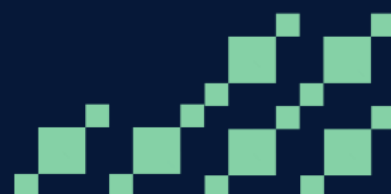




AMARU: 2026 DETAILED BUDGET PROPOSAL SCOPES BREAKDOWN

08 JANUARY 2026



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Context

In the following document, we cover the scopes of work for Amaru's 2026 proposal, their main objectives, owners, estimated resources required, and an overview of their planned milestones.

Core Development

 Main Objective	Owner
To reach feature parity with the Haskell node and keep up with the updates on the Cardano network/protocol	Matthias Benkort

Q1 - Relay Wrap-up

Goal

Deliver a production-ready relay-capable Amaru node. Said differently, a node capable of selecting and following the chain according to Ouroboros' consensus, as well as diffusing transactions and blocks to the network, while fully validating their well-formedness and ledger compliance.

Key Results

- Remaining ledger rules & stabilizations of the phase-2 validations;
- Single mempool strategy & transaction diffusion via the mini-protocols;
- Initial P2P networking stack, with basic peer discovery and management;
- Internal optimizations and polish (in particular around observability);

Key Performance Indicators (KPIs)

Indicator	Target
Ledger rules coverage (via acceptance test scenarios)	100%

Indicator	Target
Fuzzers coverage for serialisation / deserialisation of primitive types (c.f. CDDL)	100%
Resident memory usage	<1GB
Average CPU Usage	<1%
Block diffusion time (fetch + validation + sharing)	<1s
Acceptance time to mempool	<100ms
Manageable network peers	>10

Estimated Effort

3.5 FTEs

Q1 - Upcoming Intra-era Hard Fork

Goal

Follow through necessary protocol upgrades, plutus virtual machine changes (Plutus V4) and agreed-upon CIPs that will be part of the next intra-era hard fork to be planned (likely, circa February 2026).

Key Results

- Align with Intersect and IOE on the exact timelines and deliveries;
- Support for Plutus V4 semantic;
- Support for new virtual machine builtins (BLS, new built-in value methods, array, ...);
- Uninterrupted synchronization through the hard fork transition.

Key Performance Indicators (KPIs)

Indicator	Target
Coverage of the new Plutus built-ins in tests and benchmarks	100%
Single-script evaluation (turbo-benchmark)	<2ms
Readiness before hard fork point	>1 week

Estimated Effort

1.5 FTEs

Q2 - Path to Block Production

Goal

Implement remaining node functionality to close the gap between a relay and a block producer. This includes key (KES, VRF & Ed25519) management, block forging, additional metrics, SPO-specific governance tooling and necessary performance optimisations and conformance tests. This also marks the beginning of an independent security audit to look for defects or critical vulnerabilities.

Key Results

- Begin external security audit through one or more independent firms;
- Reinforce testing and conformance, in particular on Antithesis and through penetration testing;
- Finalize work on mempools and peer management;
- Implement block forging.

Key Performance Indicators (KPIs)

Indicator	Target
Resident memory usage	<1GB
Average CPU Usage	<1%
Block diffusion time (fetch + validation + sharing)	<1s
Acceptance time to mempool	<100ms
Missed slots when leader (excluding slot battles)	0

Estimated Effort

5 FTEs

Q3 - Mainnet Readiness

Goal

Get Amaru to a level of confidence that is sufficient for 'production'. Limit damages and disruptions that can be done to Cardano mainnet.

Key Results

- Finalize security audit & publish report (8 weeks, 2 engineers, about \$500K);
- Fixes and quality of life improvements as requested by SPOs;
- Performance tweaks and monitoring improvements.

Key Performance Indicators (KPIs)

Indicator	Target
Resident memory usage	<1GB
Average CPU Usage	<1%
Block diffusion time (fetch + validation + sharing)	<1s
Acceptance time to mempool	<100ms
Missed slots when leader (excluding slot battles)	0
Unpatched major security vulnerabilities or major defects	0
SPO (i.e. users) satisfaction	>80%

Estimated Effort

5 FTEs

Q3, Q4 - Explore New Horizons

Goal

Follow-up with Cardano evolutions and help in the evaluation and design of the potential next steps. Work with the Haskell team and other node implementors to draft the future of Cardano.

Key Results

- Experiment/prototype new protocol-level updates. For example, Ouroboros Peras, Ouroboros Phalanx, and/or Ouroboros (Linear) Leios;
- Prototype with StarStream as a new virtual machine.

Key Performance Indicators (KPIs)

To be defined.

Estimated Effort

5 FTEs



Core Development — Summary

- Resources estimated: 5 FTEs
- Resources already funded: 1.5 FTE
- **Resources required: 3.5 FTE**
- **Fixed Costs: \$500k**

Operations & Use Cases

 Main Objective	Owner
To facilitate operations & management of the project and pursue interesting use cases.	Damien Czapla



Q1 - Constrained Hardware Deployments

Goal

Continue the development and maintenance of Amaru running on a Raspberri Pi as showcased at the Cardano Summit

Key Results

- Polish and refine the Raspberry Pi setup presented at the Cardano summit.
- Explore deployments on new, more sustainable, constrained hardware setups (e.g., Radxa);

Key Performance Indicators (KPIs)

Indicator	Target
Time to setup and 'get started' without help	<1 day

Estimated Effort

1 FTE

 Q2 - First Node Diversity Workshop

Goal

Regularly bring together node developers and close stakeholders in a constructive environment to foster coordination between nodes.

Key results

- Organise the next node diversity workshop (in Porto?) focused on (linear) Leios and network resilience in a multi-node environment.
- Workshop organised and documented on the Cardano forum

Key Performance Indicators (KPIs)

Indicator	Target
Node implementations represented	>50%
Attendees satisfaction	>80%
Effectiveness at 6 months (completed actionable items / total items)	>50%

Estimated Effort

1 FTE + \$35K fixed cost

 Q3 - Amaru in the browser**Goal**

Run (a subset of) Amaru in the browser, to showcase Amaru versatility and ensures a clean decoupling of Amaru's internal. This effort opens the door to light clients and a potentially new form of DApps on Cardano.

Key Results

- Maintain and complete WASM support of the Amaru node components;
- Provides a browser-compatible ledger and consensus stores (e.g. IndexedDB);
- Develop a backend proxy prototype to relay TCP connections;
- Explore Zero-Knowledge validations using a WASM-based prover stack.

Key Performance Indicators (KPIs)

Indicator	Target
Time to setup and 'get started' with running a node in-browser	<1 day
Block validation (fetch + validation)	<1s
Supported browsers	Chrome >= v143

Estimated Effort

1 FTE

 Q3, Q4 - SPO Playground**Goal**

Create a low entry-barrier sandbox for SPOs to swiftly experiment with Amaru.

Key results

- Develop a playground environment for exploration and learning;
- Provide examples/templates of monitoring dashboards;
- Interface internationalization, at least Japanese.

Key Performance Indicators (KPIs)

Indicator	Target
% of operational procedures documented and integrated in the UI	>80%

Estimated Effort

1 FTE + \$20k fixed (translation) cost

Q3, Q4 - Bug Bounty Program

Goal

Incentivise the open source contributions on Amaru and improve the resilience of the Cardano network

Key Results

- Clarify the incentives, workflow, and processes for establishing and claiming bounties; ideally, using Cardano-native solutions.
- Set up a bug-bounty program that leverages existing testnets and Antithesis;

Key Performance Indicators (KPIs)

Indicator	Target
Retention/conversion rate (bounty hunters turned contributors)	>25%
Relevance of submission (number of valid submissions / total number of submission)	>50%

Estimated Effort

0.5 FTE + \$30k fixed cost

Q4 - Second Node Diversity Workshop

Goal

Bring together node developers and close stakeholders in a constructive environment to work on improving the overall resilience of the Cardano network thanks to node diversity.

Key Results

- Organise another node diversity workshop focused on mainnet readiness and hard fork decision-making criteria moving forward.
- Workshop organised and documented on Cardano forum

Key Performance Indicators (KPIs)

Indicator	Target
Node implementations represented	>3
Attendees satisfaction	>80%
Effectiveness at 6 months (completed actionable items / total items)	>50%

Estimated Effort

1 FTE + \$35K fixed cost

Q4 - Financial Audit

Goal

Have an external auditor scrutinize Amaru's finances and treasury management.

Key Results

- Publish a report at the beginning of Q1 2027 about the audited finances

Key Performance Indicators (KPIs)

Indicator	Target
Unforeseen incidents	0

Estimated Effort

1 FTE

Q1 → Q4 - Performance & profiling

Goal

Improve the resources consumption of the node and the runtime of basic features.

Key Results

- Establish realistic benchmarks and metrics to analyse Amaru's performance in a more formal, systematic manner.
- Identify codebase improvements to reduce resource usage and improve overall performance.
- Analyze dependencies to find a better fit, reduce them, or internalize interesting ones.

Key Performance Indicators (KPIs)

Indicator	Target
Resident memory usage	<1GB
Average CPU Usage	<1%
Block diffusion time (fetch + validation + sharing)	<1s

Indicator	Target
Ledger throughput (no consensus)	>100 tx/s
Time to benchmark from any release	<1 day

Estimated Effort

0.5 FTE

Q1 → Q4 - Project management

Goal

Facilitate project and product management aspects of Amaru-related activities

Key Results

- Improve work processes and coordination across the team(s);
- Maintain an alignment routine with each cluster of stakeholders;
- Publish monthly & quarterly reports detailing project's activity and progress.

Key Performance Indicators (KPIs)

Indicator	Target
Reliability: $\frac{\% \text{ delivered on schedule}}{\% \text{ late or undelivered}}$	100%
Forecast accuracy: $\frac{\text{actual} - \text{estimate}}{\text{estimate}}$	~0
Scope creep rate: $\frac{\text{total unplanned}}{\text{total done}}$	0%

Estimated effort

1 FTE

Q1 → Q4 - Marketing and communication

Goal

Maintain communication channels with each stakeholder: SPOs, DEX/CEX/Businesses running Amaru, Node implementors & dApp developers.

Key Results

- Maintain presence on social media;
- Attend the next Cardano Summit;
- Keep the website and other public resources up to date;
- Publish quarterly reports.

Key Performance Indicators (KPIs)

Indicator	Target
Social media engagement rate: $\frac{\text{likes} + \text{shares} + \text{comments}}{\text{impressions}}$	>2%
Posting frequency	>once a week
X organic followers growth	+100%

Estimated Effort

1 FTE + \$10k fixed cost



Operations & Use Cases — Summary

- Resources estimated: 2.5 FTEs
- Resources already funded: 0.5 FTE
- **Resources required: 2 FTEs**
- **Fixed Costs: \$130k**

Network compliance & Cardano level Testing

 Main Objective	Owner
To create a robust Cardano network level testing environment, find vulnerabilities, edge cases and interesting scenarios to make the Cardano network more resilient in the long-run.	Paolo Veronelli

NOTE:

For obvious reasons, activities from this scope may be documented only after remediation has been found and implemented across the entire network. The goal here isn't to attack and break the network, but to identify and fix critical vulnerabilities before a malicious actor does.



Q1, Q2 - Analyse Network Behaviour

Goal

Document the behaviour of the Cardano network and the specific characteristics of the Haskell node.

Key Results

- Analyse and (re-)evaluate peer selection rules of the Haskell implementation, looking at different angles: resilience, decentralisation, and operational concerns;

- Contribute to the Cardano blueprint with a report detailing the expectations regarding the network's behaviour, peer management strategies, and possible areas of improvement.

Key Performance Indicators (KPIs)

N/A

Estimated Effort

1 FTE



Q1 → Q4 - Support Antithesis development

Goal

Maintain a testing environment tailored with tests toolings and tests that benefits Cardano node stakeholders.

Key Results

- Support the development of Antithesis-related tooling, to maximise its ease of use and accessibility;
- Improve tooling around local development and experiments with node clusters.

Key Performance Indicators (KPIs)

Indicator	Target
Utilization of the Antithesis cluster (idle time / total time)	>25%
Manual tests ratio (test runs done manually vs triggered via on-chain transactions)	0%

Estimated Effort

1 FTE

 Q1 → Q4 - White-Hacking and Cardano-level Testing**Goal**

Investigate known attack vectors, “known unknowns,” and build robust test cases and simulation scenarios to validate (or not) network assumptions

Key Results

- Identify (if any) unknown vulnerabilities;
- Challenge researchers’ security models;
- Search for potential attack vectors / demonstrate existing ones;
- Create a reference automated test suite to exercise findings and known vulnerabilities.

Key Performance Indicators (KPIs)

Indicator	Target
% of automated tests passed against reference test suite	100%
MTTR (Mean Time To Recover) from found vulnerabilities	<48h
Open Critical Vulnerabilities	0

Estimated Effort

1 FTE + \$500k fixed costs for the Antithesis platform and related infrastructure.

**Network Compliance & Cardano-level Testing — Summary**

- Resources estimated: 1.5 FTE
- Resources already funded: 0.5 FTE
- **Resources required: 1 FTE**
- **Fixed costs: \$500k**

Middleware integrations

 Main Objective	Owner
To drive integration of Amaru into relevant and most-used infrastructure middleware and tools in the ecosystem.	Pi Lanningham

NOTE:

Because some of the planned milestones here depend on ongoing (and sometimes unfinished) projects, most far-away integrations are subject to changes and adjustments based on the latest priorities and ecosystem state. This doesn't concern integrations planned in the first quarter.

Q1, Q2 - Kupo & Dolos

Goal

Integrate Amaru as a data source in both [Kupo](#) and [Dolos](#) via the node-to-node protocols.

Key Results

- Amaru can stream blocks to Kupo and Dolos
- Amaru can provide for remaining queries necessary to Kupo (accessing chain's tip, forcing rollbacks, etc..)
- Dolos' gRPC is available through Amaru

Key Performance Indicators (KPIs)

Indicator	Target
API Coverage	100%

Indicator	Target
Synchronization time (mainnet, full index, from snapshot)	<16h

Estimated Effort

1 FTE

Q1, Q2 - Mithril

Goal

Make Mithril (signer & client) a first-class citizen within the Amaru ecosystem. Leverage the fact that both are implemented using the same stack (i.e. Rust) and that Amaru relies on snapshots to maximise synergies with Mithril and increase its adoption amongst SPOs.

Key Results

- Embed a [Mithril](#) client in Amaru to ease bootstrapping and offer a seamless entry point to the Cardano network.
- Integrate an optional [Mithril](#) signer in Amaru to provide out-of-the-box participation to Mithril's security.

Key Performance Indicators (KPIs)

Indicator	Target
% total stake running Mithril signers via Amaru	5%

Estimated Effort

1 FTE

[uncertain] Q3, Q4 - StarStream

Goal

Explore StarStream's unique model and provide a sandbox for experimentations within Amaru. We aim to validate StarStream readiness and feasibility for an eventual mainnet rollout.

Key Results

- Implement StarStream virtual machine and new execution model directly in Amaru's ledger;
- Analyse impact, iterate, refine, and collaborate with the Haskell team to support the implementation across all nodes.

Key Performance Indicators (KPIs)

To be defined.

Estimated Effort

1 FTE

 [uncertain] Q3, Q4 - L2s integrations

Goal

Explore possible integrations with various L2s (Hydra, Hydrozoa, Midgard, Sundial, Konduit, ...)

Key Results

To be defined.

Key Performance Indicators (KPIs)

To be defined.

Estimated Effort

1 FTE

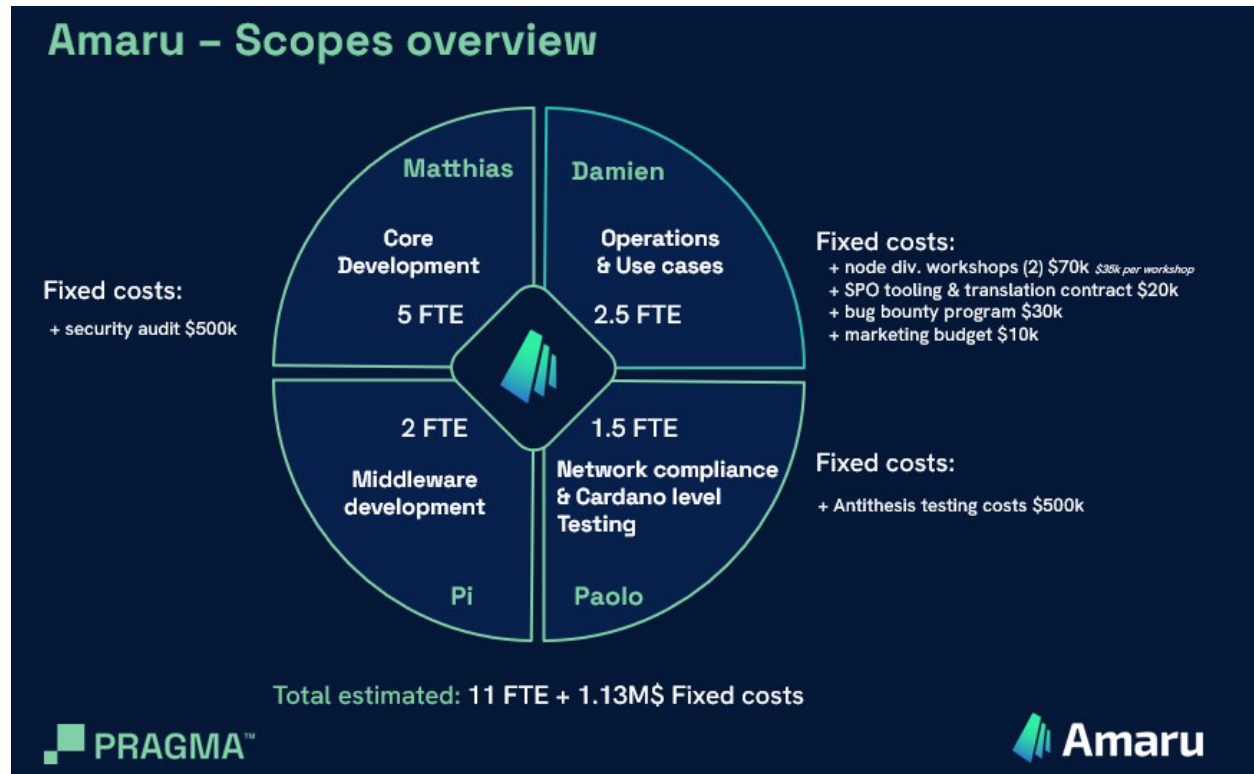


Middleware Integrations — Summary

- Resources estimated: 2 FTEs
- Resources secured: 0 FTEs
- **Resource required: 2 FTEs**
- **Fixed costs: \$0**

Budget Breakdown

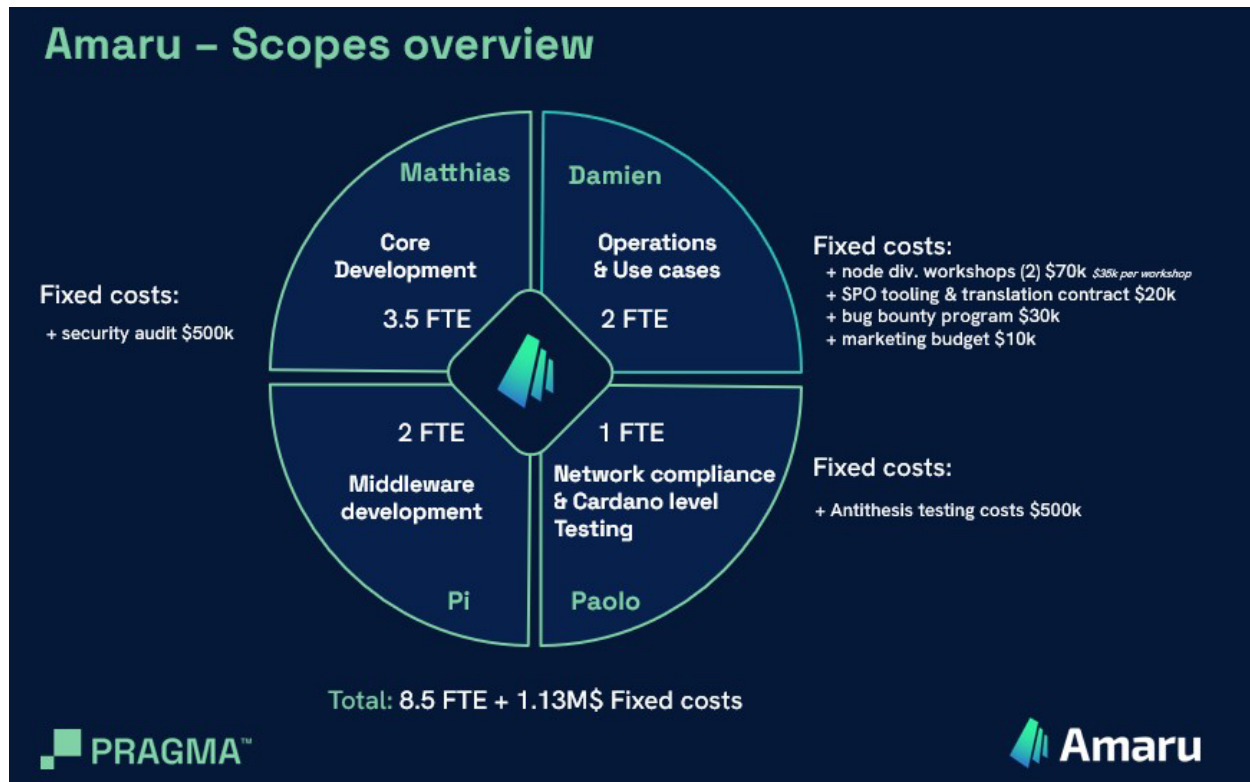
Overview



Scope	Estimated effort (FTEs)	Already Funded (FTEs)	Asked (FTEs)	Fixed costs (\$)
Core Development	5 FTEs	1.5 FTE	3.5 FTEs	\$500k
Operations & Use cases	2.5 FTEs	0.5 FTE	2 FTEs	\$130k
Network Compliance & Cardano-level Testing	1.5 FTEs	0.5 FTEs	1 FTEs	\$500k
Middleware Development	2 FTEs	0 FTEs	2 FTEs	
Total	11 FTEs	3.5 FTEs	8.5 FTEs	\$1.13M

The estimated fixed cost includes:

- (Core Development) \$500k Security audit (8 weeks, 2 engineers);
- (Operations & Use Cases) \$70k Node diversity workshops (2 anticipated, \$35k each);
- (Operations & Use Cases) \$10k for Marketing including Cardano Summit participation;
- (Operations & Use Cases) \$20k SPO contracting and Japanese translation costs;
- (Operations & Use Cases) \$30k for Bug Bounty program;
- (Network Compliance & Cardano-level Testing): \$500k yearly estimate for the Antithesis platform costs and infrastructure related to the end-to-end testing activities.



The total ask for the project is 8.5 FTEs + `1.13M` in fixed costs.

FTEs are being valued at an annual billable rate of `\$225k`.

Furthermore, like for the previous budget, we are aware of our assumption/optimism bias (our forecast is subject to underestimating complexity, overlooking challenges, and undervaluing the time and cost required to deliver). We therefore add an extra 20% contingency buffer, reduced by 5% from our last budget proposal, since we have, in fact, underspent our budget last year.

This leaves us with the following total: $8.5 \times \$225k \times 1.2 + \$1,130k = \$3,425M$

Finally, using a conservative conversion rate of `0.5` ADA per USD, we formulate a budget ask of ~~\$~~**6,850,000`**.