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Leveraging Open Source for IEC 62443-Compliant Embedded Systems

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Introduction into IEC 62443 and the Cyber Resilience Act

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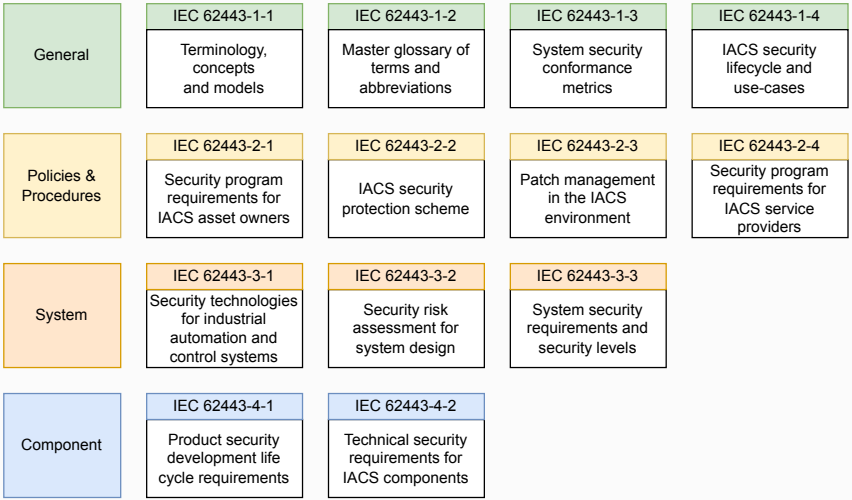

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IEC 62443-4-1 - Secure product development lifecycle requirements

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IEC 62443-4-2 - Technical security requirements for IACS components

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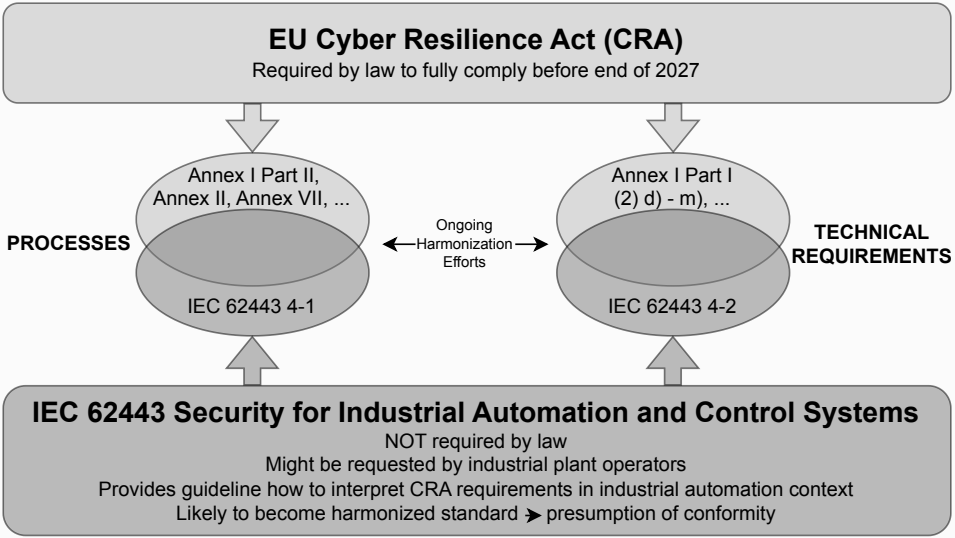

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Open Source in Industrial Automation

Collaborate on the Core, Compete on the Edges

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But is that feasible if compliance and certification is required?

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Idea: Certify a demonstrator built from open-source components

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Case Study: IEC 62443-4-2 Certification of IGLOS Secure Beacon

- Embedded device with simple application:
  Remote control of blinking LED
- Locked-down and hardened Linux system
- Fulfills all 57 applicable security requirements from 4-2
- Certified by TÜV SÜD according to IEC 62443-4-2 in Q1 2025
- Serves as blueprint to implement more complex applications

Industrial IT Security
TÜV SÜD
IACS Component
Secure Product Development Lifecycle assessed & monitored according to IEC 62443-4-1
Technical Security Requirements assessed according to IEC 62443-4-2

How is Open Source Relevant for a Product Certification?

Traceable Documentation

Technical Requirements

External Components Management

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Traceable Documentation is the Primary Evidence for Certification

IEC 62443-4-1 SM-1

A [...] process shall be documented and enforced [...] that include [...] b) product description and requirements definition with requirements traceability [...]

IEC 62443-4-1 SI-1

A process shall be employed [...] including [...] d) review of the implementation and its traceability to the security capabilities defined to support the security design [...]

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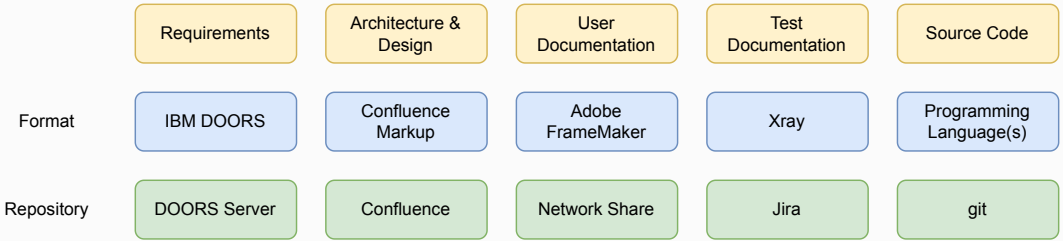
Examplary Toolset for Product Development Documentation



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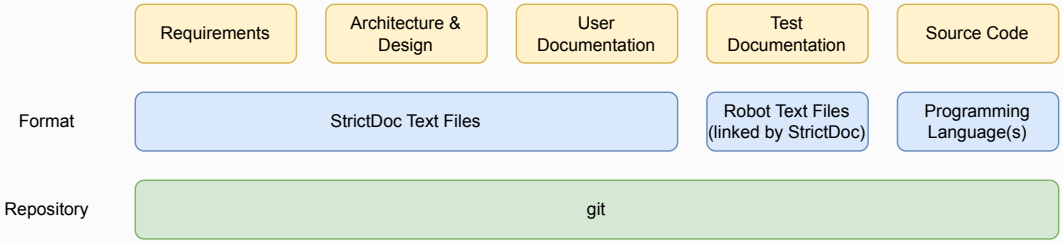
Product Development Documentation with StrictDoc



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StrictDoc Format

```
[REQUIREMENT]
MID: af79e33fb4324cccbd02fb83cdb553a1
UID: REQ-SB-DEVICE-PASSWORD-INPUT-DIALOG
TITLE: Device Password Input Dialog
TYPE: Security
STATUS: Reviewed
IMPLEMENTATION: Reviewed
STATEMENT: >>>
The [LINK: REQ-SB-INITIAL-DEVICE-PASSWORD] input dialog shall mask the password
during entry by displaying only asterisks.

On authentication failure, the UI shall present an error message that indicates
login failure without further details.
<<<
RELATIONS:
- TYPE: Parent
  VALUE: REQ-SB-COMMISSIONING-UI
- TYPE: Parent
  VALUE: REQ-SB-INITIAL-DEVICE-PASSWORD
```

Open Source for Traceable Documentation

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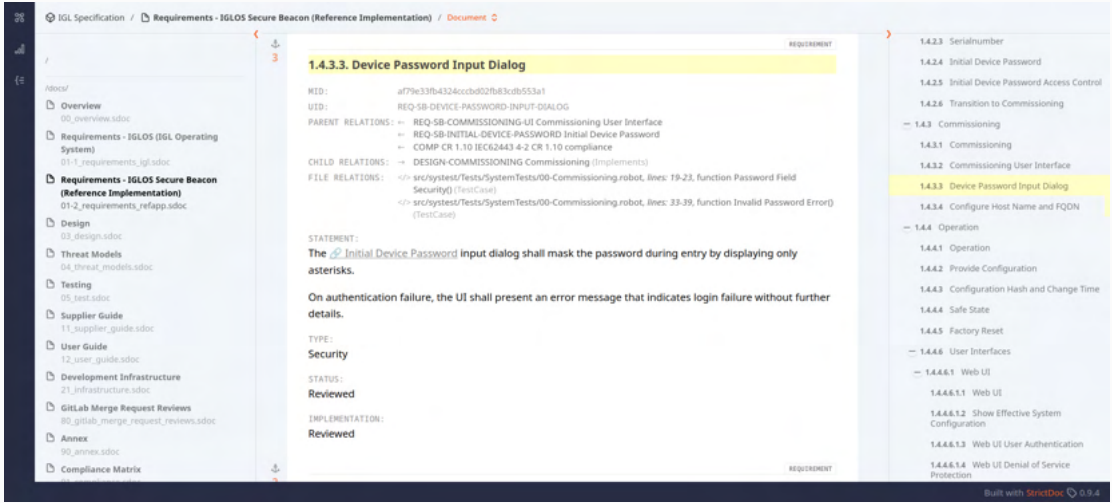

Open Source for Traceable Documentation

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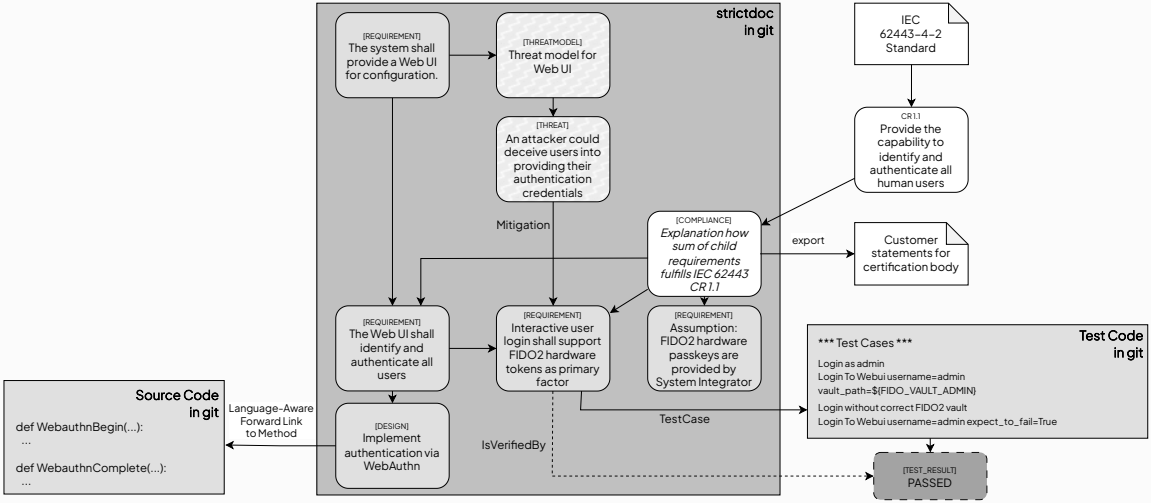

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How is Open Source Relevant for a Product Certification?

Traceable Documentation

Technical Requirements

External Components Management

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IEC 62443-4-2 EDR 3.14 - Integrity of the boot process

Embedded devices shall verify the integrity of the firmware, software, and configuration data needed for the component's boot and runtime processes prior to use.

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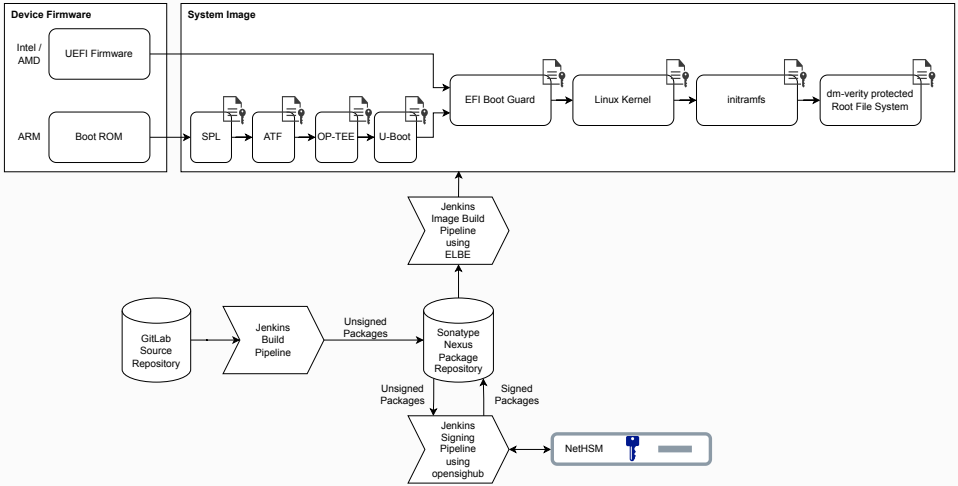
IGLOS Secure Boot Chain and Signing Infrastructure



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IEC 62443-4-1 SM-9: Security requirements for externally provided component

A process shall be employed to identify and manage the security risks of all externally provided components used within the product. [...]

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XZ Utils Backdoor

2005–2008 — Lasse Collin et al. develop the xz file compression

2021–2024 — Attacker uses social engineering to gain maintainer permissions

> **Pressure & gaining trust over years**
> Innocent patches to gain trust *and* persistent pressure on Lasse Collin (who mentions limited resources and mental health issues)

2024-02-26 — Disguised backdoor uploaded to Debian unstable (never stable!)

2024-03-28 — Version reverted after Andres Freund notices ≈ 500 ms longer login times

> **Days to detect, hours to fix**
> Broad community and access to source code enabled rapid response

Source: https://research.swtch.com/xz-timeline

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Better Use Proprietary Software?

SolarWinds Orion
Proprietary software for IT performance monitoring
Around February 2020: Attackers inject backdoor in official builds
Many large and governmental organizations highly vulnerable
About 10 months to find & publicly disclose

Realtek Jungle SDK
SDK for building network devices
CVE-2021-35392 - CVE-2021-35395, including remote code execution
Millions of attacks by botnets
Still many vulnerable devices expected today

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Better Develop Everything Yourself?

📱 WhatsApp

Remote code execution via custom MP4 parsing
CVE-2019-11931

💿 DVD Content Scramble System

Custom algorithm and implementation → hacked

🎮 PlayStation 3

Custom ECDSA implementation → hacked

🚗 Keyless Car Entry

Multiple cases of weak custom crypto

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How to Select Software Components?

	Security vulnerabilities	Independently auditable & patchable	Supplier can be held liable
Proprietary Software	😱	×	✓
Own Implementation	😱	✓	×
Unsupported Open Source	😱	✓	×
Open Source + Support	😱	✓	✓

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OpenSSF Concise Guide for Evaluating Open Source Software

Consider Necessity | Maintainer Diversity | Vulnerability Status | Testing Practices

Activity Level | Release Recency | Best Practices Certification | Security Response | Version Stability

Verify Authenticity | Dependency Management | Secure Defaults | Static Analysis | Security Audits

Repository Security | Security Scores | License Clarity | Security Documentation | Interface Stability | Suitability

Vulnerability Reporting | Security Guidance | Communication | Name Verification | Security Development | Adoption

Interface Design | Assessment Framework | Security Implementations | Security Reviews | Behavior Testing

Dependency Impact | Code Completeness | Malicious Code Check | Sandbox Testing | Test Validation

Source: https://best.openssf.org/Concise-Guide-for-Evaluating-Open-Source-Software

Even a small systems can contain hundreds of open-source components...

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Even a small systems can contain hundreds of open-source components...

We need communities and tools!

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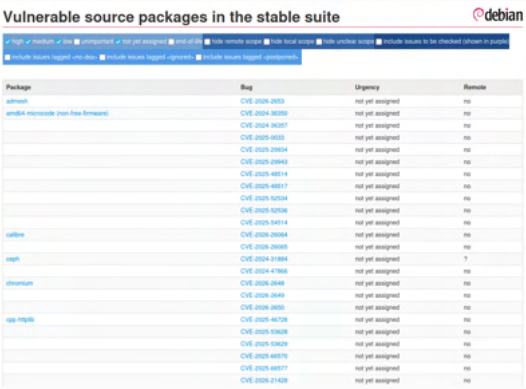
Security Metrics

OpenSSF Best Practices Badge

Debian Security Tracker



License Compliance

Linux Foundation project
for license scanning & compliance

OSADL project for curated
license compliance data

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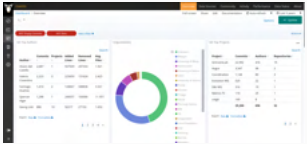
Community Health

CHAOSS

Community Health Analytics in Open Source Software

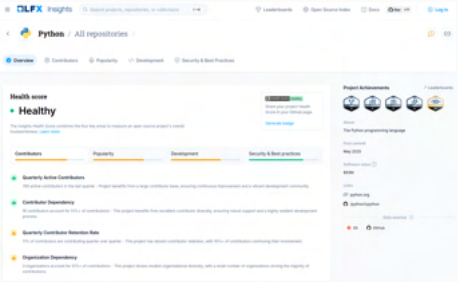
Linux Foundation project for metrics, models & software

GrimoireLab



Augur

LFX | Insights



External Components Management for Open Source

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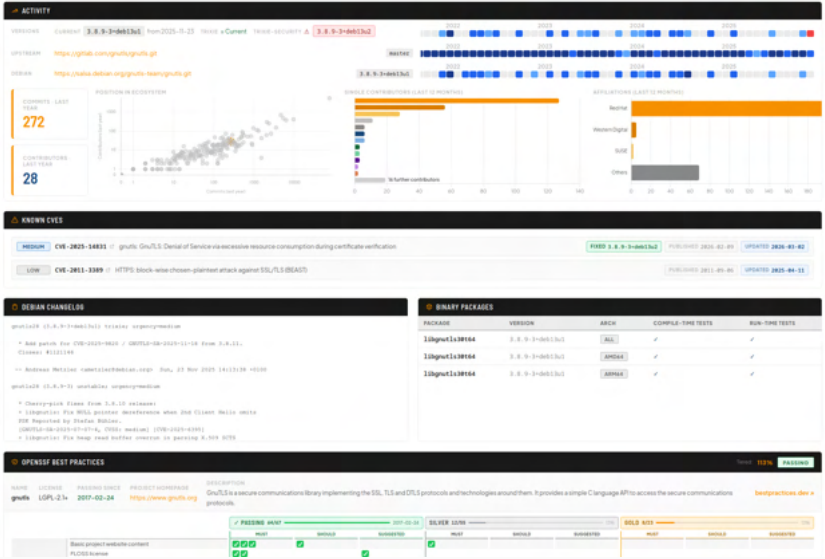

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Example for an External Component Classification

Level	Category	Example in IGLOS Context
Green	Suitable for intended use*	apache2, openssl
Yellow	Suitable for use with risk-mitigating measures*	libexpat
Blue	Suitable for limited or isolated use*	python-dbus-next
Red	Not suitable for use	OpenClaw

* with continuous monitoring

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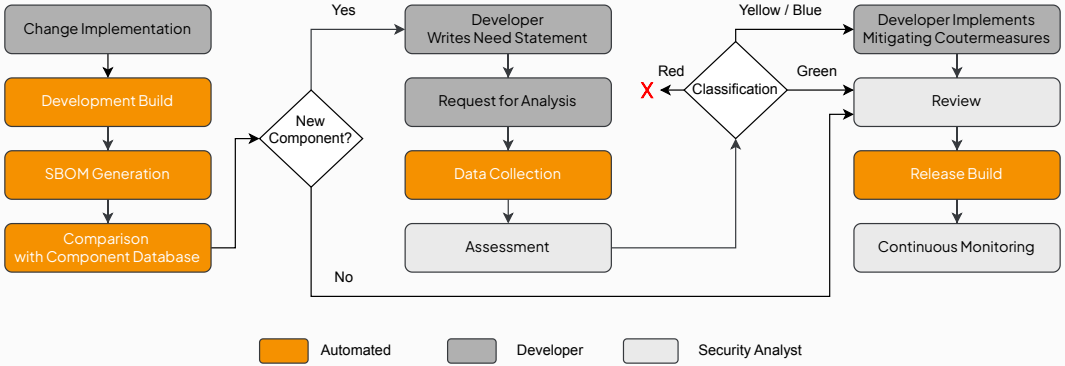
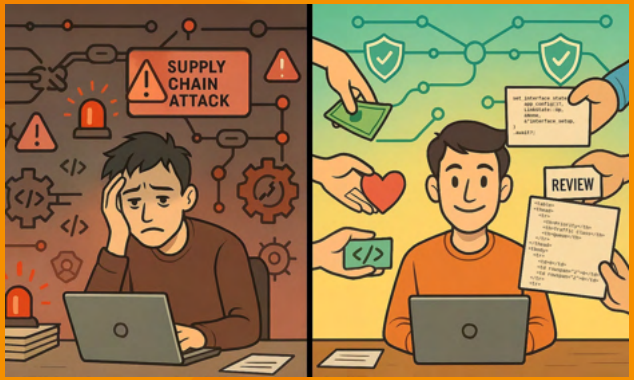
External Component Management Process





Contributing to open source and supporting maintainers is not only fair, but protects your supply chain!

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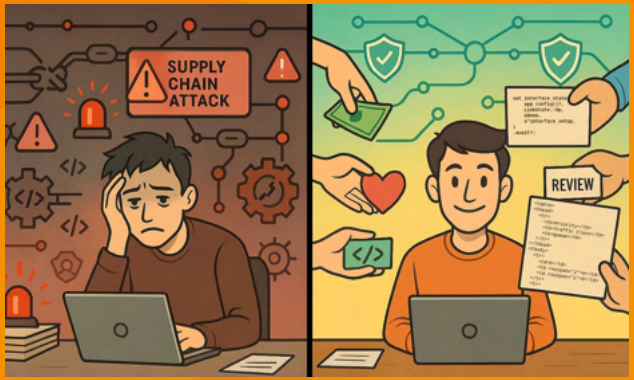
Booth 4-168



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