THE LINUX FOUNDATION | Training & Certification

# Becoming a Hyperledger Aries Developer (LFS173x)

## Course Overview

Data is driving our world today. However, we hear about data breaches and identity thefts all the time. Trust on the Internet is broken, and it needs to be fixed. As such, it is imperative that we adopt a new approach to identity management, and ensure data security and user privacy through tamper-proof transactions and infrastructures.

Blockchain-based decentralized identity management is revolutionizing this space. The three Hyperledger open source projects, Aries, Indy and Ursa, provide the foundation for distributed applications built on authentic data, applications that implement the concept of *Trust over IP*. Together, the three projects provide tools, libraries, and reusable components for creating and using independent digital identities rooted on blockchains or other distributed ledgers that are interoperable across jurisdictions, applications and other data silos. While this course will cover what you need to know about Indy and Ursa, the main focus is **Aries** and how you can use it to quickly build your own applications on a solid digital foundation of trust. This focus will be explained further in the course but for now, rest assured: if you want to start developing decentralized identity applications rooted on the blockchain, Aries is where you need to be.

This course will get you from (pretty much) zero to developing code for issuing, holding and verifying credentials with your own production-ready Aries agents. On the way, you'll look at how Aries agents use Hyperledger Indy ledgers (you'll even run your own ledger instances), dig into the architecture and components of an Aries agent, and learn about its underlying messaging protocols. Most importantly, you'll get started building applications that address your trust over IP use cases, whether they involve COVID-19 proof-of-vaccination credentials, digital driver's licenses, proof of employment, climate change, or anything else. The possibilities are endless!

## Course Instructors

**Stephen Curran** of Cloud Compass Computing, Inc. is a Software Development and DevOps veteran who dove full on into the identity-on-blockchain world in 2017. Working with the British Columbia Government, Stephen has helped define, build and launch the Verifiable Organizations Network (VON)—a production instance of the Linux Foundation's Hyperledger Aries and Indy project that makes public information about organizations (incorporations/legal entities) in BC available in the form of verifiable credentials. Stephen is a regular contributor in the Hyperledger Aries/Indy community, facilitating discussions and driving interoperability. Stephen has presented on Blockchain and the Hyperledger Indy and Aries projects many times and is a member of the Sovrin Foundation's Board of Trustees and Technical Governance Board.

**Carol Howard** of Cloud Compass Computing, Inc. is a technical writer with more than 14 years experience, working for both hardware and software companies writing user guides, technical references, help text, and so on. She has been helping document the BC Government initiatives (VON, Greenlight, OrgBook BC and IIWBook) and became hooked on self-sovereign identity at IIW28.

## Audience

The intended audience for this course is developers who want to learn how to build applications that use self-sovereign identity (SSI) and Trust over IP (ToIP) capabilities. The technical examples can be run by anyone familiar with using the command line and executing scripts. As such, a broader technical audience beyond developers will find the course helpful in understanding how ToIP can be used in designing business solutions.

## Prerequisites

This course assumes that you have knowledge of blockchain technology, cryptography and public/private key pairs. If you are not familiar with these topics, we would suggest that you take a look at either of these courses:

- Blockchain: Understanding Its Uses and Implications (LFS170x)
- Introduction to Hyperledger Blockchain Technologie (LFS171x)

If you are new to Aries and verifiable credentials, we recommend you first take the precursor to this course:

- Introduction to Hyperledger Sovereign Identity Blockchain Solutions: Indy, Aries & Ursa (LFS172x)

We review some of the core material from that course in Chapter 1, but only enough to set the context for the rest of the course. If you haven't taken it yet, you should!

You must be comfortable working with GitHub, the Linux command line and following instructions for building and running demo applications. Docker is used in many of the labs in the course, and at least some require a local installation of Docker. Some of the assignments assume at least an ability to read Python code, and some suggest doing Python development. Note that building Aries applications can be done in any modern programming language.

## Course Length

30-40 hours.

## Course Learning Objectives

By the end of this course, you should be able to:

- Have a deeper understanding of Trust over IP (ToIP).
- Develop and operate code for issuing (and verifying) credentials with your own Aries agent.
- Understand the basics of how Hyperledger Indy (and the ledger) work.
- Understand the architecture and components of Aries agents and their underlying messaging protocols.
- Comprehend additional requirements introduced when using a mobile Aries agent.
- Understand the challenges in moving to production in an Aries environment.

# Course Outline

**Welcome!**

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**Chapter 1. Overview**

- Introduction
- Why Focus on Aries Development?
- Why We Need Identity Solutions
- The Verifiable Credential (VC) Model
- Key Concepts
- Knowledge Check (Verified Certificate track only)
- Summary

**Chapter 2. Exploring Aries and Aries Agents**

- Introduction
- Examples of Aries Agents
- An Aries Ecosystem
- Aries Agent Architecture
- Knowledge Check (Verified Certificate track only)
- Summary

**Chapter 3. Running a Network for Aries Development**

- Introduction
- Ledgers: What You Don’t Need To Know
- Why Use a Distributed Ledger with Aries?
- Running a Local Indy Network
- The Indy Genesis File
- Resolving DIDs
- Knowledge Check (Verified Certificate track only)
- Summary

**Chapter 4. Developing Aries Controllers**

- Introduction
- Aside: The Term "Wallet"
- Agent Start Up
- How Aries Protocols Impact Controllers
- Building Your Own Controller
- Controllers For Other Frameworks
- Knowledge Check (Verified Certificate track only)

- Summary

**Chapter 5. Digging Deeper-The Aries Protocols**

- Introduction
- The All-Important aries-rfcs Repository
- Basic Concepts of DIDComm Messaging
- The Format of Aries Protocol Messages
- Framework Message Processing
- Aries Interop Profile (AIP) Versions
- Knowledge Check (Verified Certificate track only)
- Summary

**Chapter 6. Aries Interoperability**

- Introduction
- Interoperability Testing
- The Aries Toolbox
- Knowledge Check (Verified Certificate track only)
- Summary

**Chapter 7. Mobile Wallets and Message Routing**

- Introduction
- Agent Message Routing
- Mobile Agents and Mobile Agent Mediators
- Establishing a Connection with Routing
- Open Source Mobile Wallets
- Knowledge Check (Verified Certificate track only)
- Summary

**Chapter 8. Planning for Production**

- Introduction
- Production Challenges—Mobile Wallet Apps
- Working with Production Indy Ledgers
- Horizontally Scaling Enterprise Agents
- Multi-Tenant Aries Agency
- Advanced Capabilities
- Knowledge Check (Verified Certificate track only)
- Summary

**Chapter 9. What to Do Next**

- Introduction
- Where to Go From Here

- Building Decentralized Identity/Trust over IP Applications
- Contributing to Aries Projects
- How to Get Involved
- Knowledge Check (Verified Certificate track only)
- Summary

**Final Exam** (Verified Certificate track only)

## edX Platform

If you are using edX for the first time, we strongly encourage you to start by taking a free 'how to use edX' course that the team at edX has made available. In this course, you will learn how to navigate the edX platform, how to connect with other edX learners, how to answer problems on the edX platform, how grades work in edX courses, and how to complete your first course.

Click here to register for "*DemoX*" and you will be on your way. You will find the edX platform simple and intuitive.

## Getting Help

For any **technical issues** with the edX platform (including login problems and issues with the Verified Certificate), please use the **Help** icon located on the upper right side of your screen.

One great way to interact with peers taking this course and resolving any **content-related issues** is via the **Discussion Forums**. These forums can be used in the following ways:

- To discuss concepts, tools, and technologies presented in this course, or related to the topics discussed in the course material.
- To ask questions about course content.
- To share resources and ideas related to Hyperledger Aries.

We strongly encourage you not only to ask questions, but to share with your peers opinions about the course content, as well as valuable related resources. The Discussion Forums will be reviewed periodically by The Linux Foundation staff, but it is primarily a community resource, not an 'ask the instructor' service.

To learn more tips on how to use them, read the following article: "*Getting the Most Out of the edX Discussion Forums*".

## Course Timing

This course is entirely self-paced; there is no fixed schedule for going through the material. You can go through the course at your own pace, and you will always be returned to exactly where you left off when you come back to start a new session. However, we still suggest you avoid

long breaks in between periods of work, as learning will be faster and content retention improved.

The chapters in the course have been designed to build on one another. It is probably best to work through them in sequence; if you skip or only skim some chapters quickly, you may find there are topics being discussed you have not been exposed to yet. But this is all self-paced and you can always go back, so you can thread your own path through the material.

## Learning Aids

Besides simple exposition through text and figures, this course uses additional methods to present the learning material, including labs, demonstrations, external resources, glossary and knowledge check questions (Verified Certificate track only).

## Audit and Verified Tracks

You can enroll into an audit or a verified track. In an audit track, you will have access to all ungraded course content: course readings, videos, and learning aids, but no certificates are awarded when auditing. You will not be able to access any graded content (knowledge check questions at the end of each chapter, and the final exam).

In order to receive a certificate, you will need to obtain a passing grade (please refer to the "Grading" section below), verify your identity with edX, and pay a fee. Once all edX requirements have been met, you can download your certificate from the Progress tab.

To learn more about audit and verified tracks, visit edX Help Center > Certificates.

## Grading (Verified Certificate track only)

At the end of each chapter, you will have a set of graded **knowledge check questions**, that are meant to further check your understanding of the material presented. The grades obtained by answering these knowledge check questions will represent **20%** of your final grade.

The remaining **80%** of your final grade is represented by the score obtained in the **final exam**. The final exam is located at the end of the course and it consists of 30 questions.

You will have a maximum of two attempts to answer each knowledge check and final exam question (other than True/False questions, in which case, you have only one attempt). You are free to reference your notes, screens from the course, etc., and there is no time limit on how long you can spend on a question. You can always skip a question and come back to it later.

**In order to complete this course with a passing grade, you must obtain a passing score (knowledge check and final exam) of minimum 70%**.

## Course Progress and Completion (Verified Certificate track only)

Once you complete the course (including knowledge check questions and final exam), you will want to know if you have passed. You will be able to see your completion status using the **Progress** tab at the top of your screen, which will clearly indicate whether or not you have achieved a passing score.

## Professional Certificate Program

Professional Certificate programs are a series of courses designed by industry leaders and top universities to build and enhance critical professional skills needed to succeed in today's most in-demand fields.

To learn more about our Professional Certificates, visit Secure Software Development Fundamentals Professional Certificate, Blockchain for Business Professional Certificate, 5G Strategy for Business Leaders Professional Certificate, Developing Blockchain-Based Identity Applications Professional Certificate and Introduction to DevOps: Practices and Tools.

## About The Linux Foundation

The Linux Foundation provides a neutral, trusted hub for developers to code, manage, and scale open technology projects. Founded in 2000, The Linux Foundation is supported by more than 1,000 members and is the world's leading home for collaboration on open source software, open standards, open data and open hardware. The Linux Foundation's methodology focuses on leveraging best practices and addressing the needs of contributors, users and solution providers to create sustainable models for open collaboration.

The Linux Foundation hosts Linux, the world's largest and most pervasive open source software project in history.  It is also home to Linux creator Linus Torvalds and lead maintainer Greg Kroah-Hartman. The success of Linux has catalyzed growth in the open source community, demonstrating the commercial efficacy of open source and inspiring countless new projects across all industries and levels of the technology stack.

As a result, the Linux Foundation today hosts far more than Linux; it is the umbrella for many critical open source projects that power corporations today, spanning virtually all industry sectors. Some of the technologies we focus on include big data and analytics, networking, embedded systems and IoT, web tools, cloud computing, edge computing, automotive, security, blockchain, and many more.

## The Linux Foundation Events

Over 85,000 open source technologists and leaders worldwide gather at Linux Foundation events annually to share ideas, learn and collaborate. Linux Foundation events are the meeting place of choice for open source maintainers, developers, architects, infrastructure managers,

and sysadmins and technologists leading open source program offices, and other critical leadership functions.

These events are the best place to gain visibility within the open source community quickly and advance open source development work by forming connections with the people evaluating and creating the next generation of technology. They provide a forum to share and gain knowledge, help organizations identify software trends early to inform future technology investments, connect employers with talent, and showcase technologies and services to influential open source professionals, media, and analysts around the globe.

The Linux Foundation hosts an increasing number of events each year, including:

- Open Source Summit North America, Europe, and Japan
- Embedded Linux Conference North America and Europe
- Open Networking & Edge Summit
- KubeCon + CloudNativeCon North America, Europe, and China
- Automotive Linux Summit
- KVM Forum
- Linux Storage Filesystem and Memory Management Summit
- Linux Security Summit North America and Europe
- Linux Kernel Maintainer Summit
- The Linux Foundation Member Summit
- Open Compliance Summit
- And many more.

To learn more about The Linux Foundation events and to register, click here.

## The Linux Foundation Training

The Linux Foundation offers several types of training:

- Classroom
- Online
- On-site
- Events-based.

To get more information about specific courses offered by The Linux Foundation, click here.

## The Linux Foundation Certifications

The Linux Foundation certifications give you a way to differentiate yourself in a job market that's hungry for your skills. We've taken a new, innovative approach to open source certification that allows you to showcase your skills in a way that other peers will respect and employers will trust:

- You can take your certification from any computer, anywhere, at any time

- The certification exams are performance-based
- The exams are distribution-flexible
- The exams are up-to-date, testing knowledge and skills that actually matter in today's IT environment.

The Linux Foundation and its collaborative projects currently offer the following certifications:

- Linux Foundation Certified IT Associate (LFCA)
- Linux Foundation Certified System Administrator (LFCS)
- Linux Foundation Certified Engineer (LFCE)
- Certified Kubernetes Administrator (CKA)
- Certified Kubernetes Application Developer (CKAD)
- Certified Kubernetes Security Specialist (CKS)
- Certified Hyperledger Fabric Administrator (CHFA)
- Certified Hyperledger Fabric Developer (CHFD)
- Certified ONAP Professional (COP)
- Cloud Foundry Certified Developer (CFCD)
- FinOps Certified Practitioner (FOCP)
- OpenJS Node.js Application Developer (JSNAD)
- OpenJS Node.js Services Developers (JSNSD)

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