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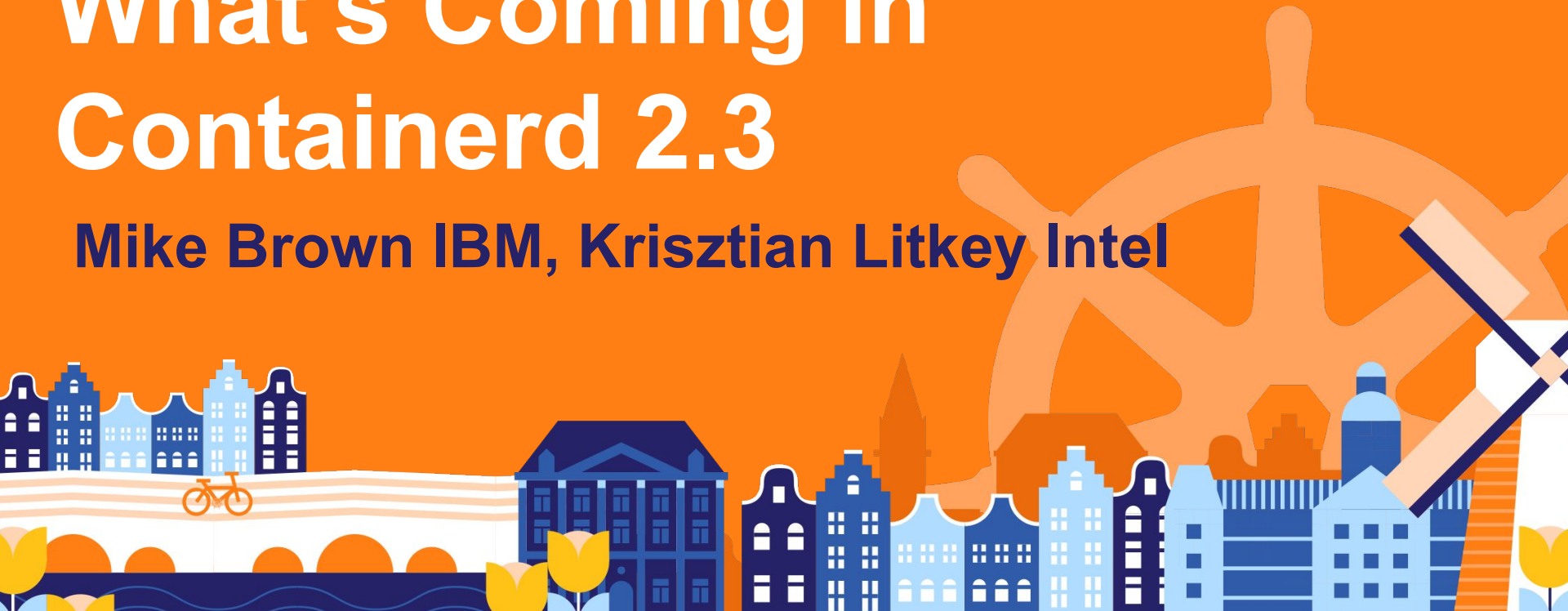
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# What's Coming in Containerd 2.3

**Mike Brown IBM, Krisztian Litkey Intel**



# Containerd Project



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- Our CNCF graduated project (since 2019) now includes 38 public OSS repos
- Adopted by well-known enterprise Kubernetes cloud providers and platform OS distributions
- Designed to be pluggable to support cutting-edge features
  - remote snapshotters
  - WASM runtimes
  - CDI
    - now supports device injection for DRA controllers
  - NRI next gen plugins for improved management of node resources tied to the Pod/Container lifecycle
  - Kubernetes Pod Sandboxes with or w/o VM isolation
  - Other sandbox types for new CRD controllers such as AI - Agent Sandboxes

# Release Support Status



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- Release Status
  - **v1.7 LTS** - Started back in March of 2023 this release is scheduled to go end of life (**EOL**) in **September of 2026**.
    - Shout out to the containerd google maintainers, @chrishenzie and @samuelkarp, for providing extended support since March 2026 for this **LTS** release.
  - **v2.0** support is **EOL** as of **Nov 2025**
  - **v2.1** support is **active**, bug fixes only, through May 2026
  - **v2.2** support is **active**, bug fixes only, through Nov 2026

# Containerd v2.3 LTS (April)



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- Release Cadence, starting with **v2.3** - now boosted to 3-times/year
  - Minor releases each **April, August, and December**
  - Yes! We are synchronizing containerd releases with the Kubernetes release schedule
  - A regular cadence should ensure better planning with cloud providers and platform OS providers
- containerd **v2.3** is the next **LTS** and is planned for April 2026
  - This release coincides with the **Kubernetes v1.36** release
  - Long Term Support Term - two years
  - Direct upgrades between sequential LTS releases (e.g., 1.7 to 2.3) will be tested and supported
- Process and Tech-Debt Improvements
  - containerd KEP issues are now created tracking containerd k8s feature implementations
  - Kubernetes v1.36 Streaming and CRI-Streaming services are now staged (thx @dims & @SergeyKanzhelev) - allows containerd, CRI-O, CRI-Tools,... to more cleanly vendor these services into the CRI Clients and Integrations

# What's new in 2.3



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- GPU vendor auto detection (PR #12839)
- Support EROFS layers as an alternative to OCI tar layers (PR #12567)
- More features in NerdCTL, please come to the booth to discuss with @AkihiroSuda
- Process and Tech-Debt Improvements
  - containerd feature KEP issues are now created tracking the containerd required implementations for each corresponding SIG-Node KEP that impacts the CRI
  - Kubernetes v1.36 Streaming and CRI-Streaming services are now staged (thx @dims) allowing containerd, CRI-O, CRI-Tools,... to more cleanly vendor these services into the CRI Clients and Integrations
- KEPs
  - we are currently tracking many WIP alpha/beta/ga KEPs for v2.3 && v2.4
    - [is:issue state:open kep](#)
- And more! <https://github.com/containerd/containerd/releases/tag/v2.3.0-beta.0>

# Container/Pod Sandbox Runtimes



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- Regular containers
  - runc: Linux
  - runhcs: Windows
  - runj: FreeBSD from @samuelkarp
- WebAssembly
  - runwasi
  - spin
- VM
  - Kata (v4 plans to use new core Sandbox Service and the Nydus snapshotter)
  - nerdbox
    - supports macOS hosts
- Others
  - runsc (gvisor): ptrace sandbox, etc.
  - urunc: unikernel

# Snapshotters For Containerd 2.3



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- Regular snapshotters:
  - overlayfs
  - btrfs
  - zfs
  - devmapper
  - Erofs
- “Remote” snapshotters support pulling image contents on demand to shorten the container startup time (aka lazy snapshotters)
  - stargz: Forward compatible with OCI v1 tar.gz images
  - nydus: Uses an alternate image format
  - overlaybd: Uses block devices as container images
  - soci 

# Experimental Projects In Containerd 2.3



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- Somewhat Experimental Projects
  - Checkpoint/Restore (see WG in SIG-Node) ++H/A && Migrations??
  - Multiple Snapshotters per/Node based on runtime handler switched config
  - Pod Spec'd OCI Image as a Volume with sub-path, next up read/write
  - Networking for Pods - v2.0
  - Hosting new Sandboxed AI workloads brings new opportunities at the container runtime layer
    - Assisting with ensuring **Least Privilege Principle** for Agent Sandboxes (NRI plugin extension integrating with keycloak and spiffe/spire)
  - ... more

... the next generation of container runtime plugins, by Krisztian Litkey, Intel

# NRI Status Update



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- Recap - What is NRI ? What can I use it for ?
- Recent Development - What we've been working on
- Current Development - Current Goals and Activities

# NRI Recap - What Is NRI ?



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- A common extension mechanism for CRI compatible OCI runtimes
- Available since containerd 1.7 and CRI-O 1.26
- Allows one to add custom, extra logic to your runtime
- Custom logic is pluggable
  - External binaries
  - Use a ttRPC-based protocol to communicate with the runtime
  - Can be plugged (started), updated, and unplugged (stopped) any time
- Custom logic is portable
  - Should work the same regardless of which CRI runtime you plug it into
- Custom logic can
  - Track pod lifecycle events
  - Track container lifecycle events
  - Adjust a subset of container attributes
  - Do these adjustments in a 'controlled' fashion

# NRI Recap - How Does NRI Work ?



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- Essence of a CRI compatible OCI runtime, oversimplified for the sake of discussion
  - Take (kubelet) CRI request for container
  - Create OCI Spec based on CRI request + runtime configuration
  - Pass OCI Spec to a low-level runtime/handler for container creation
    - Runc, crun, kata, etc. creates the container
- Essence of NRI
  - Take pristine initial OCI Spec for a container
  - Pass related pod and container metadata to each registered NRI plugin
  - Collect requested container adjustments from plugins
  - Check and flag adjustments for unintentional conflicts ('controlled' adjustment)
  - Apply collected adjustments to get final OCI Spec for container creation
- Additionally
  - Hook NRI plugins in to all other pod and container lifecycle events

# NRI Recap - What Can NRI Plugins Do ?



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- Plugins can tap into lifecycle events
  - Pods: create+start, update, stop, remove
  - Containers: create, post-create, start, post-start, update, post-update, stop, remove
- Adjust immutable container attributes during creation
  - Annotations, mounts, devices, environment variables, OCI hooks
- Adjust mutable container attributes during creation
  - 'Resources': assigned CPU, scheduling weight, assigned memory, memory limit
  - 'Unified/v2' cgroup attributes
- Update mutable container attributes during container update and stop
  - Resources
- Make unsolicited updates to mutable container attributes
  - Resources

# NRI Recent Developments



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- Adjusting additional container attributes
  - Linux scheduling attributes, I/O prioritization, namespaces, seccomp policy
  - POSIX rlimits, Linux sysctl parameters, OOM score adjustment
- Injection of
  - Network devices: interfaces moved from host to container namespace
  - CDI devices: CDI-based device injection
- Pluggable validation (more 'controlled' adjustments)
  - Allows requested adjustments to be approved or rejected
  - Custom validation can be plugged in like any other NRI-enabled logic
- Default validator plugin
  - Extra 'safety net', allows locking down selected NRI features
    - OCI hook injection, Linux seccomp policy, namespace and sysctl adjustments
    - Required plugin validation
- Additional plugin types
  - WASM plugins: strictly sandboxed, but no RPC overhead
  - Builtin plugins: added for the default validator plugin, but available for others

# NRI Current Work



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- Focus is on reaching an API stable release, “NRI v1.0”
  - Stability promise: plugin binary and source backward compatibility
    - Compiled plugins keep working
    - To benefit from any protocol etc. optimizations, just recompile
- Some work to do for manageability and observability
  - Expose NRI-related metrics (PR open)
  - Audit logging of container adjustments (PR open)
- Some functional addition work left to do
  - Linux default memory policy adjustment (merged last week)
  - Wire protocol cleanups (PR open)
  - Authenticated plugins (PR open)
    - Primary target: more fine-grained validation and feature lockdown
  - Plugin/runtime NRI version exchange (PR open) + ‘NRI capability exchange’
  - Recent feature request?: allow NRI plugins to hook into exec into containers
- Improve documentation
- Target to reach NRI 1.0 in the containerd 2.4 timeframe

# Potential Future / Post NRI 1.0 Work

- Optimizations
  - Less protocol stutter

# Thank You !

- Thank you for listening !
- Q & A

# Connecting Your Laptop to Present



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If you plan to use speaker notes, please follow the steps below to ensure your laptop is set up correctly. This will allow you to view your notes while the audience sees only your slides.

## Before Connecting

- Close all unnecessary apps & tabs
- Turn off notifications
- Disable Night Mode / TrueTone
- Don't enter full-screen presentation mode yet

## At the podium

- Plug in the HDMI cable
- If needed, use your USB-C to HDMI adapter
- On Mac, click "Allow" if prompted

## USE "EXTENDED DISPLAY" MODE (NOT MIRRORED)

### Using MAC

- Go to System Settings > Displays
- Click the "Arrangement" tab
- Make sure "Mirror Displays" is unchecked

### Using PC

- Press  $\square$ Win + P, then select "Extend"
- Or: Right-click on the Desktop > Display Settings
- Under Multiple Displays, select "Extend these displays"

# Connecting Your Laptop to Present



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## When Using PowerPoint

- Start slideshow: ⌘Cmd + Enter (Mac) or F5 (PC)
- Or: Click Slide Show > Play from Start
- If notes show on the wrong screen, click “Swap Displays”
- <https://www.youtube.com/watch?v=gQ3D4m-5pww>

## Google Slides

- Use Google Chrome as your browser
- Click the dropdown next to ‘Slideshow’ > select Presentation Display Options
- Check “Presenter View” and “Full Screen”
- If prompted, select "Allow"
- Choose the external display (may have a strange name like PanasonicXYZ)
- Click Start Slideshow
- <https://www.youtube.com/watch?v=-GT7WCvPcys>



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