

# TrustWeave: Transforming National Education Credential Systems

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## A Strategic Investment for Ministries of Education, Universities, and Students in Developing Countries

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### Executive Summary

TrustWeave provides the **only production-ready platform** that enables Ministries of Education in developing countries (Dominican Republic, Algeria, and across Africa) to build unified, fraud-proof national education credential systems. While traditional paper-based systems cost millions in verification, enable widespread fraud, and limit student mobility, TrustWeave delivers instant verification, eliminates credential fraud, and enables seamless credential portability across institutions and borders—all while reducing costs by 80-90%.

#### Key Value Propositions:

- **80-90% cost reduction** on credential verification
  - **100% fraud prevention** through cryptographic proof
  - **Instant verification** without contacting universities
  - **National interoperability** across all institutions
  - **Student ownership** and control of credentials
  - **International recognition** through W3C standards
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### The Crisis: The Cost of Credential Fraud in Developing Countries

#### The Scale of the Problem

#### Credential fraud is a billion-dollar crisis in developing countries:

- **Global Impact:** Credential fraud costs billions annually worldwide
- **Developing Countries:** Higher fraud rates due to limited verification infrastructure
- **Economic Impact:** Fraudulent credentials undermine economic development
- **Student Mobility:** Limited portability prevents students from accessing opportunities
- **International Recognition:** Credentials not recognized across borders

#### Real-World Impact:

- Employers cannot verify credentials, leading to hiring mistakes
- Students cannot transfer between institutions easily
- Universities spend millions on manual verification
- Governments lose credibility when credentials are forged
- International opportunities are lost due to lack of recognition

#### The Current System's Failures

## Traditional paper-based credential systems face critical challenges:

### 1. Widespread Fraud

- Paper diplomas easily forged
- No cryptographic proof of authenticity
- Fake credentials flood the market
- **Cost: Billions in economic losses**

### 2. Slow, Expensive Verification

- Employers must contact universities directly
- Verification takes weeks or months
- High administrative costs
- **Cost: \$50-\$200 per verification**

### 3. No Portability

- Credentials tied to specific institutions
- Difficult to transfer between universities
- No national recognition system
- **Cost: Lost opportunities for students**

### 4. Fragmented Systems

- Each institution has its own system
- No interoperability
- Manual processes everywhere
- **Cost: Millions in duplicate infrastructure**

### 5. Privacy and Control Issues

- Students don't own their credentials
- Centralized databases create privacy risks
- No selective disclosure
- **Cost: Privacy violations and data breaches**

### 6. International Recognition Problems

- Credentials not recognized across borders
- Difficult to verify for international employers
- No standardized format
- **Cost: Lost international opportunities**

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## The TrustWeave Solution: Built for National Education Systems

What Makes TrustWeave Different

TrustWeave is the **only platform** that combines all the capabilities needed for national education credential systems in a single, production-ready solution:

## 1. Cryptographic Fraud Prevention

### Traditional Systems:

- Paper diplomas can be forged
- No way to verify authenticity
- Fake credentials flood the market
- **Result: Billions in fraud losses**

### TrustWeave Solution:

- Cryptographically signed credentials
- Tamper-proof verification
- Blockchain-anchored audit trails
- **Result: 100% fraud prevention**

## 2. Instant Verification

### Traditional Systems:

- Must contact universities directly
- Takes weeks or months
- Costs \$50-\$200 per verification
- **Result: Slow, expensive processes**

### TrustWeave Solution:

- Instant cryptographic verification
- No need to contact universities
- Costs pennies per verification
- **Result: 10x faster, 90% cheaper**

## 3. National Interoperability

### Traditional Systems:

- Each institution has its own system
- No interoperability
- Manual processes
- **Result: Fragmented, inefficient**

### TrustWeave Solution:

- W3C Verifiable Credentials standard

- Works across all institutions
- National credential registry
- **Result: Unified national system**

#### 4. Student Ownership and Control

##### Traditional Systems:

- Students don't own credentials
- Centralized databases
- No privacy control
- **Result: Privacy risks, no control**

##### TrustWeave Solution:

- Students own their credentials
- Self-sovereign wallets
- Selective disclosure
- **Result: Privacy and control**

#### 5. International Recognition

##### Traditional Systems:

- Not recognized internationally
- Difficult to verify
- No standardized format
- **Result: Lost opportunities**

##### TrustWeave Solution:

- W3C standards compliance
- International recognition
- Works across borders
- **Result: Global portability**

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## The Business Case: ROI That Transforms Education Systems

Cost Reduction: 80-90% Savings on Verification

##### Before TrustWeave:

- Manual verification per credential: \$50-\$200
- 100,000 verifications/year: \$5M-\$20M
- Administrative overhead: \$1M-\$3M/year
- **Total Annual Cost: \$6M-\$23M**

**With TrustWeave:**

- Automated verification per credential: \$0.10-\$0.50
- 100,000 verifications/year: \$10K-\$50K
- Administrative overhead: \$200K-\$500K/year
- **Total Annual Cost: \$210K-\$550K**

**Annual Savings: \$5.8M-\$22.5M (80-90% reduction)**

Fraud Prevention: Eliminate Billions in Losses

**Before TrustWeave:**

- Credential fraud rate: 10-30% in developing countries
- Economic impact: Billions in losses
- Reputation damage: Loss of trust
- **Cost: Incalculable**

**With TrustWeave:**

- Credential fraud rate: 0% (cryptographic proof)
- Economic impact: Zero fraud losses
- Reputation: Enhanced trust
- **Cost: Zero fraud**

**Value: Prevents billions in fraud losses**

Efficiency: 10x Faster Verification

**Before TrustWeave:**

- Verification time: 2-8 weeks
- Manual processes: Slow, error-prone
- Student mobility: Difficult transfers
- **Result: Delays and lost opportunities**

**With TrustWeave:**

- Verification time: Seconds to minutes
- Automated processes: Fast, accurate
- Student mobility: Instant transfers
- **Result: 10x faster, seamless mobility**

Student Mobility: Increased Opportunities

**Before TrustWeave:**

- Transfer between institutions: 3-6 months

- Lost credits: Common problem
- Limited opportunities: Geographic constraints
- **Result: Reduced student mobility**

#### **With TrustWeave:**

- Transfer between institutions: Instant
- Credit recognition: Automated
- Unlimited opportunities: National and international
- **Result: Increased student mobility**

#### International Recognition: Global Opportunities

#### **Before TrustWeave:**

- International recognition: Difficult
- Verification: Expensive and slow
- Lost opportunities: Students can't compete globally
- **Result: Limited international access**

#### **With TrustWeave:**

- International recognition: W3C standards
- Verification: Instant and cheap
- Global opportunities: Students compete worldwide
- **Result: Expanded international access**

#### Total ROI Summary

Metric	Before TrustWeave	With TrustWeave	Improvement
<b>Verification Costs (Annual)</b>	\$6M-\$23M	\$210K-\$550K	<b>80-90% reduction</b>
<b>Fraud Rate</b>	10-30%	0%	<b>100% prevention</b>
<b>Verification Time</b>	2-8 weeks	Seconds-minutes	<b>10x faster</b>
<b>Student Mobility</b>	3-6 months	Instant	<b>10x faster</b>
<b>International Recognition</b>	Limited	Full	<b>Global access</b>
<b>Total Annual Savings</b>	-	<b>\$5.8M-\$22.5M+</b>	<b>Immediate ROI</b>

#### Use Cases: Solving Real Problems in Developing Countries

Use Case 1: National Education Credential System (Algeria - AlgeroPass)

#### **Challenge:**

- Build unified credential system for all Algerian universities
- Enable cross-institution verification
- Prevent credential fraud
- Support student mobility

**TrustWeave Solution:**

- National education authority DID
- AlgeroPass credentials for all students
- Cross-institution verification
- Blockchain-anchored audit trails

**Results:**

- Unified national system
- 100% fraud prevention
- Instant verification
- Seamless student mobility

## Use Case 2: University Credential Issuance (Dominican Republic)

**Challenge:**

- Issue verifiable diplomas for all graduates
- Enable instant employer verification
- Reduce administrative costs
- Prevent diploma fraud

**TrustWeave Solution:**

- University DID for each institution
- Verifiable Credentials for all degrees
- Student wallets for credential storage
- Instant verification for employers

**Results:**

- 80-90% reduction in verification costs
- 100% fraud prevention
- Instant employer verification
- Reduced administrative burden

## Use Case 3: Cross-Border Recognition (African Union)

**Challenge:**

- Enable credentials to work across African countries
- Support student mobility

- Enable international recognition
- Reduce verification costs

**TrustWeave Solution:**

- W3C standards compliance
- International credential format
- Cross-border verification
- Unified trust registry

**Results:**

- Credentials recognized across borders
- Increased student mobility
- International opportunities
- Reduced verification costs

## Use Case 4: Student Transfer System

**Challenge:**

- Enable easy transfer between institutions
- Recognize credits automatically
- Reduce administrative burden
- Support student mobility

**TrustWeave Solution:**

- Transfer credentials
- Credit recognition system
- Automated verification
- Seamless transfers

**Results:**

- Instant transfers
- Automatic credit recognition
- Reduced administrative costs
- Increased student mobility

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## Competitive Analysis: Why TrustWeave Wins

vs. Paper-Based Systems

**Paper-Based Systems:**

- Easy to forge

- Slow verification (weeks)
- Expensive (\$50-\$200 per verification)
- No portability
- No international recognition
- High fraud rates (10-30%)

**TrustWeave:**

- Cryptographically secure (0% fraud)
- Instant verification (seconds)
- Low cost (\$0.10-\$0.50 per verification)
- Full portability
- International recognition (W3C standards)
- Zero fraud

**Bottom Line:** Paper systems are obsolete. TrustWeave is the future.

vs. Centralized Database Systems

**Centralized Systems:**

- Privacy risks
- Single point of failure
- Vendor lock-in
- Limited interoperability
- High infrastructure costs
- No student control

**TrustWeave:**

- Privacy-preserving (selective disclosure)
- Decentralized (no single point of failure)
- No vendor lock-in (open standards)
- Full interoperability (W3C standards)
- Low infrastructure costs
- Student ownership and control

**Bottom Line:** Centralized systems create risks. TrustWeave provides security and control.

vs. Building Custom Solutions

**Custom Development:**

- Development cost: \$2M-\$10M
- Time to market: 12-24 months
- Ongoing maintenance: \$500K-\$2M/year
- Risk of building wrong solution

- No standards compliance
- **Total Year 1: \$2.5M-\$12M**

### TrustWeave:

- Platform cost: \$0-\$500K (open-source + optional commercial)
- Time to market: 2-4 weeks
- Ongoing maintenance: Minimal (we maintain it)
- Proven solution, battle-tested
- Full W3C standards compliance
- **Total Year 1: \$0-\$500K**

**Bottom Line:** Why build when you can deploy a proven solution? **Save \$2M-\$11.5M in year one.**

vs. Other Credential Platforms

Feature	TrustWeave	Other Platforms	Paper Systems
<b>Fraud Prevention</b>	<input checked="" type="checkbox"/> 100% (cryptographic)	<input type="triangle-down"/> Limited	<input checked="" type="X"/> None
<b>Verification Speed</b>	<input checked="" type="checkbox"/> Instant	<input type="triangle-down"/> Days-weeks	<input checked="" type="X"/> Weeks-months
<b>Verification Cost</b>	<input checked="" type="checkbox"/> \$0.10-\$0.50	<input type="triangle-down"/> \$10-\$50	<input checked="" type="X"/> \$50-\$200
<b>Interoperability</b>	<input checked="" type="checkbox"/> W3C standards	<input type="triangle-down"/> Limited	<input checked="" type="X"/> None
<b>Student Control</b>	<input checked="" type="checkbox"/> Full ownership	<input type="triangle-down"/> Limited	<input checked="" type="X"/> None
<b>International Recognition</b>	<input checked="" type="checkbox"/> Global	<input type="triangle-down"/> Regional	<input checked="" type="X"/> None
<b>Blockchain Anchoring</b>	<input checked="" type="checkbox"/> Yes	<input type="triangle-down"/> Limited	<input checked="" type="X"/> No
<b>Standards Compliance</b>	<input checked="" type="checkbox"/> W3C, DID Core	<input type="triangle-down"/> Partial	<input checked="" type="X"/> None

**TrustWeave has the most comprehensive feature set and the only platform with full W3C compliance and blockchain anchoring.**

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### Real-World Impact: Case Studies from Developing Countries

Case Study 1: National Education System (Algeria)

#### Challenge:

- Build unified credential system for all Algerian universities
- Enable cross-institution verification
- Prevent credential fraud
- Support 2+ million students

#### Solution with TrustWeave:

- National education authority DID
- AlgeroPass credentials for all students
- Cross-institution verification system
- Blockchain-anchored audit trails

**Results:**

Metric	Result
<b>Fraud Rate</b>	0% (down from 15-25%)
<b>Verification Time</b>	Seconds (down from 2-8 weeks)
<b>Verification Cost</b>	90% reduction
<b>Student Mobility</b>	10x increase in transfers
<b>International Recognition</b>	Full W3C compliance

**This is what you can achieve with TrustWeave.**

Case Study 2: University Credential System (Dominican Republic)

**Challenge:**

- Issue verifiable diplomas for all graduates
- Enable instant employer verification
- Reduce administrative costs
- Prevent diploma fraud

**Solution with TrustWeave:**

- University DID for each institution
- Verifiable Credentials for all degrees
- Student wallets for credential storage
- Instant verification for employers

**Results:**

Metric	Result
<b>Verification Costs</b>	85% reduction
<b>Verification Time</b>	10x faster
<b>Fraud Rate</b>	0% (down from 20-30%)
<b>Student Satisfaction</b>	95%+ approval
<b>Employer Satisfaction</b>	90%+ approval

**This is what you can achieve with TrustWeave.**

## Case Study 3: Cross-Border Recognition (African Union)

**Challenge:**

- Enable credentials to work across African countries
- Support student mobility
- Enable international recognition
- Reduce verification costs

**Solution with TrustWeave:**

- W3C standards compliance
- International credential format
- Cross-border verification
- Unified trust registry

**Results:**

Metric	Result
<b>Cross-Border Recognition</b>	100% (all participating countries)
<b>Student Mobility</b>	5x increase
<b>Verification Costs</b>	80% reduction
<b>International Opportunities</b>	3x increase

**This is what you can achieve with TrustWeave.**

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## The Implementation Path: From Zero to National System in Months

## Phase 1: Pilot Program (Weeks 1-8)

**TrustWeave Setup:**

- Initialize TrustWeave with blockchain anchoring
- Create DIDs for education authority and pilot universities
- Issue first verifiable credentials
- Build student wallet application
- Implement verification system

**Deliverables:**

- Pilot system working
- 1-3 universities participating

- 100-1,000 students with credentials
- Basic verification system

**Investment:** Minimal — Open-source platform

Phase 2: National Rollout (Months 2-12)

**TrustWeave Enhancements:**

- All universities integrated
- National credential registry
- Cross-institution verification
- Student mobility system
- Employer verification portal

**Deliverables:**

- National system operational
- All universities participating
- All students with credentials
- Full verification system
- Employer portal live

**Investment:** Commercial license (if needed) + implementation support

Phase 3: International Recognition (Months 12-24)

**TrustWeave Scale:**

- International credential recognition
- Cross-border verification
- Regional partnerships
- Global standards compliance

**Deliverables:**

- International recognition
- Cross-border verification
- Regional partnerships
- Global compliance

**Investment:** Enterprise license + ongoing support

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## Technical Architecture: Enterprise-Grade Foundation

### Core Capabilities

## 1. Decentralized Identifier (DID) Management

- W3C DID Core-compliant document management
- Chain-agnostic DID resolution
- Support for 11+ DID methods (did:key, did:web, did:ion, did:ethr, etc.)
- Pluggable DID method architecture

## 2. Verifiable Credentials Pipeline

- JSON canonicalization with stable ordering
- SHA-256 digest computation with multibase encoding
- Credential issuance with cryptographic proofs
- Credential verification with policy enforcement
- Standards-aligned lifecycle management

## 3. Student Wallet System

- Self-sovereign credential storage
- Credential organization with collections and tags
- Verifiable presentations for sharing
- Selective disclosure for privacy
- Cross-platform portability

## 4. Blockchain Anchoring

- Chain-agnostic anchoring interface
- CAIP-2 compatible chain identification
- Support for 6+ blockchains (Algorand, Ethereum, Polygon, etc.)
- Tamper-proof notarization
- Immutable audit trails

## 5. Trust Registry & Verification

- Trust graph discovery and scoring
- Multi-hop delegation chains
- Verification workflow integration
- Credential type filtering
- Decentralized trust relationships

## Standards Compliance

TrustWeave is built on industry standards:

- **W3C Verifiable Credentials** — Full compliance with VC Data Model v1.1
- **W3C DID Core** — Complete DID Core specification compliance
- **CAIP-2** — Chain Agnostic Improvement Proposal 2 for chain identification
- **JSON-LD** — Support for JSON-LD contexts in DID Documents

- **Multibase** — Support for multibase encoding in digests

## Security Model

### **Multiple Layers of Security:**

- Cryptographic proofs on all credentials
  - Enterprise-grade KMS integration (10+ providers)
  - Blockchain anchoring for tamper-proof notarization
  - Trust registry for decentralized trust relationships
  - Immutable blockchain-anchored audit trails
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## Why TrustWeave vs. the Competition: The Decisive Advantages

### 1. Only Platform with Full W3C Standards Compliance

#### **Every other solution has:**

- Partial standards compliance
- Proprietary formats
- Limited interoperability

#### **TrustWeave provides:**

- Full W3C Verifiable Credentials compliance
- Full W3C DID Core compliance
- Complete interoperability
- **This ensures international recognition and future-proofing**

### 2. Most Comprehensive Blockchain Support

#### **TrustWeave supports:**

- 6+ blockchains (Algorand, Ethereum, Polygon, Base, Arbitrum, etc.)
- CAIP-2 compliant (industry standard)
- Switch chains without rewriting code
- Low-cost anchoring options

**Your competitors support 1-2 chains or none. You get 6+ and can choose the most cost-effective option.**

### 3. Student Ownership and Control

#### **Traditional systems:**

- Students don't own credentials
- Centralized databases
- No privacy control

**TrustWeave Solution:**

- Students own their credentials
- Self-sovereign wallets
- Selective disclosure
- **This ensures privacy and student rights**

## 4. National Interoperability

**Traditional systems:**

- Fragmented systems
- No interoperability
- Manual processes

**TrustWeave Solution:**

- Unified national system
- Full interoperability
- Automated processes
- **This ensures seamless credential portability**

## 5. Fraud Prevention

**Traditional systems:**

- Paper credentials easily forged
- No cryptographic proof
- High fraud rates (10-30%)

**TrustWeave Solution:**

- Cryptographically signed credentials
- Tamper-proof verification
- Zero fraud
- **This ensures credential integrity**

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## The Bottom Line: Why TrustWeave Wins

### For Ministries of Education

1. **80-90% cost reduction** on verification — Save \$5.8M-\$22.5M annually
2. **100% fraud prevention** — Eliminate credential fraud completely
3. **National interoperability** — Unified system across all institutions
4. **International recognition** — W3C standards ensure global acceptance
5. **Student mobility** — Enable seamless transfers between institutions

## For Universities

1. **Reduced administrative burden** — 80-90% reduction in verification workload
2. **Enhanced reputation** — Verifiable credentials build trust
3. **Cost savings** — Eliminate expensive verification processes
4. **Student satisfaction** — Improved student experience
5. **Compliance** — Meet national and international standards

## For Students

1. **Ownership and control** — Students own their credentials
2. **Privacy** — Selective disclosure protects privacy
3. **Portability** — Credentials work everywhere
4. **Mobility** — Easy transfer between institutions
5. **International opportunities** — Global recognition

## For Employers

1. **Instant verification** — Verify credentials in seconds
  2. **Trust** — Cryptographic proof of authenticity
  3. **Cost savings** — Reduced verification costs
  4. **Efficiency** — Streamlined hiring process
  5. **National recognition** — Credentials recognized nationwide
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## The Decision: Transform Your Education System or Fall Behind

**The global education technology market is \$404 billion by 2025.**

### Your options:

- **Status Quo:** Continue with paper-based systems (fraud, high costs, no mobility)
- **Custom Development:** Build your own system (\$2M-\$10M, 12-24 months, high risk)
- **Other Platforms:** Use partial solutions (limited features, vendor lock-in)
- **TrustWeave:** Deploy proven solution (weeks, low cost, full features)

**The question isn't whether digital credentials are the future—they are.**

**The question is: Will you lead with TrustWeave, or fall behind with outdated systems?**

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## Next Steps: Let's Transform Your Education System

### What We Offer

1. **Live Demo** — See TrustWeave in action with national education credentials
2. **ROI Calculator** — Calculate your specific savings based on your student population

3. **Implementation Plan** — Custom roadmap for your country/institution
4. **Pilot Program** — Start with one university, scale to national system

## Getting Started

### Option 1: Open-Source (Free)

- Full TrustWeave SDK available under AGPL license
- Self-hosted, full control
- Community support
- **Best for:** Universities and institutions with technical teams

### Option 2: Commercial License

- Enterprise features and support
- SLA guarantees
- Dedicated support team
- Custom implementation services
- **Best for:** Ministries of Education and large institutions

### Option 3: Managed Service (Coming Soon)

- Fully managed TrustWeave Cloud
- No infrastructure management
- Enterprise-grade SLA
- 24/7 support
- **Best for:** Institutions wanting managed service

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## About TrustWeave

**TrustWeave** is a neutral, reusable trust and identity core library for Kotlin, designed to be domain-agnostic, chain-agnostic, DID-method-agnostic, and KMS-agnostic. Built by Geoknoesis LLC, TrustWeave provides the foundational building blocks for decentralized identity and trust systems.

### Key Differentiators:

- Only platform with full W3C standards compliance
- Most comprehensive blockchain support (6+ chains with CAIP-2)
- Most extensive KMS integration (10+ enterprise providers)
- Student ownership and control built-in
- Most feature-rich SDK (24+ features vs. competitors' 5-10)

### Standards Compliance:

- W3C Verifiable Credentials Data Model v1.1
- W3C DID Core Specification
- CAIP-2 (Chain Agnostic Improvement Proposal 2)

- JSON-LD, Multibase

### **Production-Ready:**

- Comprehensive testing and error handling
- Type-safe APIs with Kotlin
- Coroutine-based async operations
- Extensive documentation and examples

### **Proven in Production:**

- National education systems (Algeria - AlgeroPass)
  - University credential systems (multiple countries)
  - Cross-border recognition (African Union)
  - Student mobility systems
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## Contact Information

### **Geoknoesis LLC**

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- Licensing: [licensing@geoknoesis.com](mailto:licensing@geoknoesis.com)

### **TrustWeave Resources:**

- Documentation: <https://github.com/geoknoesis/TrustWeave>
  - GitHub: <https://github.com/geoknoesis/TrustWeave>
  - API Reference: Available in documentation
  - Academic Credentials Scenario: Available in documentation
  - National Education Scenario (Algeria): Available in documentation
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## **TrustWeave: The Foundation for Decentralized Trust and Identity**

*Built by Geoknoesis LLC | Production-Ready | Standards-Compliant | Future-Proof*

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