Developer **Days**
Automation

CISCO
The bridge to possible

Cisco Crosswork Workflow Manager

Bridging the gap from Automation to Operations

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Market Study:
Automation of Change Management Workflows

Common Themes Noted

- Want to reduce the skill levels required for creating Workflows

- To be successful, Automation Workflow must pose low risk to the operation of the network.
  - Start small, with simple workflows, and grow as they gain expertise and confidence
  - In the future it is expected that some workflows may be running at all hours of the day.

- Need to integrate to their Change Management process – currently document-based (MOPS)

- The scope of a workflow is broader than the devices it queries or provisions. The workflow engine must integrate access to multiple OSS systems in
  - gathering information for processing,
  - preparing the intended changes,
  - communicating to the operations or administration staff, and
  - validating the outcome of the workflow.

- Want to retain the strength and multi-vendor capabilities of NSO

- Need integration to Inventory and Status components
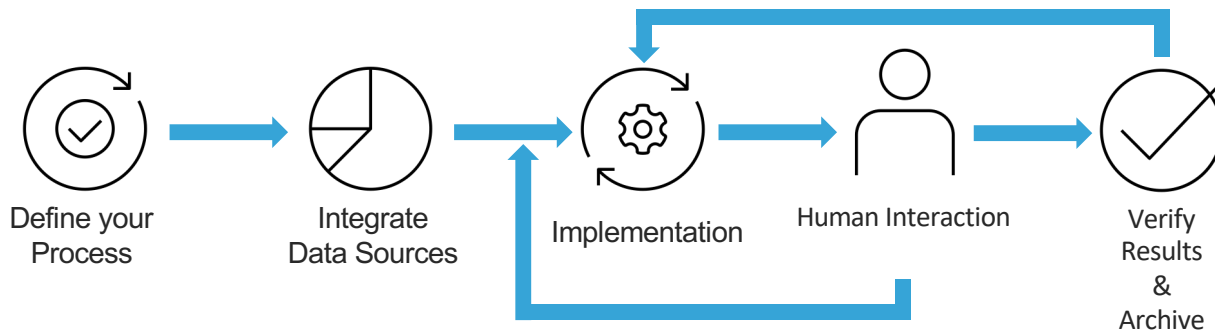
Market priorities:

- On-prem, TAC-supported product.
- High reliability, low risk
- Operational visibility (tracking, monitoring, management)

- Customization: Ability to code workflows and custom adapters
- Initial adapters:
  - NSO
  - REST for integration to systems supporting REST APIs

Why a Workflow Manager

Common Network Administration Tasks

- Which router OS levels am I running?
- Patch and Security Update Installation
- Compliance to standardized configurations

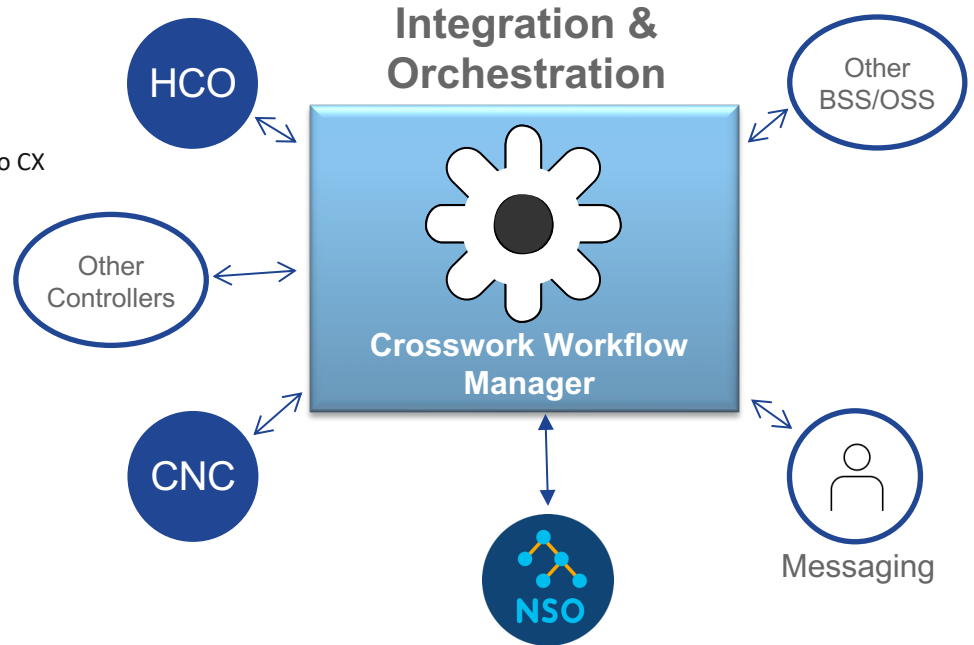- On-boarding of new equipment
- Service deployment

Automate the Change Management for your Network with Confidence and Repeatability.

Define your Process → Integrate Data Sources → Implementation → Human Interaction → Verify Results & Archive

Build the Workflows to fit Your needs.

Crosswork Workflow Manager (CWM) 1.0

- Highly flexible workflow programmability

  - Domain-specific language for workflows

  - SDK for adapters for integration

  - For customers that prefer to outsource the use case development, Cisco CX can offer contracted services using CWM.

- Operational Control of Workflows

  - Job status

  - Repository for workflows

  - Administration functions

  - Role-based Access Controls for User Management

- Integration

  - Open for integration to 3rd party multi-vendor infrastructure via API

    - Swagger available for all REST API calls

  - Within Cisco portfolio, will be the programable element for orchestrating our rich set of automation "Action" tools

Integration & Orchestration

HCO

Other BSS/OSS

Other Controllers

Crosswork Workflow Manager

CNC

NSO

Messaging

CWM Limited Availability release, coming this Summer

Fully flexible workflow capability

CWM is the execution engine.
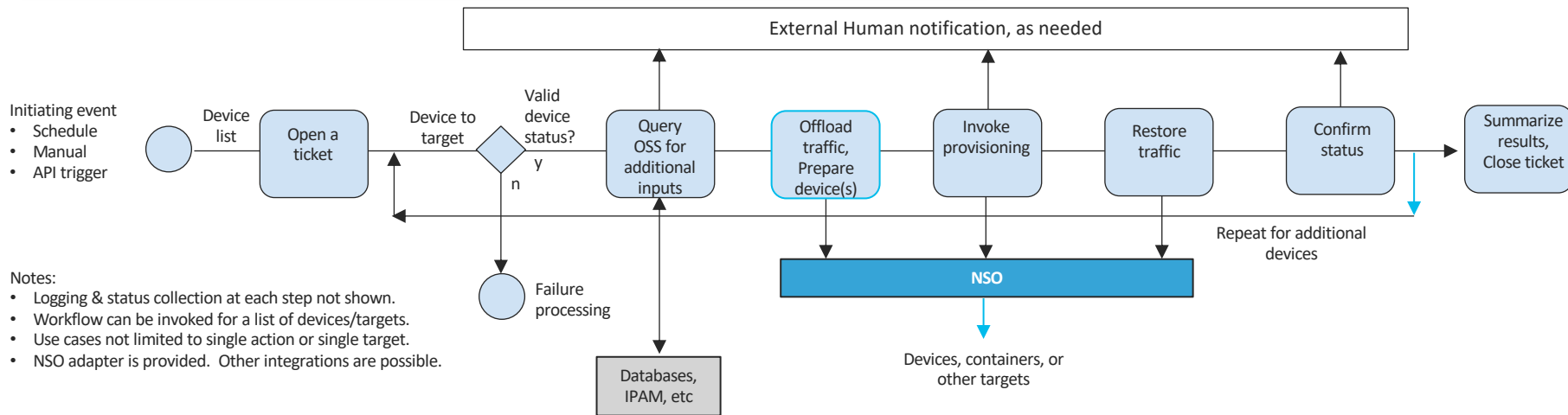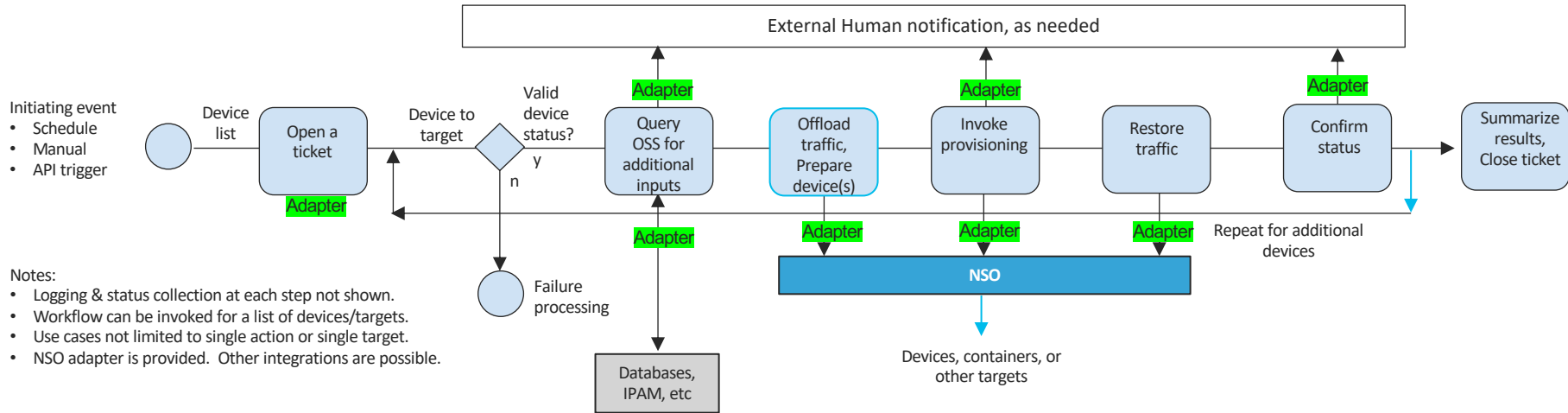Customer writes the workflow per their use case.
- Customer defines the actions, integrations, and complexity
- Completely customizable

Transforming your change management process from a chore to a science
- Repeatable workflows – mitigate human error
- Faster time to design using reusable elements
- Integration possible to all steps of change management process, and tracking

Highly adaptable
- Multi-vendor
- Flexible Integration
  - Adapters provided for NSO and REST APIs
  - Adapter development kit is provided

External Human notification, as needed

Initiating event
- Schedule
- Manual
- API trigger

Device list → Open a ticket → Device to target → Valid device status? → y → Query OSS for additional inputs → Offload traffic, Prepare device(s) → Invoke provisioning → Restore traffic → Confirm status → Summarize results, Close ticket

n → Failure processing

NSO

Databases, IPAM, etc

Devices, containers, or other targets

Repeat for additional devices

Notes:
- Logging & status collection at each step not shown.
- Workflow can be invoked for a list of devices/targets.
- Use cases not limited to single action or single target.
- NSO adapter is provided. Other integrations are possible.

Fully flexible workflow capability

Workflows

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External Human notification, as needed

Initiating event
- Schedule
- Manual
- API trigger

Device list → Open a ticket (Adapter)

Device to target

Valid device status? y/n

Adapter — Query OSS for additional inputs

Adapter — Offload traffic, Prepare device(s)

Adapter — Invoke provisioning

Restore traffic

Adapter — Confirm status

Summarize results, Close ticket

Failure processing

NSO

Adapter / Adapter / Adapter

Repeat for additional devices

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Crosswork Workflow Manager

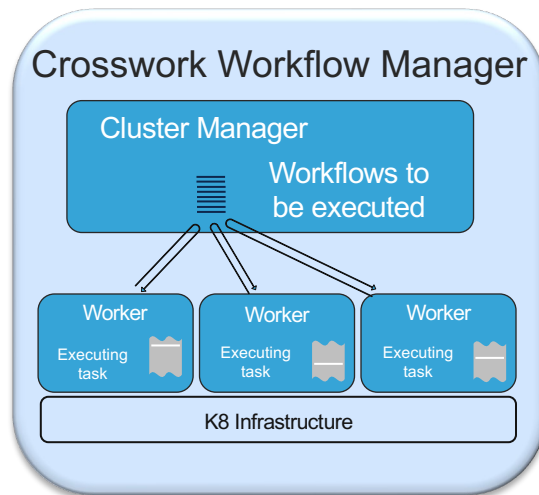Ability to Visualize, Test, and Reuse automation workflows

Strengths of the CWM offering

Ultra Reliability – Never Drop Any Work

- Workflows as critical tasks:
  - Resumable (suspend/resume)
  - Recoverable from failures
  - Responsive to outside signaling
- PostgreSQL DB with extensive reliability capabilities.

Flexibility

- Workflows can be written in JSON or YAML
  - https://github.com/serverlessworkflow/specification
- Integrate to customer OSS/BSS via Adapters.
  - Protobuf for definition of structured data between adapters.
  - Adapter SDK provides ability to build your own custom adapters

Crosswork Workflow Manager

Cluster Manager

Workflows to be executed

Worker — Executing task

Worker — Executing task

Worker — Executing task

K8 Infrastructure

High Scalability

- Capable of running thousands of workflows
- Horizontal scaling
  (in 1.0, within a single node).
- Workers consume workflows as they become available.

APIs for Machine-to-Machine integration

- REST API is available for all interaction with the system.
- Includes publishing workflows, instantiating instances, managing workers, etc.

Management

- Logging of all progress
- Metrics reporting

CWM 1.0 Capabilities

CWM 1.0 Offering

As a workflow engine, CWM allows you to define all manner of workflows. The CWM package contains:

- ✓ Workflow Engine. On-prem, multi-user.

- ✓ Kubernetes-based infrastructure and management interfaces.

- ✓ Pre-packaged adapters
    - NSO
    - Generic REST
        - Enables general communication to any number of controllers or BSS/OSS systems with REST interfaces

- ✓ Sample workflows
    1. Simple Router file download (CSR1Kv with IOS-XE) using NSO Adapter
    2. Using REST adapter to interface NetBox for IPAM

- ✓ Adapter SDK which enables administrator to build custom integrations to their management applications

- ✓ Simple installation as a VMware OVA with Alma Linux
    - Minimum footprint is single VM

Customer Workflows

- Security
- Status tracking
- Notifications
- Completion Results

CWM

NSO

OSS Apps

REST-enabled applications within customer ecosystem
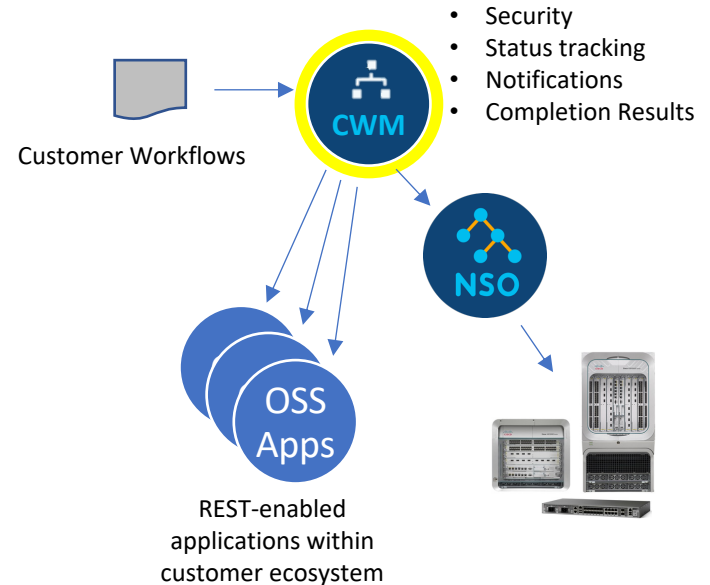
Infrastructure and Management

PostgreSQL	V 14.5	Database Private schema only.	
MINIO	2022-12-12T19-27-27Z	Log storage	
Grafana loki	2.6.1	Log aggregation	
Timescale	2.9.1-pg15	Time series DB, used for Metrics storage	

Customers can further integrate to their own versions of these tools:

Prometheus	v2.0 and above	Metrics collection	Customer integration. Not included in the package. CWM delivers with TimescaleDB. Requires Promscale to interface these to Prometheus
Grafana Labs Grafana	v2.5 and above	Metrics visualization Log visualization	Customer integration. Not included in the package.

Sample Workflow: Router Upgrade/Downgrade

Upgrade/Downgrade Steps & Flow Diagram

- Check Version

- Download Image(s)

- Check if Upgrade/Downgrade

- Get Name of image to use

- Perform Sync From

- Update Router Configuration – set boot system

- Copy Running Config to Start (to reboot with new image)

- Reload – Reboot router

- Check version post image Update
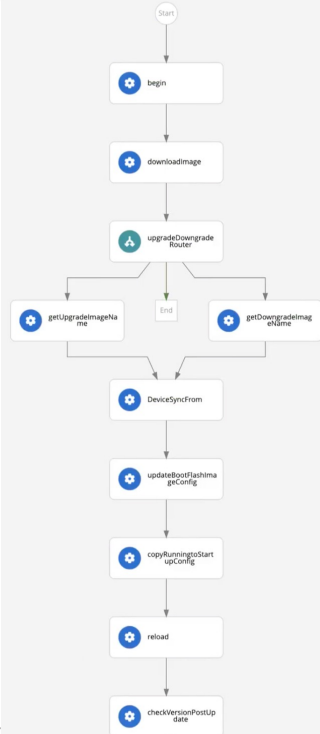
Note: For simplicity, this Demo downloads both images to the router and then selects which one to use as boot image. In real life a customer may want to be more selective up front.

Flow diagram is not part of the product today. We used Kogito Serverless Workflow Editor extension to Visual Studio code.

Workflow Definition (snippets)

Get version of running image

"updateBootFlashImageConfig"

Decision: upgrade or downgrade

"copyRunningtoStartupConfig"

Operations User Interface

Focus of User Interface work for this release has been on Operations and Management
- Administration
- Status tracking
- Archival of workflow activities and results
- Logging

UI replicates similar look and feel as Cisco Crosswork

Details formatting is subject to minor change between now and actual General Availability of the product.

CWM – Job Tracking

The following are aimed at Operational Awareness for Workflows that have been scheduled, running, or completed.
- Conceptually a customer may have hundreds of workflows once the platform becomes key for their operational needs.
- An admin must have the ability to track workflows, and then be able to dive further for more details.

Managing large numbers of Workflows, by list

Each executing workflow is tracked by the USERID who started it, and specific information about the job. Filtering capability is available.

Job Details

Within a scheduled workflow, the customer can display the set of activities and expand further into the activity itself.

Crosswork Workflow Manager — Job Manager

Last Refresh: 2020-Apr-29, 13:56:06 (GMT -07:00)

Job Manager

Active jobs | Completed jobs | Cancelled jobs | All jobs

All jobs — Selected 1 / Total 32

Export selected

	Job name	Run ID	Status	Completed activities	Start date	End date	Duration	Actions
	Job 1	123	Running	2	7/7/2022 9:35:35 AM	In progress	-	Cancel
✔	Job 2	13	Terminated	3	7/7/2022 9:35:35 AM	7/7/2022 9:35:35 AM	5h 13m 5s	Rerun
	Job 3	456789	Failed	24	7/7/2022 9:35:35 AM	7/7/2022 9:35:35 AM	5h 13m 5s	Rerun
	Job 4	789999	Timed out	3	7/7/2022 9:35:35 AM	7/7/2022 9:35:35 AM	5h 13m 5s	Rerun
	Job 5	1234	Completed	88	7/7/2022 9:35:35 AM	7/7/2022 9:35:35 AM	5h 13m 5s	Rerun
	Job 6	98777	Completed	65	7/7/2022 9:35:35 AM	7/7/2022 9:35:35 AM	5h 13m 5s	Rerun
	Job 7	99898989898989898989	Completed	9	7/7/2022 9:35:35 AM	7/7/2022 9:35:35 AM	5h 13m 5s	Rerun
	Job 8	6565656	Cancelled	2	7/7/2022 9:35:35 AM	7/7/2022 9:35:35 AM	5h 13m 5s	Rerun
	Job 9	32222	Running	3	7/7/2022 9:35:35 AM	In progress	-	Cancel
	Job 10	1	Completed	1234	7/7/2022 9:35:35 AM	7/7/2022 9:35:35 AM	5h 13m 5s	Rerun

Rows per page 10 < 1 2 ... 10 >

Crosswork Workflow Manager — WF1 - 2022/10

Job Manager / Jobs / WF1 - 2022/10

Last Refresh: 2020-Apr-29, 13:56:06 (GMT -07:00)

WF1 - 2022/10 — Running — Duration: 15m 11s — Cancel workflow

Details

Job name	Run ID		Start user	Attempts
WF1 - 2022/10	1234567890876545343221111		Chuck Norris	1 / 10

Workflow Defintion name	Workflow Definition ID	Version	Start time	Finish time
WF1	54645657	1	7/7/2022 9:35:35 AM	Running

Task queue	Worker			
23	worker1			

Activity log — Selected 1 / Total 32

Full even history in JSON format

Activity name	Activity type	Status	Attempts	Worker	Start time	End time	Assignee
Workflow execution started	Workflow execution	Completed	1	worker1	7/7/2022 9:35:35 AM	7/7/2022 9:35:36 AM	Automatic
Activity 1	ActivityTask	Completed	1	worker1	7/7/2022 9:35:35 AM	7/7/2022 9:37:35 AM	Automatic

{
    "eventId": "7",
    "eventTime": "2023-01-12T08:52:34.150687Z",
    "eventType": "ActivityTaskCompleted",
    "version": "0",
    "taskId": "35651606",
    "workerMayIgnore": false,
    "activityTaskCompletedEventAttributes": {
    "result": {
    "payloads": [
    {
    "metadata": {
    "encoding": "anNvbi9wbGFpbg=="

Activity 3	ActivityTask	Running	1	worker1	7/7/2022 9:35:35 AM	-	Automatic
Activity 4	ActivityTask	Scheduled	1	worker1	Not started	-	Automatic
Activity 5	ActivityTask	Scheduled	1	worker1	Not started	-	Automatic

Licensing

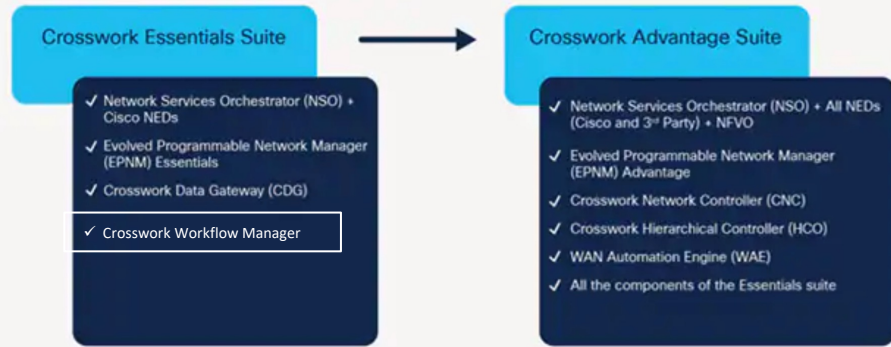Crosswork Workflow Manager is an included entitlement within the Crosswork Essentials Suite

Customers with existing entitlement for the Suite are entitled to use Crosswork Workflow Manager at no extra charge.
- Subject to limitations for RTM licenses that they own.

The Crosswork Advantage package may be needed for customers wanting to leverage the additional functionality from the added components.

CWM as part of Crosswork Essentials Suite

Crosswork Essentials and Advantage Suites
Embedded Product Components

Crosswork Essentials Suite
✓ Network Services Orchestrator (NSO) + Cisco NEDs
✓ Evolved Programmable Network Manager (EPNM) Essentials
✓ Crosswork Data Gateway (CDG)
✓ Crosswork Workflow Manager

Crosswork Advantage Suite
✓ Network Services Orchestrator (NSO) + All NEDs (Cisco and 3rd Party) + NFVO
✓ Evolved Programmable Network Manager (EPNM) Advantage
✓ Crosswork Network Controller (CNC)
✓ Crosswork Hierarchical Controller (HCO)
✓ WAN Automation Engine (WAE)
✓ All the components of the Essentials suite

Licensing

Crosswork Essentials and Advantage are sold as suites. Customers interested in individual applications from the suite should consider a la carte options for each of the applications.

The licensing of the Crosswork Automation suites is based on three factors:

1. A flat annual fee that grants you access (Right to Use or RTU) to the base application software included in the suite
2. A per-device Right-To-Manage (RTM) fee
3. 1-year to 5-year term contracts

Please refer to the Cisco Crosswork Essentials and Advantage Suites Data Sheet on Cisco.com for details on these packages.

Crosswork Workflow Manager is our newest addition to the Crosswork Essentials Suite

Table 1.   Crosswork Essentials and Crosswork Advantage Top-Level Assemble-to-Order (ATO) Details

Product Number	Description
SPAUTO-CWS	Cisco Crosswork Automation Suite ATO

Cisco Crosswork Essentials and Crosswork Advantage PIDs can be found under the top-level assemble-to-order (ATO) PID below. This top-level ATO is searchable and orderable in Cisco Commerce Workspace (CCW).

Table 2.   Base Application Right-to-Use (RTU) Platform Details

Product Number	Description
CWS-E-RTU-K9	Crosswork Essential RTU
CWS-A-RTU-K9	Crosswork Advantage RTU

Early user feedback

'Our workflows are far to complex to be effectively managed with pictures [visual programming]. We are very happy to see a workflow system with full programming capability from Cisco.'

[Workflow development]:

'The serverless workflow domain specific language (DSL), dictates how a workflow should be constructed
– triggers, actions, flow, logic, etc
– what you'd expect to find in process modelling language.'

[Adapter development]:

'Currently requires expertise with
o The Go Language …
o The target system API …
For people with knowledge in those respective areas, the process is rather uncomplicated.'

[Focus on increased Automation]

'With shrinking budgets for governance, over the next 5 yrs we are shifting budget from personnel to tools, expecting to transition to 70% of the governance budget going to automation tools [currently at 40%].'

CWM Product Development

Cross-product collaboration across multiple Cisco teams

Within Engineering:
- Shared knowledge & experience
- Sharing of best practices
- Sharing of components, as applicable

Across the board:
- Strong collaboration with Cisco Services Team
- Strong collaboration with Cisco Automation field specialists
- Market input

The CWM Product Team attendees

Fredric Zeisig – Engineering Manager

- Built NSO NED Team
- Managing CWM Dev and Test team
- Engineering Locations:
    - Stockholm, Sweden (coresident with NSO team)
    - UK
    - Krakow, Poland
    - Bucharest, Romania

Jay Kurji – Technical Leader

- One of our leading architects for CWM
- Based in UK

Lou Menditto – Product Line Manager

- 27yrs at Cisco
- Former Engineering Manager
- Launched multiple products
- Based in RTP, NC USA

Dimitris V - Technical Marketing Engineer

- Extensive experience with Cisco automation products, including NSO and Crosswork
- Based in Alpharetta, GA USA

Team mission

Product:
- Delivery of on-prem Workflow Manager product
  - Including software infrastructure
  - Easy Installation, Small footprint
  - Adapters for integration, plus SDK to enable bespoke adapter development
  - Sample workflows, to be used to facilitate understanding
- To date, have delivered 2 internal Beta releases, with first public release intended to come in the next few weeks
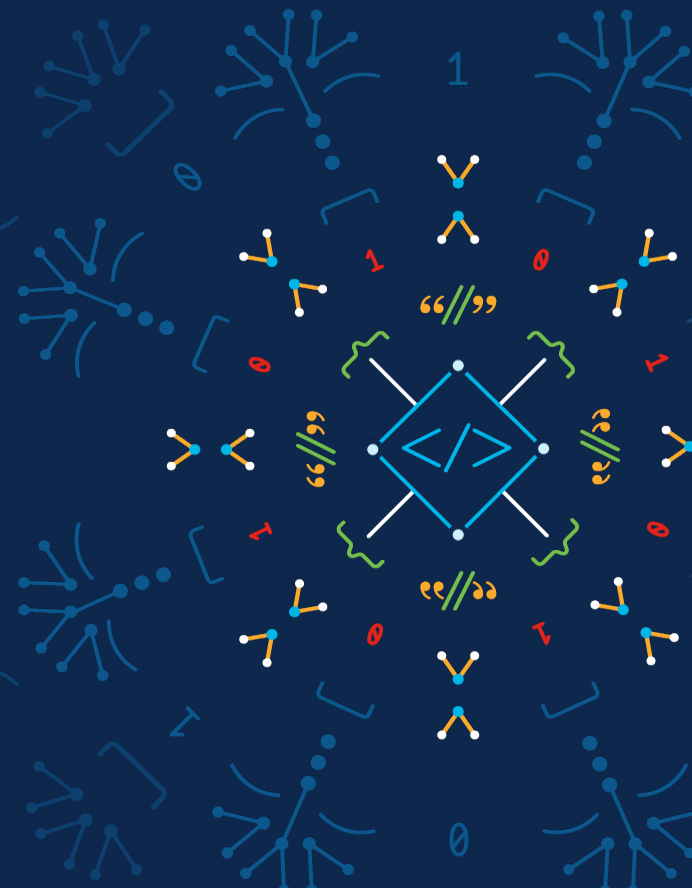

Release strategy:
- Rapid feature development with release cadence of 3-4 months
- Additional adapters, prioritized by market demand
  - Would like to facilitate sharing of customer-contributed adapters as they become available

CWM

The party thrower

- Predictable

- Great work environment

The proposal

- Versatile team

- Know the ask

- Come with a suggestion

The rehearsal

- Be inspired by what you have

- Adapt and improve

- Show results – it helps!

The party

- Expand our automation journey

- Capitalize on culture and people

- Be the number one party

- Thank you!

CISCO

The bridge to possible

- General questions about Crosswork Workflow Manager
  Please email them to cs-cwm@external.cisco.com

- To arrange a lab trial, please contact your Cisco Account Manager