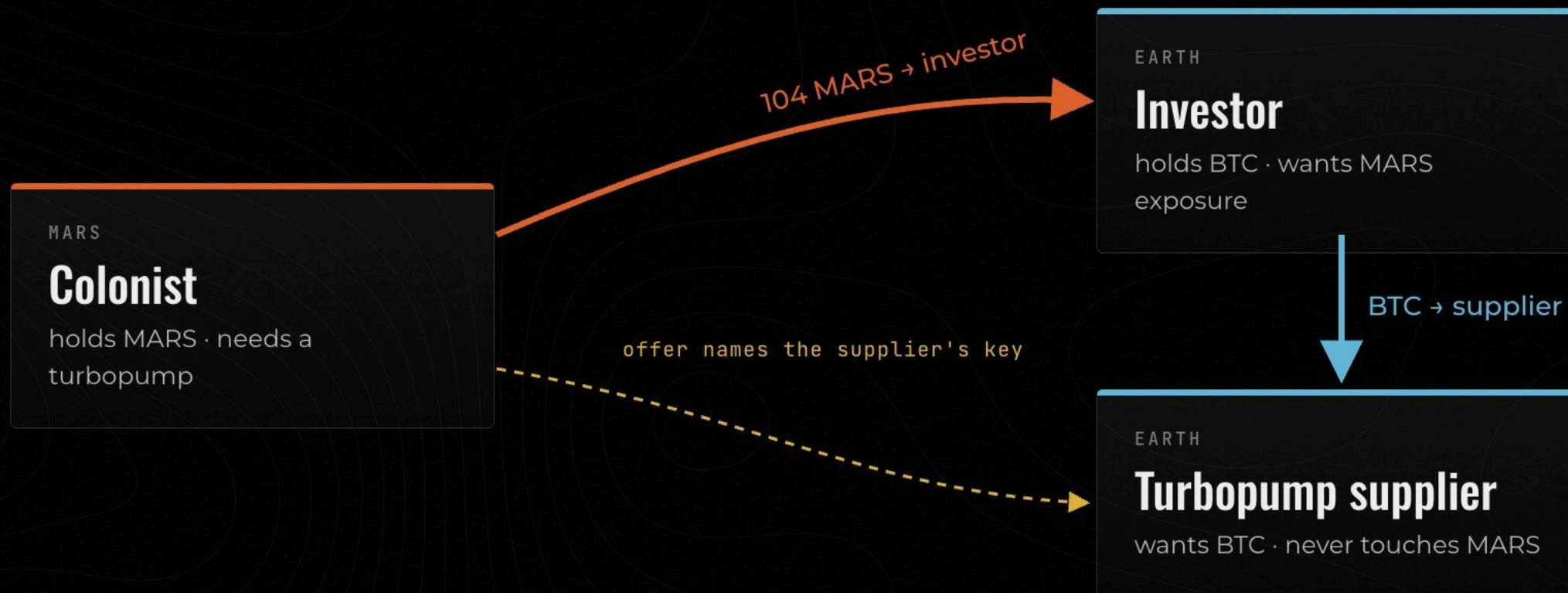
PART IV

From swap to commerce

The destination-address construction



The twist: the lockbox can pay someone else



THREE PARTIES · TWO CHAINS · TWO PLANETS · ZERO INTERMEDIARIES

The claim path pays a **key** — any key. A trading primitive becomes a commerce primitive, without adding a third trusted role.

What a commerce primitive unlocks



Pay an Earth supplier

From a Mars wallet, straight to the turbopump maker. No bank on either planet.



Sell a Martian dataset

The secret that settles payment also releases the hash-addressed data. Settlement = delivery.



Emergency medicine

The antibiotic is paid for in days. The cargo follows on the next transfer window.



Fund a Martian treasury

Earth capital into an on-chain multisig in days, not grant cycles — auditable by anyone.



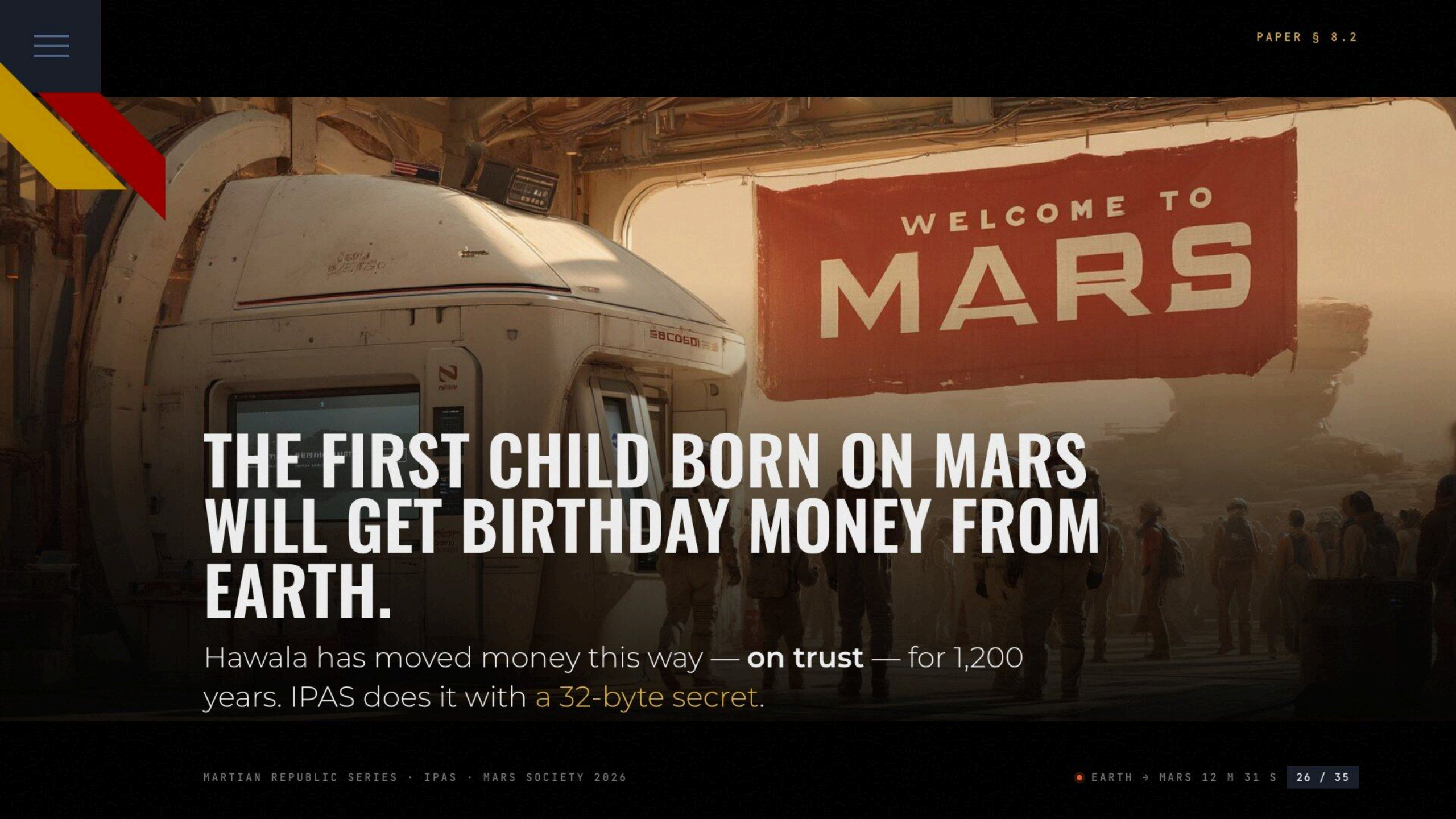
License Martian invention

A patent licence to an Earth firm, its settlement timestamped on both chains.



Remittance

A grandparent on Earth sends MARS straight to a grandchild born on Mars.



THE FIRST CHILD BORN ON MARS WILL GET BIRTHDAY MONEY FROM EARTH.

Hawala has moved money this way — **on trust** — for 1,200 years. IPAS does it with a 32-byte secret.

Every new kind of value needed a new kind of market

1602

Amsterdam — VOC shares: the first liquid stock market

1865

Chicago — standardized grain futures

20—

Earth ↔ Mars — the first interplanetary exchange rate, set
peer-to-peer and settled by hash

Emanuel de Witte, *The Courtyard of the Exchange in Amsterdam*,
17th c. (public domain)

Why not Lightning?

Bitcoin's off-chain payment channels: brilliant on Earth, fragile across 22 minutes and 14 dark days.

	LIGHTNING CHANNELS	ON-CHAIN IPAS
Operator or hub in the payment path	yes	no — two parties, two chains
Old channel state that can be replayed	yes	no — every swap is fresh
Must be online during disputes	yes, or a watchtower	no — chains stay online for you
Readable by a future Martian historian	no — off-chain	yes — on both chains
Behaviour across a conjunction	depends on liveness	handled by parameters

FOR MARS, SIMPLER IS SAFER.

Closest work: Puente & Puente (2025), arXiv:2508.20591 — rigorous; recommended

The math doesn't pick a constitution

01 • MARS-LOCAL CURRENCY

Mars clears its own economy; IPAS for cross-planet trade. The Marscoin position since 2014.

02 • PEGGED OR FEDERATED

A Mars token pegged to an Earth base. IPAS keeps the exchange trust-minimized.

03 • RESTRICTED INTERCHANGE

A sovereign Mars limits flows. The mechanism exists; policy bounds its use.

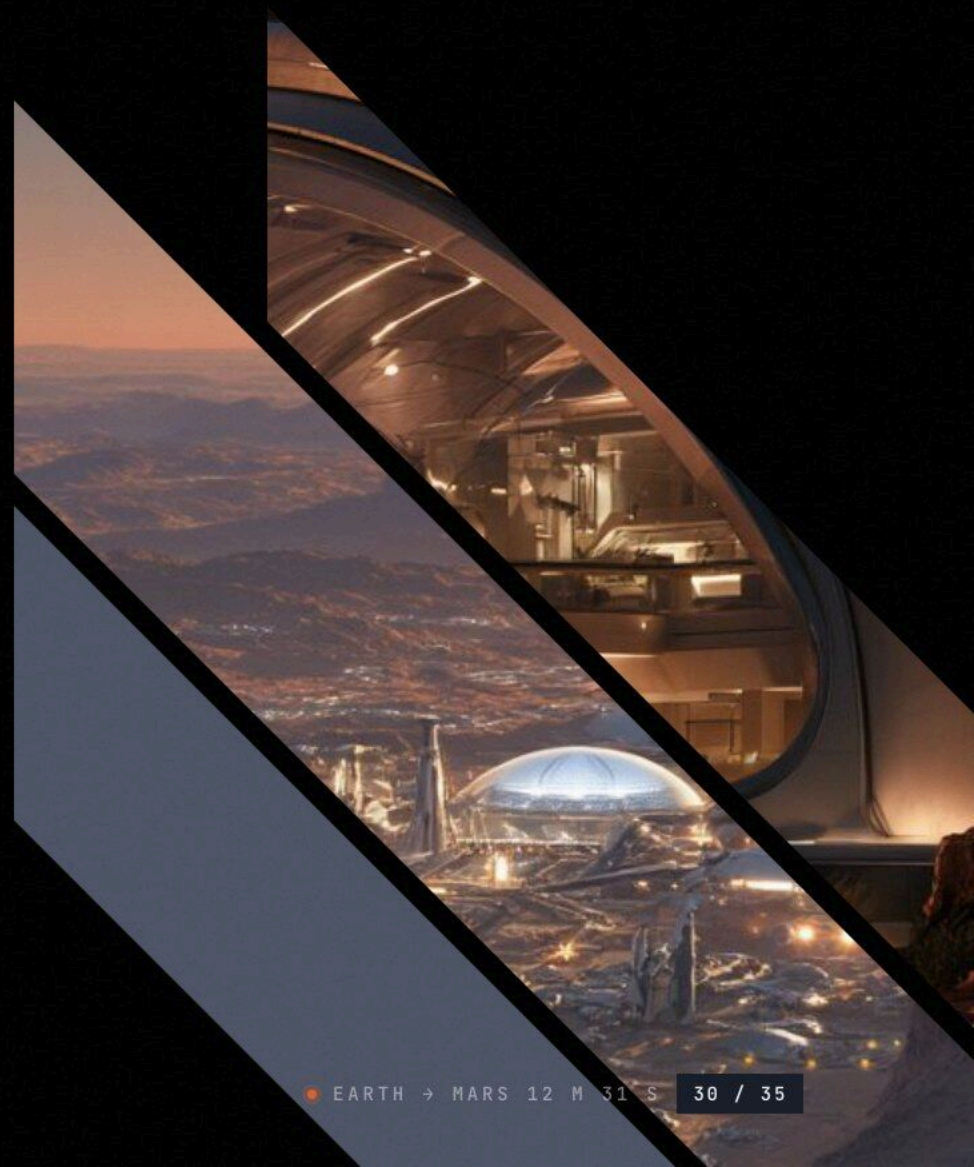


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PART V

Final thoughts

A design principle for the solar system



SETTLE BY EVIDENCE, NOT BY SYNCHRONY

- DTN** **packets** — store, carry, forward
- IPFS** **data** — fetch by hash, not by server
- IPAS** **value** — settle by hash, not by shared ledger state
- NEXT** naming · identity · delivery attestation

Whenever delayed, verifiable evidence can replace continuous agreement, the evidence design is the more robust one.

Honest limits, and what comes next

WHAT IPAS DOES NOT DO

- 01 Prove the cargo arrived — that still needs contracts, arbitration, reputation.
- 02 Stop grieving — capital can be locked up to 28 days, so spreads will price time.
- 03 Forgive sleepy monitoring — run redundant watchers.
- 04 Prevent censorship — that is politics, not protocol.

WHAT COMES NEXT

- 01 Simulate timeouts against real Deep Space Network contact schedules.
- 02 Specify how offers propagate across the interplanetary link.
- 03 Taproot adaptor signatures — smaller, more private swaps.
- 04 Post-quantum signatures — the hash lock already is; first SPHINCS+ transaction on marsqnet, 20 April 2026.

WHEN THE FIRST SHIP LANDS, THE COLONY CAN TRADE WITH EARTH **THE MOMENT IT POWERS ON**

The Seed: a bootable image of the Marscoin and Martian Republic stack, with twelve years of chain history. **Next on its manifest: the IPAS swap engine.**



THE HASH DOES NOT KNOW WHAT PLANET IT IS ON.

TWO SOVEREIGN CHAINS • ONE SECRET • FOR ALL MANKIND

Thank you!

Questions — and counter-examples — welcome.



THE PAPER



THE EXPLAINER

PAPER github.com/novalis78/Interplanetary-Atomic-Swaps · LaTeX source · CC-BY 4.0

TRY IT Electrum-Mars → Atomic Swap tab · github.com/marscoin/electrum-mars

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