

Phase 3 Tasks

Aa Task ID	# Phase	📍 Checkpoint ID	📍 Section	☰ Task	☰ Notes	📍 Area	📍 Com
<u>P3-A-001</u>	3	P3-A	0) Conventions	Redi s keys (add ition s for Pha se 3):		Standards	
<u>P3-A-002</u>	3	P3-A	0) Conventions	On-chai n strat egy: Con firm the targ et EVM L2 for ReFI N (e.g. , Bas e / OP Mai nnet / Arbi trum) and Ethe reu m L1 for anc hori ng.		Standards	
<u>P3-A-003</u>	3	P3-A	0) Conventions	Has hing algo rith m: Stan dard ize Pha se-3		Standards	

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				has hing ; defa ult SHA -25 6 with opti on to swit ch to kec cak 256 via conf ig (mu st be con siste nt acro ss Writ er, Buil der, Expl orer).			
<u>P3-A-004</u>	3	P3-A	1) Google Cloud Project & Networking	Egre ss allo w- list (upd ates):		Infra	
<u>P3-A-005</u>	3	P3-A	1) Google Cloud Project & Networking	GCS buc ket (upd ates): Cre ate per- env Audi t Prei		Infra	

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				mag es buc ket; ena ble obje ct vers ioni ng and rete ntio n. (Exp lorer serv es reda cted prei mag es from GCS .)			
<u>P3-A-006</u>	3	P3-A	2) Data Stores — MongoDB Atlas	Appl y Clou d Spa nner Pha se-3 DDL and verif y tabl es exist : audi t_le aves , mer kle_i nter vals, refin _roo ts, l1_a nch ors, anc		Data Infra	

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				hor_ que ue, anc hor_ runs , expl orer _ind ex			
<u>P3-A-007</u>	3	P3-A	2) Data Stores — MongoDB Atlas	Key inde xes:		Data Infra	
<u>P3-A-008</u>	3	P3-A	3) Security & IAM	Serv ice acc ount s (ne w): 'sa- audi t- writ er', 'sa- mer kle- buil der', 'sa- anc hor- job', 'sa- refin - inde xer', 'sa- expl orer - api'.		Security	
<u>P3-A-009</u>	3	P3-A	3) Security & IAM	Lea st- privi lege role s:		Security	

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<u>P3-A-010</u>	3	P3-A	3) Security & IAM	Secrets (new):		Security	
<u>P3-A-011</u>	3	P3-A	4) Pub/Sub Event Bus	Topics (updates): Create 'audit.evnt' (if not already present).		Messaging	
<u>P3-A-012</u>	3	P3-A	4) Pub/Sub Event Bus	Subscriptions: Add Audit Writer subscriber with DLQ; ordering by suitable shard key.		Messaging	
<u>P3-A-013</u>	3	P3-A	4) Pub/Sub Event Bus	Producer modifications: Ensure Risk Engine, Execution		Messaging	

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				Gateway, Trade Manager publish to `audit.event` at key state transitions.			
P3-A-014	3	P3-A	5) CI/CD & Runtime Configuration	Repository: Add service directories: `audit-writer/`, `merkle-builder/`, `anchor-job/`, `refinement-indexer/`, `explorer-api/`.		CI/CD	
P3-A-015	3	P3-A	5) CI/CD & Runtime Configuration	Smart contracts: Add `con		CI/CD	

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				tract s/ref in/' for Audi tReg istry (and libs) ; conf igur e Har dhat /Fou ndry depl oys per env (cha in IDs, sub mitt er role) .			
<u>P3- A- 016</u>	3	P3-A	5) CI/CD & Runtime Configuration	Pipe lines : Buil d & depl oy Clou d Run serv ices ; com pile & depl oy cont ract s to the cho sen L2; pro mot e via		CI/CD	

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				staged envs.			
P3-A-017	3	P3-A	5) CI/CD & Runtime Configuration	Runtime config:		CI/CD	
P3-A-018	3	P3-A	7) Observability & SLOs	Dashboards:		Observability	
P3-A-019	3	P3-A	7) Observability & SLOs	Alerts:		Observability	
P3-A-020	3	P3-A	7) Observability & SLOs	Phase-3 SLO baselines:		Observability	
P3-A-021	3	P3-A	8) Component-Level Preflight (Phase 3) — On-Chain	Contracts deployed: AuditRegistry on L2; L1 Anchor on Ethereum.		On-chain	On-Chain
P3-A-022	3	P3-A	8) Component-Level Preflight (Phase 3) — On-Chain	Submitter role: grant Builder's wallet the sub		On-chain	On-Chain

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				mitt er role in Audi tReg istry .			
<u>P3-A-023</u>	3	P3-A	8) Component-Level Preflight (Phase 3) — Audit Writer	Sub scri ptio n: serv ice sub scri bed to `aud it.ev t` with DLQ .		Service	Audit V
<u>P3-A-024</u>	3	P3-A	8) Component-Level Preflight (Phase 3) — Audit Writer	Con fig: can onic aliza tion/ reda ctio n poli cies in `Au ditC onfi g`.		Service	Audit V
<u>P3-A-025</u>	3	P3-A	8) Component-Level Preflight (Phase 3) — Audit Writer	Cre ate/ verif y Clou d Spa nner inde xes per Pha se-3 DDL (ix_l eav es_		Data Infra	Audit V

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				batch, ix_leaves_cor, ux_intervals_root, ix_intervals_list, ix_intervals_window, ux_roots_root, ix_roots_status, ix_l1_tx, ix_l1_status, ix_queue_e_status, ix_queue_enqueue, ix_runs_started, ix_explorer_ttl)			
<u>P3-A-026</u>	3	P3-A	8) Component-Level Preflight (Phase 3) — Merkle Builder	Use time /size win		Data Model	Merkle

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				dow rotat ion and Spa nner quer ies for new leav es (no cha nge stre ams)			
<u>P3-A-027</u>	3	P3-A	8) Component-Level Preflight (Phase 3) — Merkle Builder	Con fig: rotat ion poli cy (tim e/si ze), shar d poli cy.		Service	Merkle
<u>P3-A-028</u>	3	P3-A	8) Component-Level Preflight (Phase 3) — Merkle Builder	Secr ets: L2 sub mitt er priv ate key load ed.		Service	Merkle
<u>P3-A-029</u>	3	P3-A	8) Component-Level Preflight (Phase 3) — Anchor Job	Sch edul er: Clou d Sch edul er cad enc e (e.g. , ever y 5–		On-chain	Anchor

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				15 min)	.		
<u>P3-A-030</u>	3	P3-A	8) Component-Level Preflight (Phase 3) — Anchor Job	Secrets: L1 anchor wallet key and CCI P config present.		On-chain	Anchor
<u>P3-A-031</u>	3	P3-A	8) Component-Level Preflight (Phase 3) — Anchor Job	Cloud Spanner tables: `Anchor Queue`, `L1 Anchors`, `Anchor Runs`.		Data Infra	Anchor
<u>P3-A-032</u>	3	P3-A	8) Component-Level Preflight (Phase 3) — Explorer API	Config: L2/L1 RPC endpoints; GCS bucket for redacted preimages; Redis rate limits.		API	Explore

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<u>P3-A-033</u>	3	P3-A	9) Smoke Tests	Publ ish a test `aud it.ev t` (e.g. , from Risk).		Validation	
<u>P3-A-034</u>	3	P3-A	9) Smoke Tests	Veri fy Writ er con sum es and crea tes `Au ditL eav es`/ Audi tLog s` entr y with leaf/ chai n has hes.		Validation	
<u>P3-A-035</u>	3	P3-A	9) Smoke Tests	Inse rt sev eral leav es; conf irm Buil der ope ns a batc h, then final izes a `Mer klel nter		Validation	

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				vals` with `root `; sub mitR oot to ReFI N; rece ipt app ears in `ReF INR oots `.			
<u>P3- A- 036</u>	3	P3-A	9) Smoke Tests	Trig ger Anc hor Job; see cac he- miss sele ctio n, bun dle, CCI P sen d, and L1An chor s ups ert; che ck L1 expl orer for rece ipt.		Validation	
<u>P3- A- 037</u>	3	P3-A	9) Smoke Tests	Call `GE T /v1/r esol ve/{		Validation	

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				has h}'; resp ons e incl ude s leaf, inter val, L2 rece ipt, and L1 anc hor rece ipt (wh en avail able).			
<u>P3-B-001</u>	3	P3-B	1) Development & Integration Plan — Producers (Risk	Emit com pact 'aud it.ev t' at eac h defi ned tran sitio n with requ ired attri bute s 'sch ema _ver sion , 'cor relat ionl d', 'emi tter', 'emi tted _at',		Engineering	Produc

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				plus the natu ral dom ain key (`cli ent Ord erId` `inte nt_i d` `pla n_id `)). Bodi es mus t be dete rmin istic and omit non dete rmin istic field s.			
<u>P3-B-002</u>	3	P3-B	1) Development & Integration Plan — Producers (Risk	Ens ure per- dom ain orde ring keys mat ch the hot- path con vent ions so repl ays are stab le.		Engineering	Produc
<u>P3-B-</u>	3	P3-B	1) Development & Integration Plan — Audit Writer (Cloud Run)	Sub scri		Engineering	Audit V

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<u>003</u>				ption: Consume `audit.ev t` with DLQ; apply shard- aware ordering for con- sistent sequen- cing.			
<u>P3-B-004</u>	3	P3-B	1) Development & Integration Plan — Audit Writer (Cloud Run)	Sequencing: Allocate `seq_no` per shard; keep mon- otonic sequences via Redis `audit:seq` : {shard}`. Maintain shor		Engineering	Audit V

Aa Task ID	# Phase	⦿ Checkpoint ID	⦿ Section	≡ Task	≡ Notes	⦿ Area	⦿ Comj
				t- TTL 'aud :see n: {ide m}' for ide mpo tenc y.			
<u>P3- B- 005</u>	3	P3-B	1) Development & Integration Plan — Audit Writer (Cloud Run)	Can onic aliza tion & reda ctio n: Stab le JSO N (ord ered keys , UTC time sta mps , nor mali zed num eric s); appl y reda ctio n map s prio r to has hing . Uplo ad reda cted prei mag es		Engineering	Audit V

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				to GCS and store only references.			
P3-B-006	3	P3-B	1) Development & Integration Plan — Audit Writer (Cloud Run)	Hashing : Compute leaf _hash` using the standardized algorithm (default SHA-256, optional keccak256 via config; must be consistent across Writer, Builder, Explorer).		Engineering	Audit V
P3-B-007	3	P3-B	1) Development & Integration Plan — Audit Writer (Cloud Run)	Persistence (Clo		Data Infra	Audit V

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				ud Spa nner): Ups ert to `aud it_le aves , with field s `{lea f_id, leaf _has h, emit ter, type , corr elati onId , clie ntOr derI d, inte nt_i d, plan _id, seq_ no, shar d_id , sch ema _ver sion , prei mag e_re f, crea ted_ at}`. Cre ate sec ond ary			

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				indexes on `correlationId`, `clientIdOrderId`, `intentId`, and `createdAt` DES C'.			
P3-B-008	3	P3-B	1) Development & Integration Plan — Audit Writer (Cloud Run)	Observability: Emit ingest and redact latency, duplicates, dropped counters, DLQ metrics.		Engineering	Audit V
P3-B-009	3	P3-B	2) Testing & Validation Checklist	Manual end-to-end trigger: Push an `account.inte`.		Validation	

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				ady` to driv e Pha se-1 (Ris k → EG → TM). Veri fy prod ucer s publ ish `aud it.ev t` at eac h tran sition.			
P3- B- 010	3	P3-B	2) Testing & Validation Checklist	Eve nt publ ishin g verif icati on: In Pub/ Sub, conf irm `aud it.ev t` from Risk , Exe cuti on Gate way, and Trad e Man ager carr y exp		Validation	

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				ecte d sna psh ots.			
P3- B- 011	3	P3-B	2) Testing & Validation Checklist	Audi t Writ er verif icati on: Log s sho w `seq _no` allo cati on and `ide m` com puta tion; Spa nner cont ains new `aud it_le aves , row s; `leaf _has h` reco mpu tes loca lly; `prei mag e_re f` poin ts to a reda cted GCS obje ct.		Data Model	

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P3- B- 012	3	P3-B	2) Testing & Validation Checklist	Idempotency check: Republish a captured audit event; confirm no duplicate leaf due to audit: see n: {idemp} and leaf-idempotency.		Validation	
P3- C- 001	3	P3-C	1) Development & Integration Plan — Merkle Builder (Cloud Run)	Intake: Detect new leaves from Spanner ('audit_leaves') using commit-time stamp polling or a		Data Model	Merkle

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				light wei ght notif ier; deri ve `sha rd_k ey` (e.g. , `(em itter, win dow _sta rt`)); use Redi s `mrk :loc k: {sha rd_k ey}` to guar d final izati on. Mai ntai n a per- shar d ide mpo tenc y toke n.			
P3- C- 002	3	P3-C	1) Development & Integration Plan — Merkle Builder (Cloud Run)	Ope n- batc h stat e: Trac k an ope n batc h in Spa		Data Model	Merkle

Aa Task ID	# Phase	⦿ Checkpoint ID	⦿ Section	≡ Task	≡ Notes	⦿ Area	⦿ Comj
				nner (buil der stat e or 'mer kle_i nter vals' row with 'stat e=o pen') stori ng '{ba tch_ key, win dow _sta rt, leaf_ cou nt}' Pres erve mon oton ic orde r by '(se q_n o, leaf _id)' for dete rmin istic proo fs.			
P3- C- 003	3	P3-C	1) Development & Integration Plan — Merkle Builder (Cloud Run)	Rota tion poli cy: Seal by time (e.g. , ≥5- 10 min) or		Engineering	Merkle

Aa Task ID	# Phase	⦿ Checkpoint ID	⦿ Section	≡ Task	≡ Notes	⦿ Area	⦿ Comj
				size thre shol ds; mar k `stat e=cl osin g` with `win dow _en d`.			
P3- C- 004	3	P3-C	1) Development & Integration Plan — Merkle Builder (Cloud Run)	Fina lize — root & proo fs: Loa d orde red `leaf _has h[]`, com pute Mer kle root (def ault SHA -25 6, `kec cak 256` opti onal via conf ig), and buil d incl usio n proo fs.		Engineering	Merkle
P3- C-	3	P3-C	1) Development & Integration Plan — Merkle Builder (Cloud Run)	Pers iste		Data Infra	Merkle

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<u>005</u>				nce (Spanner): Write `merkle_interval` {batch_id, emitter, window_start, window_end, root, leaf_count, has_halgo, created_at}` and set `batch_id` on the linked leaves. Create indexes on (root), (window_start DESC).			

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P3- C- 006	3	P3-C	1) Development & Integration Plan — Merkle Builder (Cloud Run)	L2 sub mit: Call `Au ditR egis try.s ubm itRo ot(b atch Id, root, met a...)` ; pers ist `refi n_ro ots` `{ba tch_i d, root, l2_tx _has h, anc hor_ stat us}` and bac kfill `l2_t x_ha sh` on `mer kle_i nter vals` .		Engineering	Merkle
P3- C- 007	3	P3-C	1) Development & Integration Plan — Merkle Builder (Cloud Run)	Anc hor enq ueue: Inse rt into `anc hor_ que ue` `{ba		Engineering	Merkle

Aa Task ID	# Phase	Ⓢ Checkpoint ID	Ⓢ Section	≡ Task	≡ Notes	Ⓢ Area	Ⓢ Com
				tch_id, root, l2_tx _has h, stat us= pen ding }'.			
<u>P3- C- 008</u>	3	P3-C	1) Development & Integration Plan — Merkle Builder (Cloud Run)	Index : ReFI N Index er mirr ors rece ipts into 'refi n_ro ots' and links to inter vals; alert on inde xer lag.		Engineering	Merkle
<u>P3- C- 009</u>	3	P3-C	2) Testing & Validation Checklist	Dete rmin ism: Rec omp ute the Mer kle root from batc h leav es and conf irm it equ als		Validation	

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				`merkle_inter vals.root` .			
P3-C-010	3	P3-C	2) Testing & Validation Checklist	L2 transaction: Submit a dev batch; verify L2 receipt; confirm `refin_roots` upsert and `l2_tx_hash` linked on `merkle_inter vals` .		Validation	
P3-C-011	3	P3-C	2) Testing & Validation Checklist	Queueing: Validate `anchor_queue` row creation post-submit with `status`		Validation	

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				pending			
P3-C-012	3	P3-C	2) Testing & Validation Checklist	Latency SLO : Leaf → root completes within the configured cadence (e.g. , ≤ 60 s).		Validation	
P3-D-001	3	P3-D	1) Development & Integration Plan — Anchor Job (CCIP)	Eligibility: Select finalized roots with `anchor_status` = pending, from `refin_roots` or pop from `anchor_queue`; sort		Engineering	Anchor

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				dete rmin istic ally.			
P3- D- 002	3	P3-D	1) Development & Integration Plan — Anchor Job (CCIP)	Bun dle com pos e: Cre ate `Anc hor Bun dle` with in thre shol ds (`ma x_ro ots`, `ma x_by tes`, `ma x_ag e_se con ds`); deri ve `bun dle_i d` from orde red `bat ch_i d[]`.		Engineering	Anchor
P3- D- 003	3	P3-D	1) Development & Integration Plan — Anchor Job (CCIP)	Sen d via CCI P: Sub mit to L1 Anc hor; pers ist `me ssa ge_i		Engineering	Anchor

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				d', provisional 'l1_tx_hash'.			
P3-D-004	3	P3-D	1) Development & Integration Plan — Anchor Job (CCIP)	Confirm & mark: Upsert 'l1_anchors' { bundle_id, root_s[] super_root, message_id, l1_tx_hash, status, block_no, confirmed_at } and set 'refinements'. anchor_status= anchored'.		Engineering	Anchor
P3-D-005	3	P3-D	1) Development & Integration Plan — Anchor Job (CCIP)	Idempotency &		Engineering	Anchor

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				safe ty: Nev er re-anc hor the sam e `bat ch_i d`; exp one ntial bac koff and circ uit brea kers on RPC /CCI P failu res.			
P3-D-006	3	P3-D	1) Development & Integration Plan — Explorer API	Res olve path : Join `aud it_le aves → mer kle_i nter vals → refin _roo ts → l1_a nch ors`; retu rn a com pact reco rd key ed by		Engineering	Explore

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				<p>correlation', including leaf metadata, interval root, L2 tx has h, L1 anchor tx has h, and 'preimage_ref'.</p>			
P3-D-007	3	P3-D	1) Development & Integration Plan — Explorer API	Verify inclusion: Recompute Merkle proof for a given leaf against stored root; return validity result and refe		Engineering	Explore

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				renc es.			
<u>P3-D-008</u>	3	P3-D	1) Development & Integration Plan — Explorer API	Prei mag e acc ess: Serv e reda cted prei mag es from GCS und er auth ; enfo rce rate limit s.		Engineering	Explore
<u>P3-D-009</u>	3	P3-D	1) Development & Integration Plan — Security	Serv ice acc ount s: `sa-anc hor-job`, `sa-expl orer - api`; keys and CCI P conf ig in Secr et Man ager .		Engineering	Securit
<u>P3-D-010</u>	3	P3-D	1) Development & Integration Plan — Security	On-chai n conf ig: L1/L 2		Engineering	Securit

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				RPC end poin ts and CCI P rout er; addr ess boo ks per env.			
P3- D- Q11	3	P3-D	1) Development & Integration Plan — Security	Obs erva bilit y: Das hbo ards for CCI P sen d late ncy, L1 conf irm time , inde xer lag; API p95 ≤ 200 ms. Aler ts for bac klog gro wth and verif icati on mis mat che s.		Observability	Securit

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<u>P3-D-012</u>	3	P3-D	2) Testing & Validation Checklist	Anc hor Job verif icati on: Ens ure sev eral un- anc hore d L2 root s exist ; trigg er a run; logs sho w sele ctio n, bun dle crea tion, CCI P sen d; conf irm the L1 tx on a bloc k expl orer ; verif y `l1_a nch ors` ups ert and `refi n_ro ots. anc hor_		Validation	

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				stat us= anc hore d`.			
P3- D- 013	3	P3-D	2) Testing & Validation Checklist	Expl orer verif icati on: Pick a `leaf _has h` from an anc hore d batc h; `GE T /v1/r esol ve/{ has h}` retu rns inter val/r oot, L2 tx, L1 tx, and prei mag e poin ter; vali date incl usio n via `PO ST /v1/ verif y/in clusi on`.		Validation	

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<u>P3-D-014</u>	3	P3-D	2) Testing & Validation Checklist	For matt ing & time line: Res pon ses pres ent a chro nolo gica l trail for a give n `cor relat ion! d`.		Validation	