# Module 17 – CTO Certification & Verification Grid (Final v4.1)

Version: 4.1 (Final CTO Edition)

Layer: Certification Logic, Threat-Based Score Grid, Simulation Coverage, Capsule Integrity

Status: RELEASE

Dependencies: Modules 13, 14, 15, Threat Model, Federation, Alerts, Recovery

## 0. Purpose & Score Authority Role

This module defines the sovereign CTO-grade certification process, simulation coverage enforcement, capsule integrity score grid, alert readiness check, and trust violation downgrade logic. All certified systems must pass capsule traceability validation, federation verification, observer alert linkage, and audit replay completeness.

## 1. Certification Capsule Format & Scope Coverage

Certification is granted via:  
`CTO Certification Capsule (CCC)`:  
`{ cert\_id, issuer\_id, score\_matrix[], grace\_zone[], capsule\_scope[], alert\_window[], recovery\_ref[], fed\_sync\_confirm[], replay\_chain\_status, simulation\_coverage\_ok, downgrade\_trigger[], timestamp }`  
Each entry is traceable and audit-bound via Module 13.

## 2. Score Grid Dimensions & Downgrade Triggers

Scored dimensions (0–100 each):  
- Capsule Chain Integrity  
- Replay Resilience  
- Alert Signal Coverage  
- Federation Trust Sync  
- Observer Trace Visibility  
- Grace Zone Compatibility  
- Simulation Response Verification  
Triggering events:  
- Unresolved VSC  
- Unlinked Alert Capsule  
- Missing FCC or GRCC  
- Audit Drift without fork justification

## 3. Simulation Requirement & Capsule Validation Depth

To certify a system:  
- at least 75% capsule paths must be replayed via simulation (Module XX)  
- each capsule type must be verified with mock injection flow  
- alert response must produce deterministic response capsules  
- output is sealed in `Simulation Confirmation Capsule (SCC)`

## 4. Federation Checks & Trust Isolation Barriers

Systems must present:  
- verified Federation Consent Capsule (FCC)  
- fork resolution via FAC lineage  
- role-level trust separation scores ≥ 85  
- duplicate capsule detection scan (cross-ledger)

## 5. Certification Output & Reentry Binding

Output includes:  
- full score matrix  
- signed CCC capsule  
- trace overlay snapshot (audit capsule set)  
- alert link references  
- reentry profile (if from Grace Recovery)  
Certification validity requires active audit + ledger connection and zero unresolved HIGH-class violations.