

# Feature-based Comparison of Open Source OPC-UA Implementations

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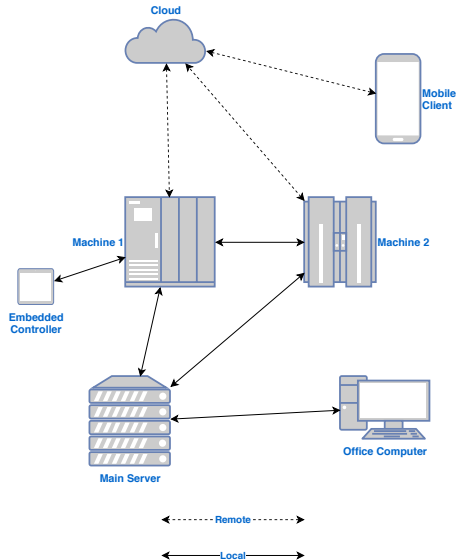


- OPC UA widely used in M2M and IIoT
  - Transportation, oil and gas, energy and utilities and automation [2]
- Many open-source solutions available in different languages
- OPC Foundation ensures conformity and interoperability by issuing certificates
- No certificate for most open-source implementations
- Goal 1: comparisomal feature-based analysis of open-source implementatons
- Goal 2: check their interoperabilities

- Released in 2008
  - Latest version 1.04 in 2017
- Customers: Microsoft, Siemens, ABB, ...
- Service-oriented
- Hierarchical address space
- Security features, e.g. Certificates, SecureChannels

# OPC UA

## A Scenario



- Identify implementations:
  - Open Source
  - Actively Maintained
  - Server and full stack
- Resulting implementations:

Table 1: Implementation overview with GitHub stars as of 2020/07/14

Implementation	Language	Version	Stars
open62541	C	1.0.1	1205
UA-.NETStandard	C#	1.4.359.31	867
node-opcua	JavaScript	2.4.4	866
python-opcua	Python	0.98.9	717
(Eclipse Milo)	(Java)	(0.3.8)	(482)

- Approach:
  - Feature comparison
  - Crosswise connection test

# Features

## Supported Service Sets 1/4

Table 2: Supported Service Sets

Service Set	open62541	node-opcua	python-opcua	UA-.NETStandard
Discovery	✓	✓	✓	✓
SecureChannel	✓	✓	✓	✓
Session	✓	✓	✓	✓
NodeManagement	✓	x	✓	✓
View	✓	✓	✓	✓
Query	x	x	x	✓
Attribute	✓	o	✓	✓
Method	✓	✓	✓	✓
MonitoredItem	✓	✓	✓	✓
Subscription	✓	✓	✓	✓

Service Set is

✓ completely

,

✓ almost completely

,

o partially

,or

x not

implemented.

# Features

## Supported Security Policies 2/4

Table 3: Supported Security Policies

Security Policy	open62541	node-opcua	python-opcua	UA-.NETStandard
None	✓	✓	✓	✓
Basic128Rsa15	✓	✓	✓	✓
Basic256	✓	✓	✓	✓
Basic256Sha256	✓	✓	✓	✓
Aes128_Sha256_RsaOaep	✓			✓
Aes256_Sha256_RsaPss				✓

Security Policy is  
implemented (✓) and

highly secure , average secure , broken , or not secure.

## Supported Transport Protocols 3/4

Table 4: Supported Transport Protocols.

	Transport	open62541	node-opcua	python-opcua	UA-.NETStandard
server-client	OPC UA TCP	✓	✓	✓	✓
	Websockets	✓			✓
	HTTPS				✓
pub-sub	UADP	✓			
	MQTT	✓			
	AMQP				

stable

,

experimental



Table 5: Supported Transport Protocols.

OS support	open62541	node-opcua <sup>1</sup>	python-opcua <sup>2</sup>	UA-.NETStandard
Windows		✓	✓	✓
Linux		✓	✓	
Android/iOS				✓

- Offer most useful functionality, s.a. Browsing, creating MonitoredItems
- node-opcua's GUI is text-based, i.e. a TUI

<sup>1</sup> opcua-commander: <https://github.com/node-opcua/opcua-commander>

<sup>2</sup> opcua-client-gui: <https://github.com/FreeOpcUa/opcua-client-gui>

# Crosswise connection tests

## Cross-wise connection test

- Simple test setup:
  - Security Policy None
  - Open SecureChannel and Session
  - Read server time
  - Close Session and SecureChannel



<https://memegenerator.net/img/instances/46442362/check-mark-all-the-things.jpg>

# Crosswise connection tests

## Cross-wise functionality test

- Test as before plus:
  - Security Policy Basic256Sha256
  - Services Browse, CreateSubscription, CreateMonitoredItems, Publish, AddNodes
- UA-.NETStandard is reference  $\Rightarrow$  no need for test

Table 6: Cross-wise functionality test.

server\client	open62541	node-opcua	python-opcua
open62541	✓	✓	✓
node-opcua	✓	✓	✓
python-opcua	✓	✓	✓

Table 7: Overall results

Aspect	open62541	node-opcua	python-opcua	UA-.NETStandard
Service Sets	✓	✓	✓	✓
Security Policies	✓	✓	✓	✓
Server/Client protocols	✓	✓	✓	✓
Pub/Sub protocols	✓	X	X	X

- Good interoperability
- Some GUIs available

- [1] [Unified architecture.](https://opcfoundation.org/about/opc-technologies/opc-ua/)  
<https://opcfoundation.org/about/opc-technologies/opc-ua/>.
- [2] [OPC Foundation.](https://opcfoundation.org/resources/case-studies/)  
*OPC UA Case Studies.*  
<https://opcfoundation.org/resources/case-studies/> Accessed 28 June. 2020.