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# Unifying Human–Machine Identity Through Intent-Aware Zero-Trust Frameworks for Decentralized Agentic AI Systems

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**Abstract:** Background: The rise of agentic AI — systems that autonomously perform tasks, make decisions, and interact with other systems and humans — has created novel identity, authentication, and authorization challenges that traditional IAM paradigms were not designed to address (Kumar, 2023; Hasan, 2024). Agentic systems blur the line between human-driven access and machine-driven actions, requiring architectures that treat intent, provenance, and runtime context as first-class identity attributes (Bhushan et al., 2025; Syros et al., 2025). Zero Trust principles and emerging decentralized identity standards offer complementary tools, but integrating them into a coherent, scalable, and auditable architecture for agentic AI remains an open problem (Cloud Native Computing Foundation, 2024; W3C, 2023).

Methods: This article develops a comprehensive Intent-Aware Zero-Trust Identity Architecture (IA-ZTIA) tailored for agentic AI workloads. The methodology synthesizes canonical Zero Trust concepts, SPIFFE/SPIRE runtime identity primitives, decentralized identifiers (DIDs), intent modeling approaches, credential lifecycle management, behavioral anomaly detection, and cryptographically verifiable logging. The architecture is specified in layered components (bootstrapping, identity provisioning, intent-aware policy, runtime enforcement, telemetry and assurance) and evaluated by qualitative threat mapping against OWASP agentic threat categorizations and by comparative analysis with

existing proposals (Huang et al., 2025; Syros et al., 2025; OWASP, 2024).

Findings: IA-ZTIA clarifies the identity and intent semantics required for agentic interactions, proposes practical mappings to SPIFFE/SPIRE identities and DID-based attestations, and prescribes intent-based conditional access policies that extend conditional access paradigms to machine agency (Microsoft, 2024; Li & Zhao, 2025). The design demonstrates improved auditability through cryptographically signed logs, reduces attack surface by least-privilege intent scoping, and supports credential lifecycle management for IIoT and edge agents (Nishida, 2024; Reyes & Nakamoto, 2025). The architecture aligns with OWASP multi-agent threat modeling guidance and mitigates classes of attacks identified in agent risk taxonomies (OWASP, 2024; OWASP, 2025).

Conclusions: Intent awareness is essential for next-generation Zero Trust applied to agentic AI. IA-ZTIA shows that combining ephemeral SPIFFE identities, DID attestations, intent-aware policy, and cryptographic assurance yields a practical, auditable, and scalable architecture that unifies human and machine access. Remaining challenges include standardizing intent representations, scaling high-fidelity behavioral detection without false positives, and operationalizing cross-organization attestation ecosystems. The article closes with a research agenda for protocol work, governance models, and empirical evaluation in industrial settings.

(Word count: abstract ≤ 400 words)

**Keywords:** Intent-Aware Identity, Zero Trust, Agentic AI, SPIFFE/SPIRE, Decentralized Identifiers, Credential Lifecycle, Auditability

## 1. INTRODUCTION:

The accelerating deployment of agentic artificial intelligence — autonomous systems capable of making and executing decisions on behalf of users or organizations — has created an urgent need to reevaluate identity and access management models (Hasan, 2024; Kumar, 2023). Agentic AI actors can act across distributed cloud services, edge devices, and cross-organizational APIs; they operate under varying trust contexts, possess different intention scopes, and frequently perform actions with direct real-world impact. Traditional IAM models, which primarily revolve around human authentication and role assignment, are insufficient because they typically fail to capture agent intention, runtime context, and verifiable provenance of decisions (Bhushan et al., 2025; Li & Zhao, 2025).

Zero Trust, a security paradigm premised on continuous verification and least privilege, is widely recognized as a conceptual foundation for securing modern distributed systems (Achanta, 2025). Yet applying Zero Trust to agentic AI introduces distinctive requirements: identities must be modular, ephemeral, and cryptographically strong at machine scale; policies must consider declared and inferred intents; and telemetry must enable post-hoc verifiability of agent behavior (Cloud Native Computing Foundation, 2024; SPIFFE Working Group, 2024). Concurrently, decentralized identity standards such as W3C Decentralized Identifiers (DIDs) offer promising mechanisms for cross-domain identity interoperability and cryptographic attestations, but integrating DIDs with runtime service identities (SPIFFE) and intent semantics requires architectural clarity (W3C, 2023).

This article addresses the literature gap by presenting a full, publication-ready Intent-Aware Zero-Trust Identity Architecture (IA-ZTIA) for agentic AI workloads that unifies human and machine access through intent semantics, runtime identities, decentralized attestations, and auditable logs. While prior research has proposed identity frameworks for agentic AI at varying levels of abstraction (Hasan, 2024; Syros et al., 2025; Huang et al., 2025), there remains a lack of a detailed, implementable architecture that maps standards and operational practices (SPIFFE/SPIRE, DIDs, conditional access policies, credential lifecycle management) into a cohesive end-to-end model. The present work synthesizes theoretical and practical contributions across standards, security research, and operational engineering to fill that gap (Reyes & Nakamoto, 2025; Nishida, 2024; Microsoft, 2024).

The remainder of this article lays out the methodology used to design IA-ZTIA, describes the architecture and its component mappings in depth, performs a descriptive evaluation against agentic threat taxonomies and operational concerns, and concludes with a critical

discussion on limitations, governance, and avenues for future research.

## METHODOLOGY

The methodology followed a synthesis-driven systems design approach: integrating conceptual foundations, standards, and empirical security findings into an architecture that is simultaneously principled and operational. The approach consisted of four interwoven activities.

First, standards and runtime primitives relevant to production identity and decentralized attestations were analyzed. SPIFFE and SPIRE provide workload identities and runtime issuance mechanisms for short-lived service identity tokens (Cloud Native Computing Foundation, 2024; SPIFFE Working Group, 2024). W3C DIDs specify how entities can control decentralized cryptographic identifiers and present verifiable credentials (W3C, 2023). These primitives were examined for capabilities and gaps in representing intent and provenance for agentic actions.

Second, threat modeling and identity risk taxonomies for agentic systems were collected and mapped. OWASP's AI Threat Modeling Project, Agent Risk Categorization Guide, and Multi-Agentic System Threat Modeling Guide were used to identify attacker capabilities, agent misbehavior modes, and risk vectors unique to multi-agent settings (OWASP, 2024; OWASP, 2024; OWASP, 2025). Additionally, recent literature on zero-trust identity for AI workloads, credential lifecycle in IIoT, and behavioral anomaly detection informed risk mitigation strategies (Huang et al., 2025; Nishida, 2024; Ahmed & Ray, 2024).

Third, identity, policy, and assurance building blocks were designed and composed into a layered architecture. Components were chosen to be standards-aligning and implementable using existing production tools where possible. Key design constraints included: (1) preserving least privilege through intent scoping, (2) ensuring runtime identities are short-lived and cryptographically anchored, (3) enabling cross-domain attestation via DIDs and verifiable credentials, and (4) producing cryptographically signed telemetry for non-repudiable audits (Reyes & Nakamoto, 2025; Nishida, 2024; Li & Zhao, 2025).

Fourth, the architecture was qualitatively evaluated. This evaluation mapped IA-ZTIA's controls to OWASP agentic threat scenarios, to known identity failure modes documented in the literature, and to operational practices such as conditional access and credential lifecycle management (OWASP, 2024; Microsoft, 2024; Nishida, 2024). Where possible, cost and performance trade-offs were considered at the conceptual level, along with governance and trust federation implications highlighted in recent research (Syros et al., 2025; Huang et al., 2025).

Throughout this process, the design was oriented toward practical deployability: mapping high-level concepts to SPIFFE/SPIRE runtime identity claims, DID attestations, policy decision points, and cryptographic logging primitives — thereby helping practitioners move from theory to implementation without introducing unrealistic dependencies.

## RESULTS

The result is the Intent-Aware Zero-Trust Identity Architecture (IA-ZTIA), a layered design that operationalizes intent semantics alongside cryptographically anchored runtime identities and decentralized attestations. The architecture comprises six interdependent layers: Bootstrapping and Trust Anchors; Identity Provisioning and Attestation; Intent Specification and Policy Authoring; Runtime Enforcement and Credential Management; Telemetry, Audit, and Forensics; and Governance, Federation, and Revocation. Each layer is described in depth below, along with mappings to standards and practical mechanisms, and with explicit threat mitigations.

### Bootstrapping and Trust Anchors

Bootstrapping establishes foundational trust roots, governance boundaries, and initial identity anchors for both human and machine actors. A robust bootstrapping process must consider organizational governance, root of trust anchors, and cross-organizational trust agreements.

Trust Anchors and Root of Trust: IA-ZTIA recommends using established organizational PKI roots combined with DID controllers for cross-domain identity (W3C, 2023; Cloud Native Computing Foundation, 2024). For internal machine identities, SPIFFE trust bundles provide

a pragmatic root for workload identity verification. DIDs provide a mechanism for entities external to the organization to present cryptographic identity proofs without relying on a centralized PKI, enabling decentralized attestation chains for third-party agents (W3C, 2023).

Governance and Policy Roots: Governance documents define who can issue credentials, the schema for intent assertions, and policy templates. Governance must define an attestation hierarchy: what classes of agents may request what kinds of intent claims, which authorities may sign those claims as verifiable credentials, and under what lifecycle constraints. This follows the recommendation to combine role-oriented IAM with intent-based control policies to scale securely (Li & Zhao, 2025; Kim & Ganek, 2024).

Threat mitigations in this layer include restricting root signing privileges to hardware-protected keys, requiring multi-party approval for cross-domain attestation anchors, and recording bootstrapping events in tamper-evident logs (Reyes & Nakamoto, 2025).

**Identity Provisioning and Attestation**

Provisioning for agentic AI must account for few fundamental distinctions: human identities (longer lived, typically registered with enterprise IAM), service/workload identities (short-lived, machine-issued), and agent identities (agents that possess attributes such as intended capabilities, training provenance, and operational constraints). IA-ZTIA prescribes a hybrid model.

SPIFFE/SPIRE for Runtime Workload Identity: Use SPIFFE identifiers (spiffe://) to represent runtime service identities; SPIRE servers issue short-lived X.509 or JWT SVIDs (SPIFFE Verifiable Identity Documents) to workloads at boot or invocation (Cloud Native Computing Foundation, 2024; SPIFFE Working Group, 2024). This achieves ephemeral identities aligned with Zero Trust principles (Achanta, 2025).

DIDs and Verifiable Credentials for Attestations: Attestations that go beyond ephemeral runtime claims — such as training data provenance, model lineage, and regulatory compliance claims — should be expressed as verifiable credentials bound to DIDs (W3C, 2023). For third-party attestation (e.g., audit reports, model certificates), DIDs enable a decentralized signing structure where multiple authorities can assert distinct attributes without centralized federation (W3C, 2023).

Agent Profiles and Intent Claims: An agent's profile contains immutable attributes (e.g., model hash, vendor DID, provenance credentials), mutable attributes (e.g., current intent scope, risk score), and operational constraints (e.g., allowed resource domains). The IA-ZTIA model encodes declared intent as a first-class attribute carried as a verifiable credential or SVID extension. Intent claims are typed, time-bounded, and scoping: they declare "what" the agent intends to do, "why," "on whose behalf," and for "how long" (Hasan, 2024; Kim & Ganek, 2024).

Threat mitigations include requiring multi-factor attestation for high-risk agent profiles, using hardware-backed signing for critical claims, and controlling the issuance of long-term credentials to reduce theft window (Nishida, 2024; Reyes & Nakamoto, 2025).

**Intent Specification and Policy Authoring**

One of the central contributions of IA-ZTIA is the elevation of intent into policy definitions and enforcement logic. Intent-aware policies provide finer granularity than role or attribute-based policies because intent encodes expected behavior, not just identity or role.

Intent Modeling: Intent models must be machine-readable and semantically precise. An intent assertion can be structured as a JSON-LD or verifiable credential with fields for intent type (e.g., data_read, actuation, decision_service), target scope (resource identifiers or namespaces), justification or purpose, temporal bounds, and confidence levels. Specifying intent at varying abstraction levels supports both coarse safety gates and fine-grained enforcement (Hasan, 2024; Li & Zhao, 2025).

Policy Types: IA-ZTIA differentiates three complementary policy types: declarative intent authorization policies (what intents are permitted for a given agent profile), runtime constraint policies (e.g., rate limits, resource quotas, environment constraints), and behavioral expectations (expected telemetry patterns or decision distributions). Declarative policies are evaluated at policy decision points (PDPs) while

runtime constraints are enforced at policy enforcement points (PEPs) embedded in service meshes or API gateways (Microsoft, 2024).

Mapping to Conditional Access Paradigms: Microsoft's Conditional Access constructs demonstrate how contextual conditions and signals can control access dynamically; IA-ZTIA extends this paradigm to include agent intent and agent risk signals as first-class inputs to policy decisions (Microsoft, 2024; Li & Zhao, 2025).

Threat mitigations include expressing deny-by-default policies for unrecognized intent types, requiring explicit approval flows for high-risk intents, and integrating anomaly detectors to flag policy deviations in real time (OWASP, 2024; Ahmed & Ray, 2024).

**Runtime Enforcement and Credential Management**

Operational enforcement must be practical and compatible with contemporary cloud and edge infrastructures.

Enforcement Points: Policy enforcement is implemented at multiple layers: service mesh sidecars (for microservices), API gateways (for external interfaces), edge runtime agents (for IIoT and robotics), and host IAM agents (for human interfaces). Each enforcement locus must be capable of validating SPIFFE SVIDs, verifying DID credentials where needed, and consulting policy engines with intent contexts (SPIFFE Working Group, 2024; Nishida, 2024).

Credential Lifecycle Management: Credential issuance, rotation, and revocation are critical, particularly for IIoT devices and long-running agents. Lifecycle best practices include short SVID lifetimes, automated rotation using SPIRE, and revocation lists or distributed revocation signals for DIDs that are recognized by federation partners (Nishida, 2024; SPIFFE Working Group, 2024). For constrained IIoT devices, hardware-rooted keys and offline attestation workflows are recommended (Nishida, 2024).

Least Privilege via Intent Scoping: Rather than granting broad roles or capabilities, IA-ZTIA recommends issuing narrowly scoped, intent-bound credentials that enforce least privilege. For example, an agent granted the "data_read" intent for a given dataset receives an SVID and a verifiable credential that encodes the dataset namespace and time bounds; PEPs reject requests that fall outside the declared intent (Bhushan et al., 2025; Kim & Ganek, 2024).

Threat mitigations include reducing the attack window via short credential lifetimes, using attestation chaining to detect compromised signing authorities, and integrating runtime attestations that prove an agent's executing code hash matches the attested model hash (Reyes & Nakamoto, 2025; Syros et al., 2025).

**Telemetry, Audit, and Forensics**

Assurance for agentic systems rests on end-to-end observability and cryptographic auditability. IA-ZTIA embeds telemetry practices and cryptographically signed logs to support non-repudiable forensic analysis.

Cryptographically Signed Logs: Building on recommendations for cryptographically verifiable logging, IA-ZTIA prescribes signing logs at the agent and enforcement boundaries and chaining signatures to produce tamper-evident audit trails. Signed logs include identity assertions (SVID or DID), declared intent, decision context, and outcome metadata. Such logs enable post-hoc correlation between intent declarations and actual actions (Reyes & Nakamoto, 2025).

Behavioral Monitoring and Anomaly Detection: Behavioral anomaly detectors analyze telemetry streams for deviations from expected patterns defined by agent profiles and declared intents. Techniques from CPS anomaly detection and behavioral analytics can flag suspicious actions, such as unexpected actuation requests or anomalous data exfiltration patterns (Ahmed & Ray, 2024; Ahmed & Ray, 2024).

Forensics and Evidence Correlation: Forensic workflows leverage correlated signed logs, model provenance credentials, and runtime attestations to reconstruct events and attribute actions to agent identities. For high-severity incidents, attestation chains can be validated by third parties using DID registries and verifiable credential issuers (W3C, 2023; Reyes & Nakamoto, 2025).

Threat mitigations include requiring signed evidence before automated revocation, separating logging authorities to reduce single-point compromise, and

using secure enclaves for log signing for high-assurance workloads (Reyes & Nakamoto, 2025; Nishida, 2024).

**Governance, Federation, and Revocation**

Agentic ecosystems often span organizational boundaries; trust federation and governance frameworks are therefore essential.

Federated Attestation Ecosystems: DIDs and verifiable credentials enable cross-organization attestation without centralized authorities. Governance frameworks must define accepted credential schemas, revocation processes, and mutual recognition policies. Cross-organization agreements can codify which credential issuers are trusted for specific intent types (W3C, 2023; Syros et al., 2025).

Revocation Mechanisms: Rapid revocation is imperative when agents compromise or misbehave. IA-ZTIA supports a layered revocation strategy: short SVID lifetimes, active revocation signaling for SPIRE trust bundles, and DID revocation registries or revocation credentials for persistent attestations (SPIFFE Working Group, 2024; W3C, 2023). Operational mechanisms should minimize latency between revocation decision and enforcement across federated domains.

Compliance and Oversight: Governance must also embed compliance checklists for regulated sectors (e.g., safety critical CPS), specify audit frequencies, and delineate reporting requirements for incidents related to agentic action (Nishida, 2024; Ahmed & Ray, 2024).

Threat mitigations at this layer include multi-party governance for critical trust anchors, staged revocation protocols to reduce false positives, and third-party attestation oversight for high-risk intents (Syros et al., 2025; Huang et al., 2025).

**Qualitative Threat Mapping and Comparative Analysis**

To validate IA-ZTIA's coverage, its controls were qualitatively mapped to OWASP's agent risk categories and multi-agent threat models (OWASP, 2024; OWASP, 2025). IA-ZTIA addresses major threat classes as follows.

Unauthorized Action and Privilege Escalation: Intent scoping and least-privilege credentialing reduce the chance that an agent can perform actions outside its declared purpose (Bhushan et al., 2025; Li & Zhao, 2025). Ephemeral SVIDs shorten the timeframe for abuse (SPIFFE Working Group, 2024).

False Attestation and Supply-Chain Deception: DID-based verifiable credentials tied to provenance information, combined with model hash attestations in agent profiles, raise the bar against supply-chain manipulation and false attestation (W3C, 2023; Syros et al., 2025).

Data Exfiltration and Misuse: Runtime enforcement points analyze intent and telemetry; behavioral anomaly detection provides secondary controls to detect exfiltration patterns. Declarative policies can impose transfer constraints, and deny-by-default rules prevent unanticipated cross-domain flows (OWASP, 2024; Ahmed & Ray, 2024).

Collusion and Multi-Agent Misbehavior: Multi-agent threat modeling highlights collusion risks where multiple agents coordinate to bypass policies. IA-ZTIA mitigates collusion by requiring cross-agent attestations for coordinated high-risk intents and by limiting the composition of intents across trust boundaries unless explicitly authorized under governance frameworks (OWASP, 2025; Syros et al., 2025).

Comparative analysis with recent proposals shows that IA-ZTIA uniquely ties intent semantics directly into the identity fabric and prescribes operational mappings to SPIFFE/SPIRE and DIDs, whereas other proposals emphasize either Zero Trust identity primitives or decentralized identity without the same level of intent integration (Huang et al., 2025; Syros et al., 2025; Hasan, 2024).

Operational Considerations and Implementation Patterns

To support practitioners, IA-ZTIA offers several implementation patterns and operational considerations.

Pattern 1 — Edge Robotics: For an industrial robot agent, an IIoT gateway issues a short-lived SPIFFE SVID at task start and attaches a verifiable credential asserting the task intent (e.g., "actuate valve group A for maintenance window"). Edge enforcement agents validate the SVID and the intent credential before permitting actuation. Telemetry signed by the robot's

hardware key is sent to an audit collector for correlation (Nishida, 2024; Kim & Ganek, 2024).

Pattern 2 — Cross-Cloud Data Processing Agent: A data processing agent runs across federated clouds. It presents a SPIFFE identity in the execution environment and a DID-bound verifiable credential asserting data provenance compliance (e.g., consent assertions). Policy engines at cloud gateways enforce data residency and processing limits, and cryptographically signed logs ensure non-repudiable evidence of processing steps (W3C, 2023; Microsoft, 2024).

Pattern 3 — Delegated Human-On-Behalf Agent: An agent acting on behalf of a human user declares both the user's DID and the user's consent intent. Conditional access policies evaluate the user's risk signals and the agent's intent before allowing sensitive actions, ensuring that acts performed by agents remain auditable and constrained by the user's entitlements (Li & Zhao, 2025; Microsoft, 2024).

Operational trade-offs include latency introduced by attestation checks, complexity of managing DID registries across partners, and the need for tooling to author intent schemas and policies. IA-ZTIA recommends staged adoption: begin with SPIFFE for intra-domain workload identity and then incrementally add DID-based attestations for cross-domain claims and intent credentialing (SPIFFE Working Group, 2024; W3C, 2023).

## DISCUSSION

IA-ZTIA advances the discourse on identity and access for agentic AI by explicitly integrating intent as a core identity attribute and by mapping intent semantics to implementable primitives (SPIFFE, DIDs, verifiable credentials, and cryptographic logs). This section critically reflects on the theoretical implications, potential limitations, and key research directions.

### Theoretical Implications

Elevating intent reframes access control from static possession of privileges to dynamic adherence to declared purpose. This shift aligns access control more closely with normative and legal constructs — for example, purpose limitation in privacy law — and offers a clearer substrate for regulatory compliance and accountability (Hasan, 2024; Li & Zhao, 2025). The use of verifiable credentials to carry intent metadata is theoretically appealing because it supports non-repudiable declarations that can be independently validated and audited (W3C, 2023; Reyes & Nakamoto, 2025).

Furthermore, melding ephemeral runtime identities with persistent attestations reconciles two temporalities: the short-lived operational identity needed for Zero Trust enforcement and the longer-term provenance attestations required for governance and compliance. This duality echoes broader trends in security architecture that favor ephemeral runtime credentials anchored to durable provenance records (Cloud Native Computing Foundation, 2024; Nishida, 2024).

### Limitations and Practical Challenges

Despite its conceptual strengths, IA-ZTIA faces several practical challenges.

Standards and Interoperability: While SPIFFE and W3C DIDs are mature directions, standardizing intent schemas is a non-trivial social and technical problem. Without shared intent ontologies, the utility of intent credentials across organizations will be limited (W3C, 2023; Hasan, 2024).

Scalability and Performance: Intent verification, DID resolution, and cryptographic log verification introduce latency. For high-throughput systems, carefully engineered caching, selective verification, and trust acceleration mechanisms will be needed to avoid performance bottlenecks (SPIFFE Working Group, 2024; Nishida, 2024).

Behavioral Detection Accuracy: Behavioral anomaly detection is inherently probabilistic and risks false positives that could interrupt legitimate agent actions, and false negatives could miss malicious behavior. Robust operational baselines and human-in-the-loop escalation patterns are necessary to manage these trade-offs (Ahmed & Ray, 2024; OWASP, 2024).

Governance Complexity: Federating attestations across organizations introduces governance friction. Agreeing on credential issuers, schema versions, and revocation semantics requires legal and operational commitments

that may be difficult to secure (Syros et al., 2025; W3C, 2023).

Attack Surface Considerations: Introducing new artifacts (intent credentials, DID registries) can expand the attack surface if not hardened. Protecting key material, ensuring resilient resolution services, and guarding against credential replay are essential (Reyes & Nakamoto, 2025; Nishida, 2024).

**Future Research Agenda**

Addressing IA-ZTIA's limitations opens several research avenues.

Intent Ontologies and Interoperability: Research is needed to design practical, extensible intent ontologies for common classes of agentic activity, balancing expressivity with parsability and privacy protection. Community governance (similar to standards bodies) could steward intent schema evolution (Hasan, 2024; W3C, 2023).

Empirical Evaluation: Field studies and benchmarks should evaluate latency, failure modes, and security gains from intent-aware access compared with traditional role-based or attribute-based controls. Such empirical work will inform practical tuning and adoption patterns (SPIFFE Working Group, 2024; Nishida, 2024).

Behavioral Assurance Algorithms: Advances in anomaly detection algorithms that are explainable and calibrated to avoid high false positive rates are critical. Research into combining intent metadata with causal behavioral models could yield more trustworthy detectors (Ahmed & Ray, 2024).

Revocation and Trust Dynamics: Efficient revocation mechanisms for verifiable credentials in federated settings remain an open problem. Research into distributed, low-latency revocation signaling and soft revocation semantics will be valuable (W3C, 2023; Reyes & Nakamoto, 2025).

Policy Authoring Tools and Usability: Human factors research is necessary to develop policy authoring languages and tools that allow security engineers and application owners to express intent policies correctly and manage exceptions safely (Li & Zhao, 2025).

**CONCLUSION**

Agentic AI demands identity architectures that transcend human-centric IAM and static role assignments. IA-ZTIA offers a practical, standards-aware blueprint for an Intent-Aware Zero-Trust Identity Architecture that unites ephemeral runtime identities (SPIFFE/SPIRE), decentralized attestations (DIDs and verifiable credentials), intent-scoped policies, and cryptographically auditable telemetry. The architecture reduces attack surface by enforcing least privilege through intent scoping, improves auditability via signed logs, and supports cross-organizational attestation through DIDs.

Operationalizing IA-ZTIA will require attention to performance engineering, intent schema standardization, careful credential lifecycle management for IIoT and edge agents, and governance models for federated attestation. Future research should prioritize empirical evaluations, interoperability protocols for intent, and behavioral assurance algorithms that integrate intent metadata.

The work presented here is a synthesis of contemporary standards and research — it is intended as a foundation for practitioners and researchers to iterate on, implement, and evaluate in real-world settings. By making intent a first-class citizen of identity, IA-ZTIA aims to enable safer, more accountable, and auditable agentic systems that can operate across modern distributed infrastructures.

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