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11-12.11/2016

INTERNATIONAL LINUX CONFERENCE

ST.PETERSBURG

How devops exhausts itself, and what will happen next

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jetware.org

The next generation of models of software systems management

Kirill Vechera

CTO **jetware.org**

- Software system management automation
  - Building, configuring, testing, deployment, updating

Bio

- System programming
  - Solaris, FreeBSD, Linux
- System and network administration
  - Unix, OSPF, BGP
- Internet services development
  - C, Perl, Java, Python, Ruby

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Annotation

The evolution of information systems management

Present instruments and emerging

How do we contribute to it

Why devops becomes unnecessary

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Modern information system

Big

100 — 100 000 servers

Complex

10 — 100 apps

10 — 1000 connections

100 — 10 000 libraries and programs

Growing

0.1 — 100 updates/day

Problems

Control

Update

Diagnose

Optimize

Repair

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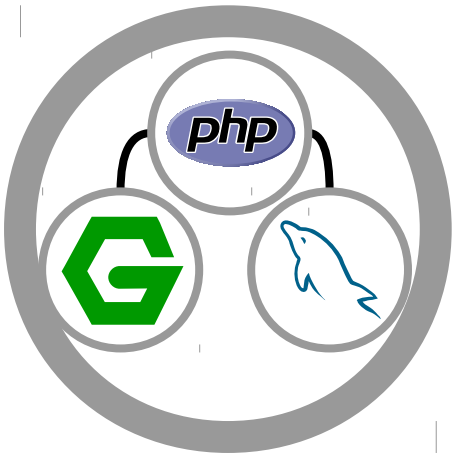
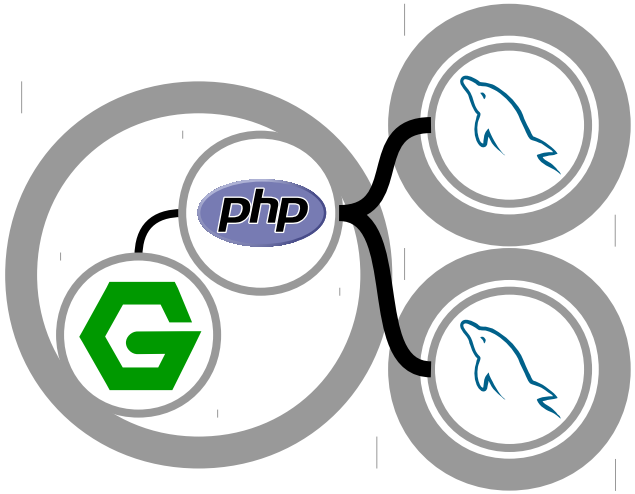
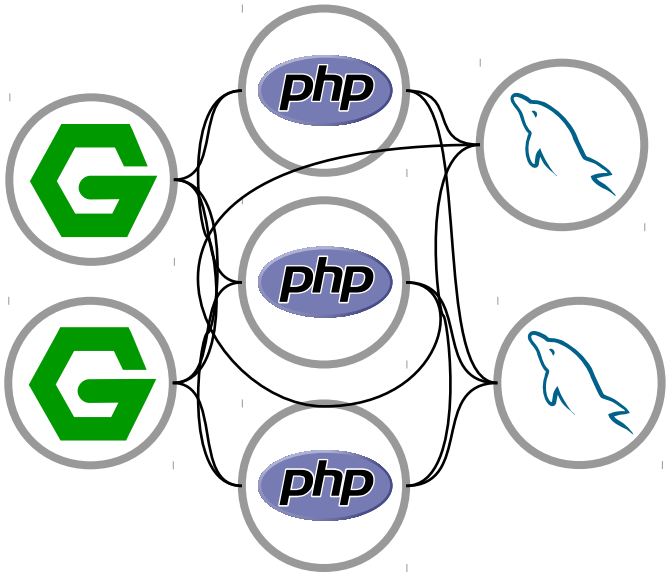
Structure of systems



Monolithic



Distributed,
tight coupled



Distributed,
loosely coupled

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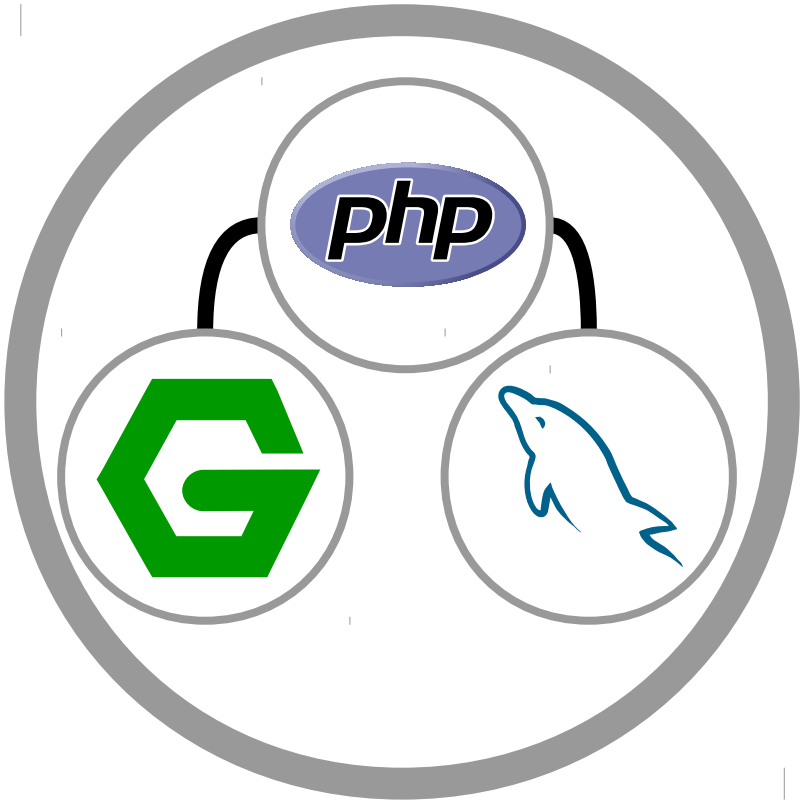
Monolithic system

- Fixed configuration
- Everything as a single copy
  - Services
  - Connections
- Loss of service and communication disrupts the whole system
- Capacity is limited



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Distributed system

Connected components

Component

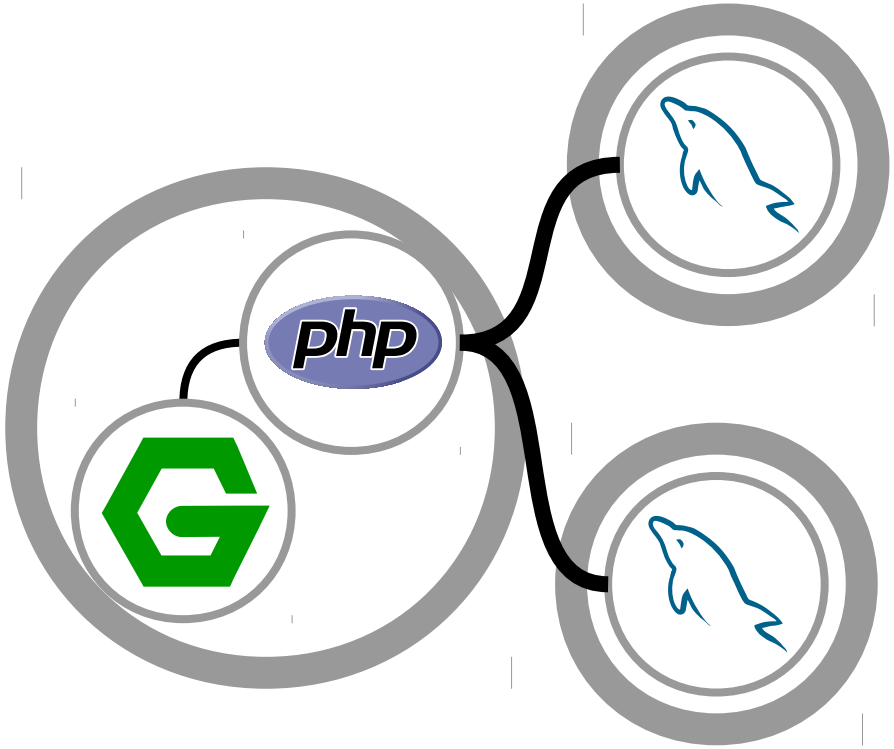
Single service or multiple different services together

Services

Single service or multiple instances of a service

Macrolevel

Microlevel



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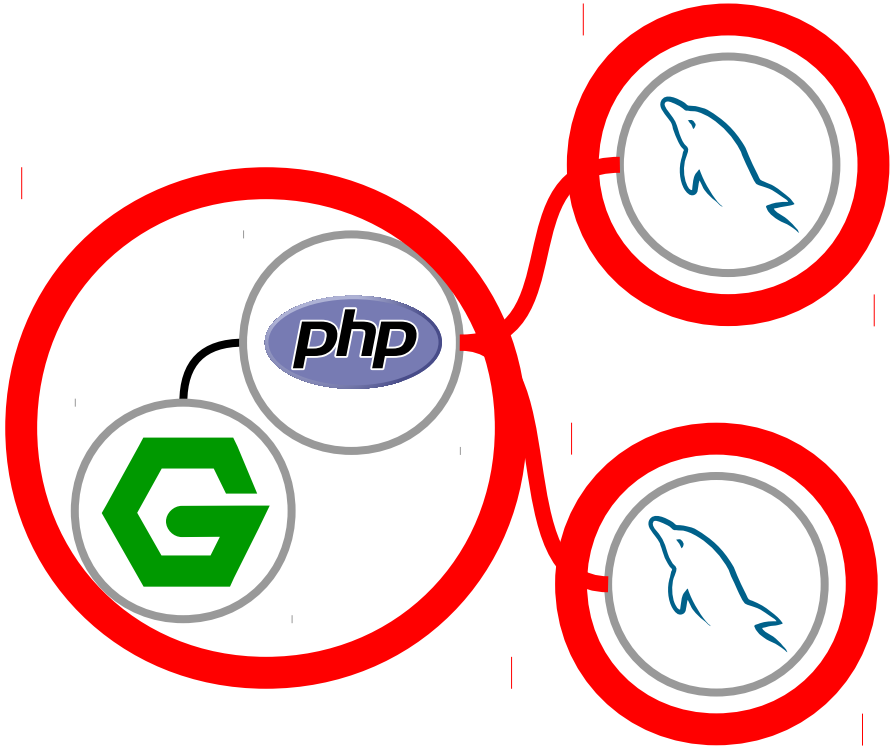
Macrolevel

Components

services

Topology

connections between the components



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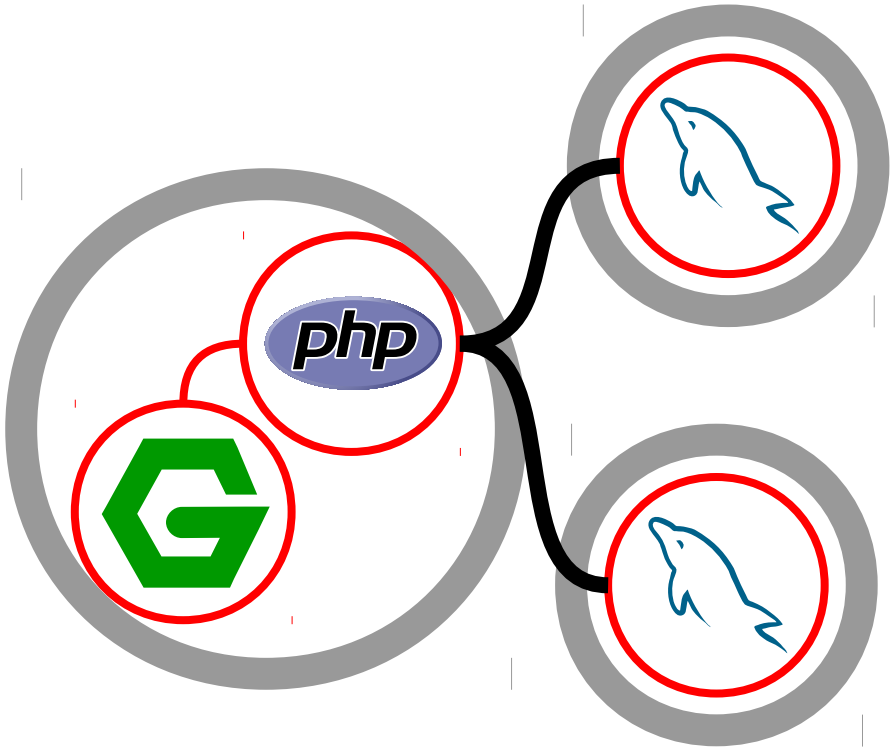
Microlevel

Internal arrangement of the component

- Programs, libraries, settings, data
- Connections between internal services



Inside the component — monolithic subsystem

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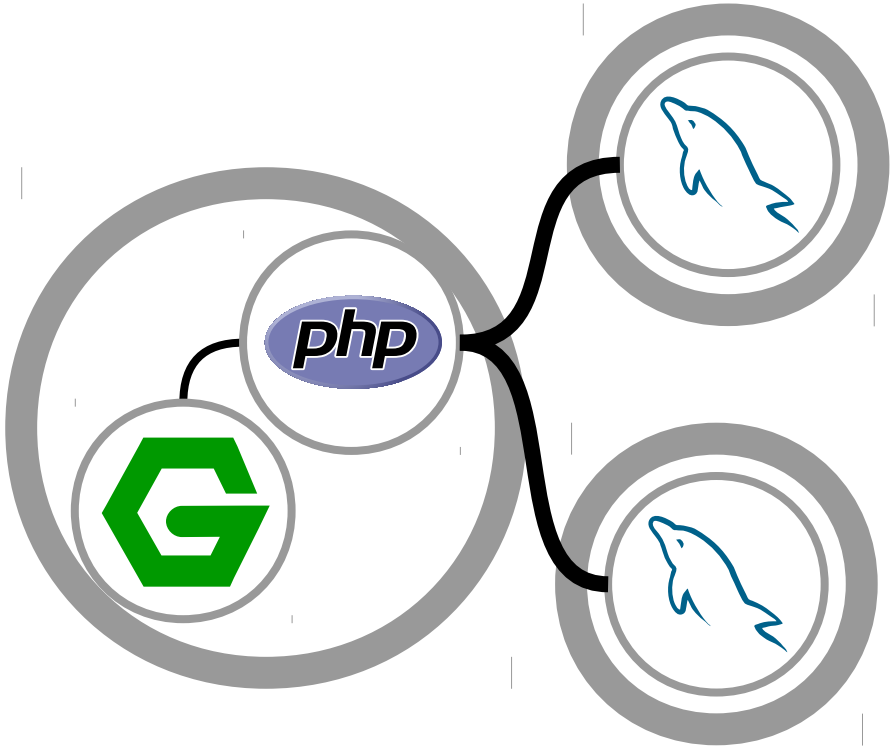
Distributed tightly coupled system

Everything is predetermined

- Connections to the services
- Binding to the equipment
- Adding/removing the components or connections
- The reaction to the failures

Management

- Centralized
- Connections and bindings are organized by the administrator



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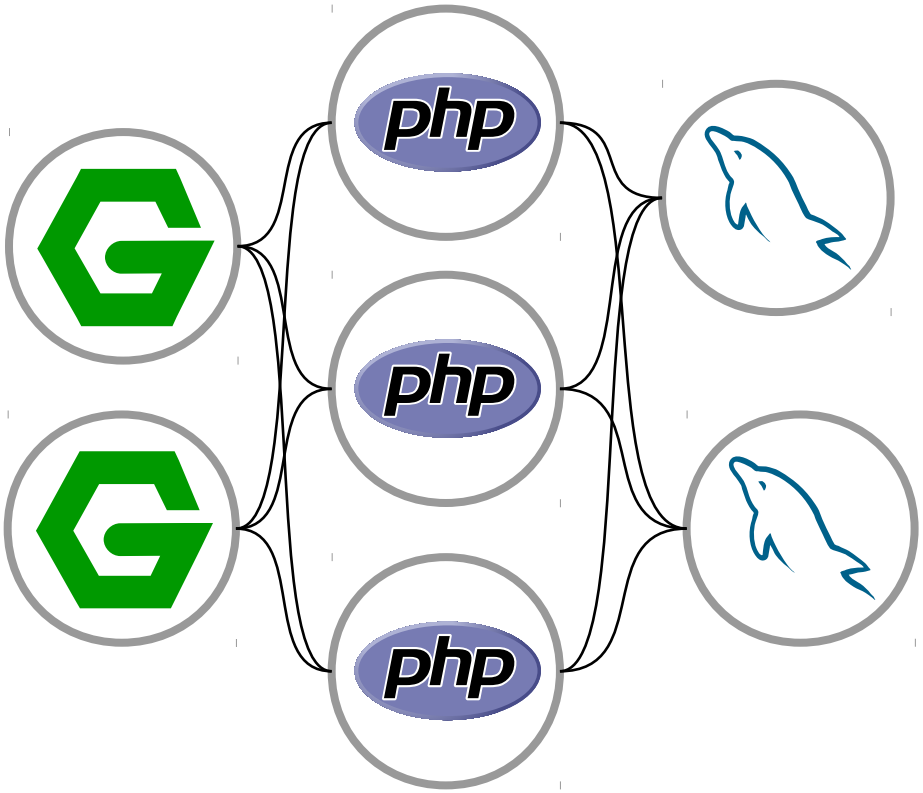
Distributed loosely coupled system

Everything is changeable

- Connections to the services
- Binding to the equipment
- Adding/removing the components or connections

Management

- Continuous
- Automated
- Centralized



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Systems management evolution

Equally — both monolithic system, and tightly coupled distributed systems

3. Tools

2. Scripts

1. Hands

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What follows IaC tools?

Switching to loosely coupled systems

Systems management is stratified

- We need macro-level menegement
- We need micro-level menegement

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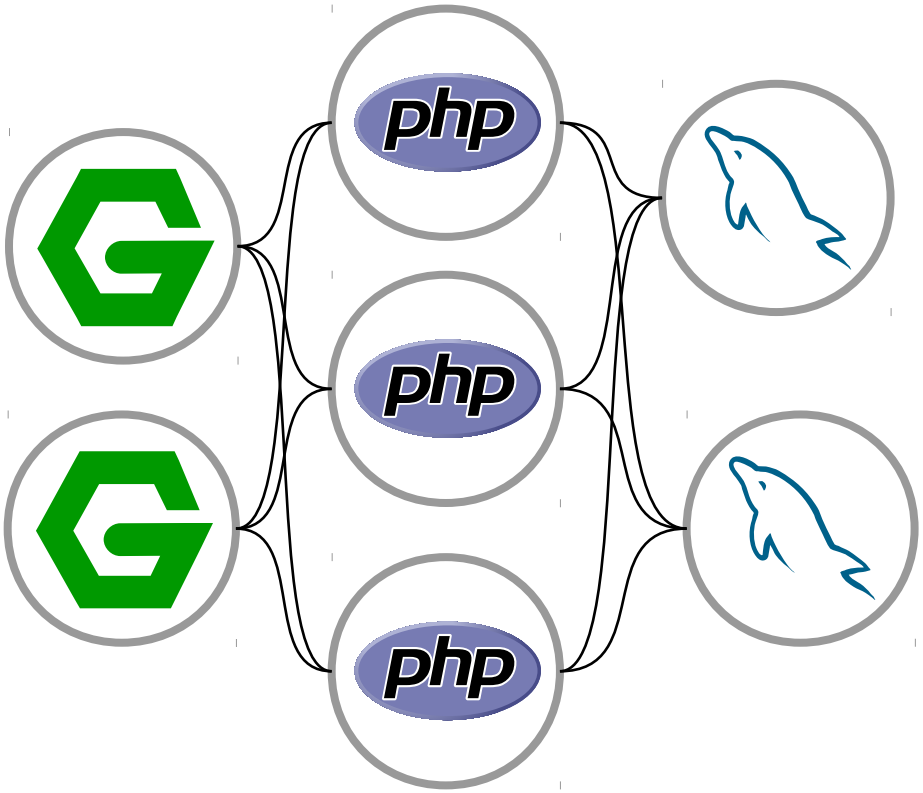
Loosely coupled system

Minimal requirements

- Automated management
  - Connections to the services
  - Binding to the equipment
  - Adding/removing the components or connections



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Minimal requirements to the component

Portability

Replicability

Interface

Isolation from neighbours

Equipment independent

Separate date storage

Connections for services

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AWS helped to get accustomed

Services oriented architechture

Immutable images of virtual machines

Separate data storage

Multiple service instances

Docker

PaaS basement

Development tool

Service execution engine

Docker-container as a component of a system

Lightweight replacement of the virtual machine

- Application isolation and dependency
- Interface - the network and data
  - Stimulates the use of immutable image

Dockerfile

- Fast building and replicability

All requirements for the component of loosely coupled system are complete

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The evolution of distributed systems management – macrolevel

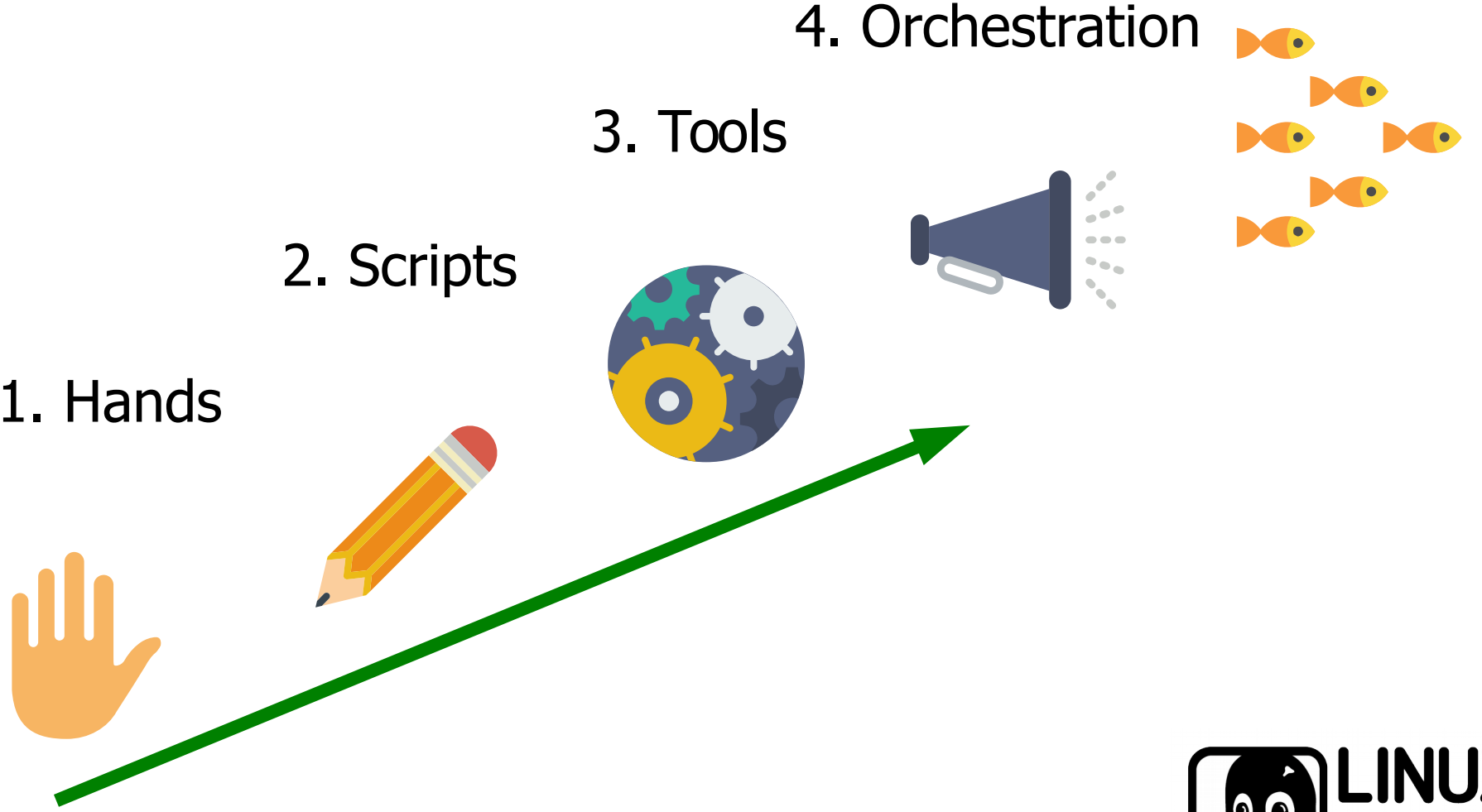
5. Self-organization

4. Orchestration

3. Tools

2. Scripts

1. Hands



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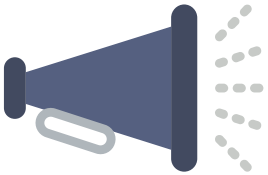
Distributed systems management

4. Orchestration



Alternatives

- Kubernetes
- Mesos Marathon
- Docker Swarm mode

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The evolution – microlevel, monolithic system

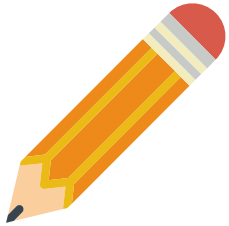
5. Self-organization

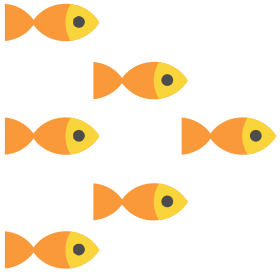
4. ???

3. Tools

2. Scripts

1. Hands





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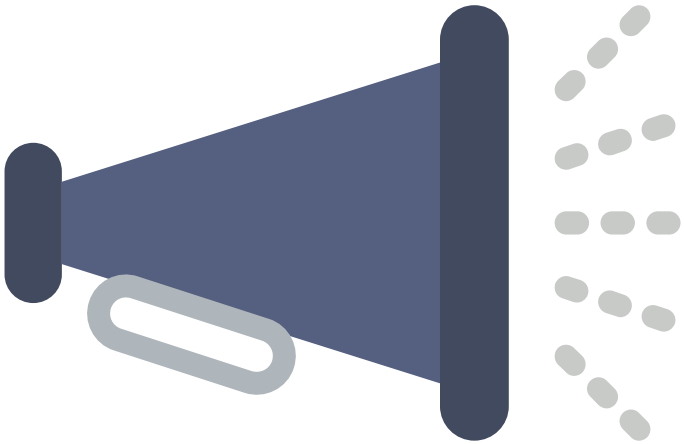
The evolution of distributed systems management

Macro-level

Orchestration

Micro-level

Docker ???



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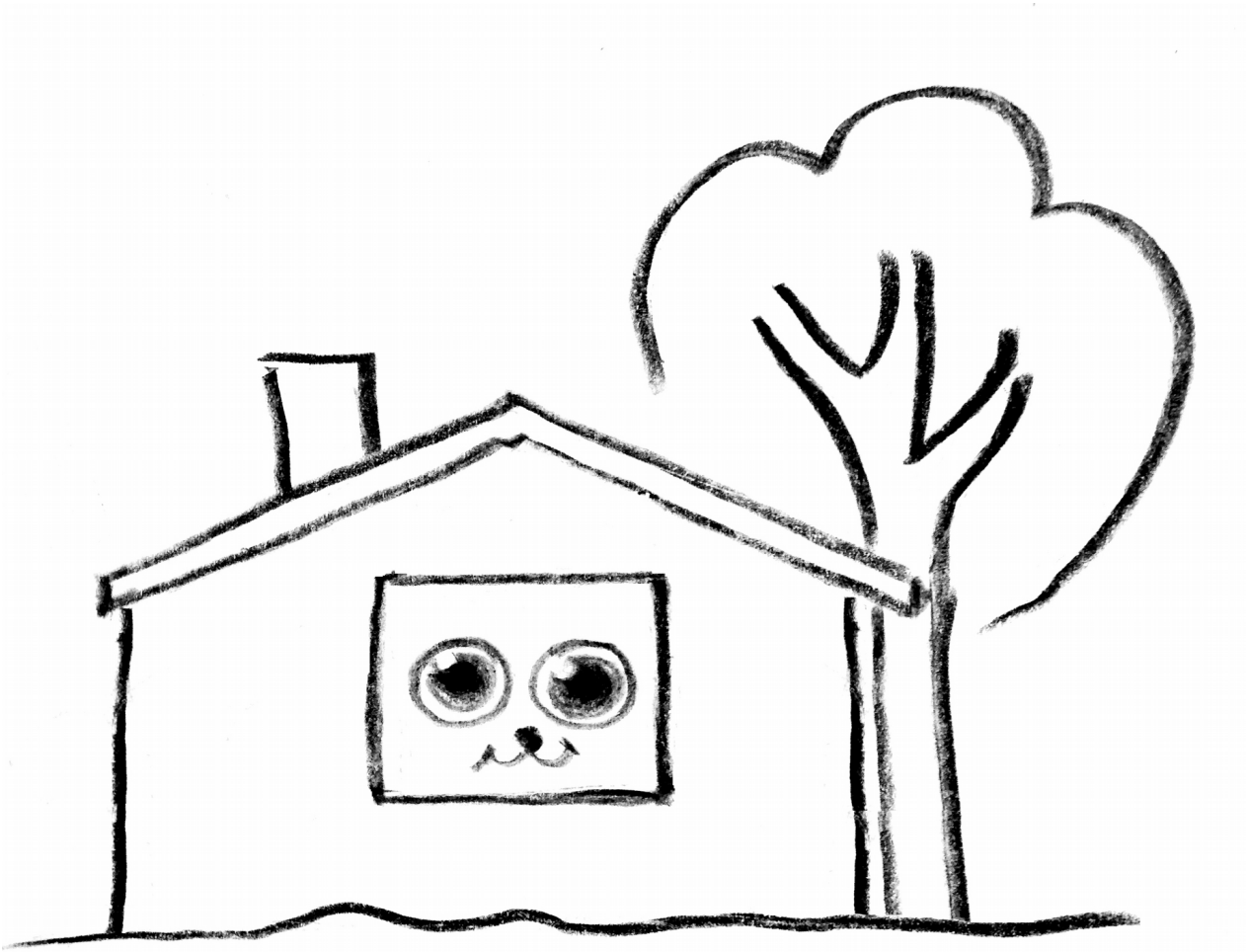
A service in a Docker-container



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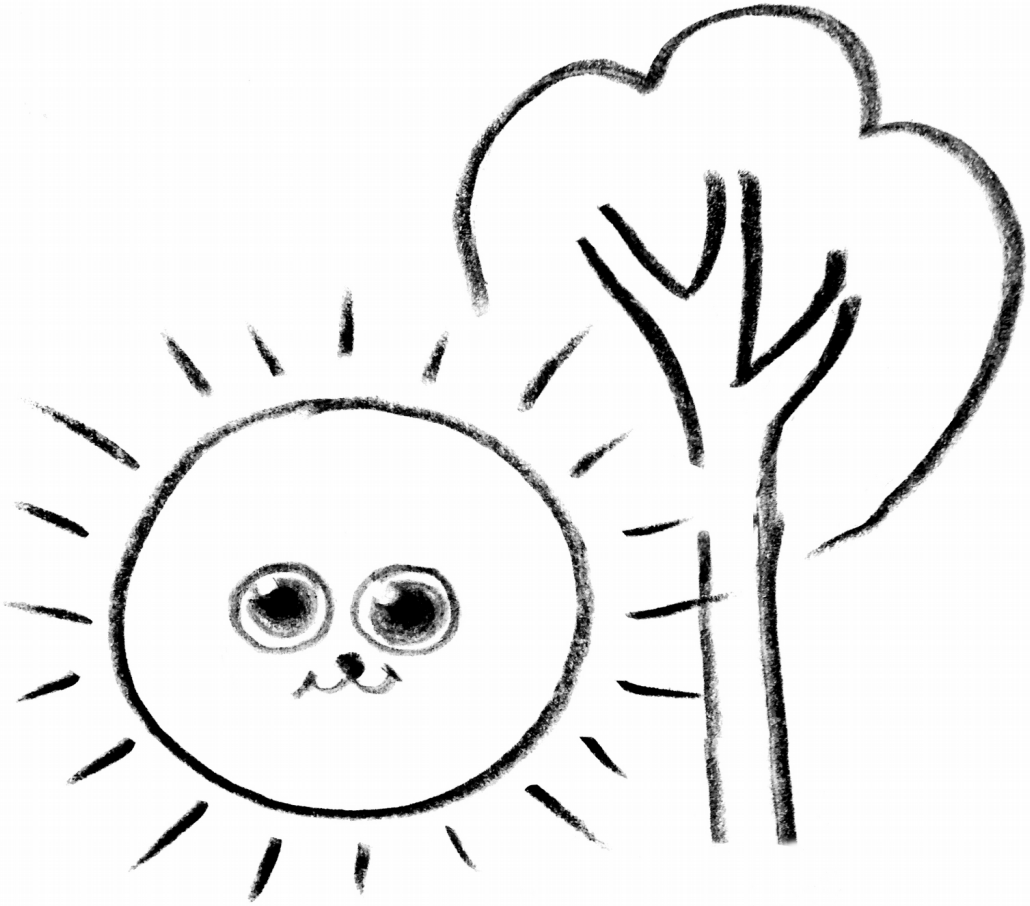
You'd imagine inside ...



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But in fact

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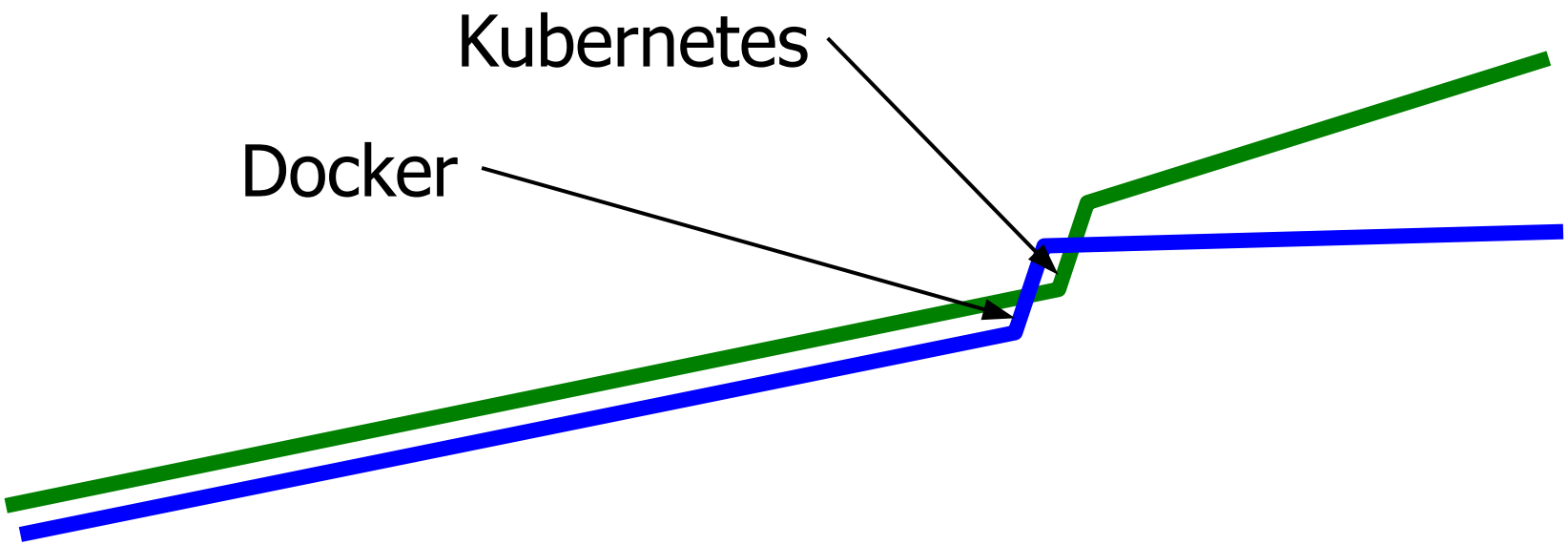
The evolution of systems management

Distributed system, macro-level

Service application, micro-level



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Docker for micro-level management

Simple provisioning

Dockerfile: **shell, deb/rpm, chef/puppet/salt**

Quick update: **layers**

Interface to macro-level: **manual**

Components integrations

Microserices: **separate containers, manual**

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Micro-level, service application

Frequent updates

Many dependencies (components)

- Programs, libraries, date

Dependency versions

Components integration

Settings

Interface to the macro-level

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Actual problems

Versions incompatibility

bugs or API changes in the new versions

bugs or vulnerabilities in the old versions

Human error

when updating

internal settings

orchestration meta-data

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Easy rider

- Software development, corporate customers
- Customized software solutions
  - Business Intelligence
- Continuous integration
- Several hundred projects
  - Common components
  - Customized compoments
- Some merges & acquires before

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Easy rider

Primary software

- Oracle, SAP Hana, PostgreSQL, MySQL
- Java, C++, Python, JavaScript, PHP

And

- R, Excel, ImageMagick, other stuff

OC

- RHEL, Oracle Linux, SLES
  - own patches for JRE, libc, OMP etc
- Windows

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Easy rider

Delivery to the client

- SaaS
- Virtual machines
- .exe + jar
- RPM packages

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Easy rider

Before

- Platform
  - X build servers
  - Different OSes
- Management
  - Scripts — make, shell, python
  - Jenkins
  - Puppet

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Easy rider

Problems

- Poor testing
  - Long wait for the result → rarely tested
- Nonconformant test and the work environment
  - Errors raised on the customer side
- Build process often breaks
- A lot of manual labor

Easy rider

What is needed

- Well controlled environment
  - SaaS, Virtual machines
- Quality building and testing
  - Reproducible builds
  - Fast builds
  - Minimum manual intervention
  - Similar to Maven or Gradle

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Easy rider

Considering

- Juju Charms
- Nix

Nix package manager

Built package — pure function of

- Source code
- Configuration values
- Dependencies (another built packages)
- Building rules

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Nix

Everything consist of a packages

Every package

- Separate directory
- Read-only
- Is built when required as dependency
  - or installed pre-built from repository

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Nix – user environment

- Union point for several **nix**-packages
- Every user environment — in a separate read-only directory
- Every packages combination — independent environment
- Adding or removing a package
  - Copy current environment to the new one
  - Add or remove package to the new environment
  - Switch current environment to the new (symlink replaced)

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Nix – user environment

Directories structure complies FHS

Present bin, etc, lib, include, share, libexec

Absent var, log, tmp — read-only

Symlinks from user environment to the corresponding files in a packages

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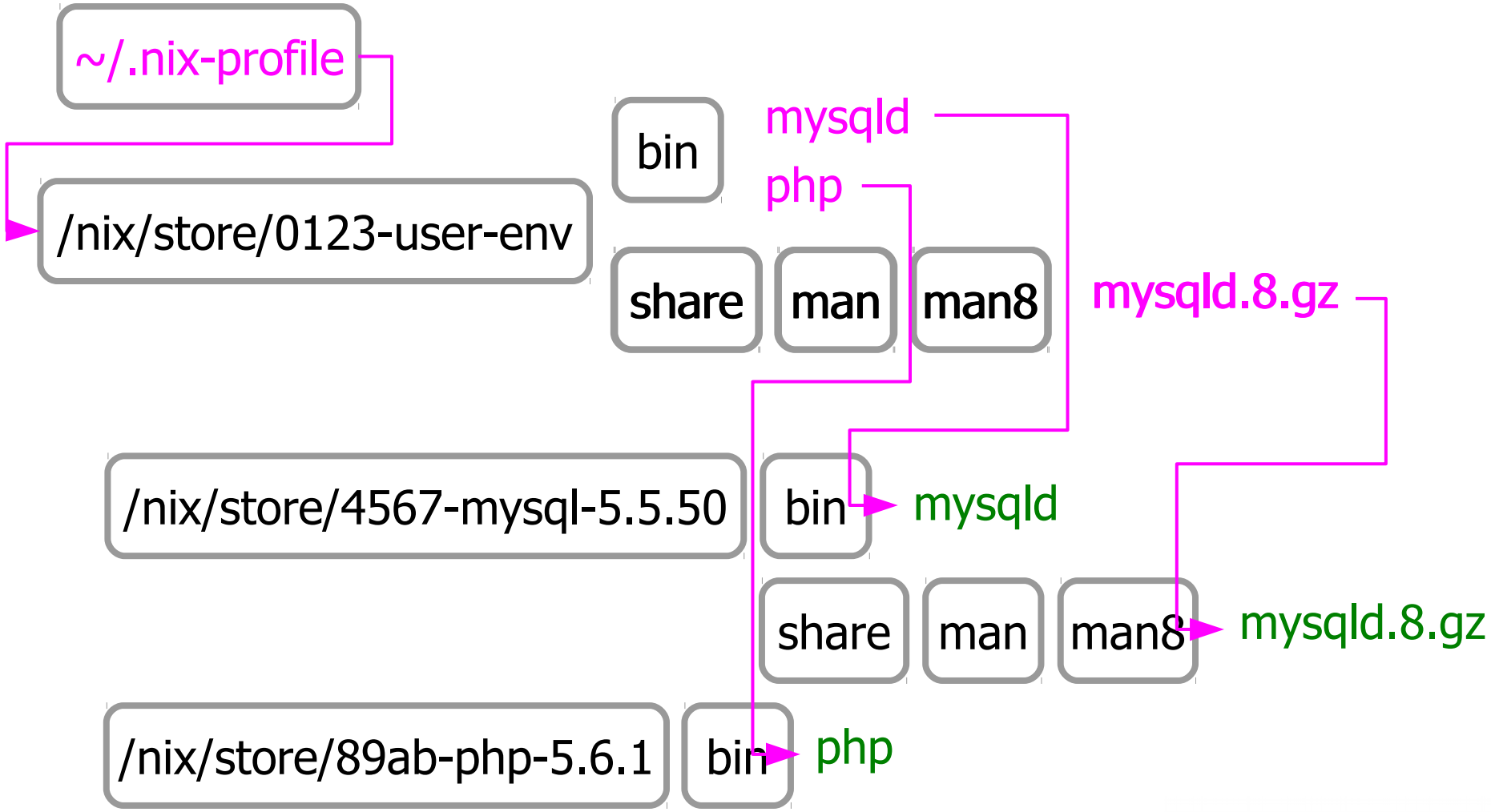
Nix — user environment



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Easy rider

Now

Hardware (SaaS & CI)

- ~ 180 own machines (SaaS — 90 & CI — 90)
- < 200 AWS (mostly CI)
- 500 — 2000 containers

Management

- Nix + Docker + Kubernetes
- Jenkins
- Puppet

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Easy rider

Problems with Nix

- No version dependencies
- All dependency consumers rebuilding
  - Long wait for the result - up to 2 hours

Nix — rebuild on argument changes

`mysql: libc openssl`

`0123-libc 4567-openssl → 89ab-mysql`

patched **libc** → **`cdef-libc`**

`cdef-libc 4567-openssl → 3210-mysql`

Easy rider

Searching

- Has Nix's advantages
  - Automated builds
  - Dependencies
  - Isolation
  - Repeatability
- Plus
  - No unnecessary builds
  - Suitable for multiple versions

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Easy rider

Considering

- Habitat
- Snappy
- Gentoo
- Jetware

Jetware vs Nix, in common

- Consists of a packages
  - Read-only
  - With versions
  - With build variations (flavours)
- Packages with dependencies
  - Automated installation
  - Automated building
- Configuration variables of a package

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Jetware — packages

Not a pure function

Dependencies

on package, on version conditions

Incapsulated packages

Packages self-integration and self-configuration

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Jetware — runtime environment

- Union point for packages
- Keeping packages data and settings
- Separated from OS environment
  - works directly on any OS
    - **libc** — just a package

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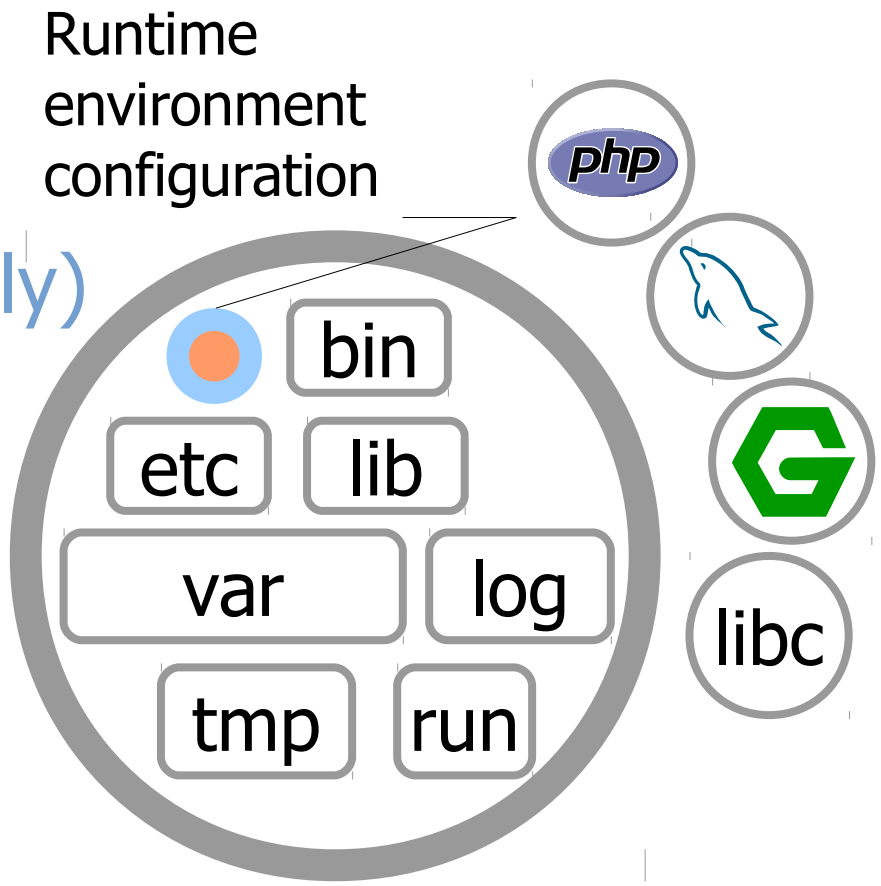
Jetware — runtime environment

Package — outside

Package — namespace

Package keeps all (read-only)

Data and settings — inside



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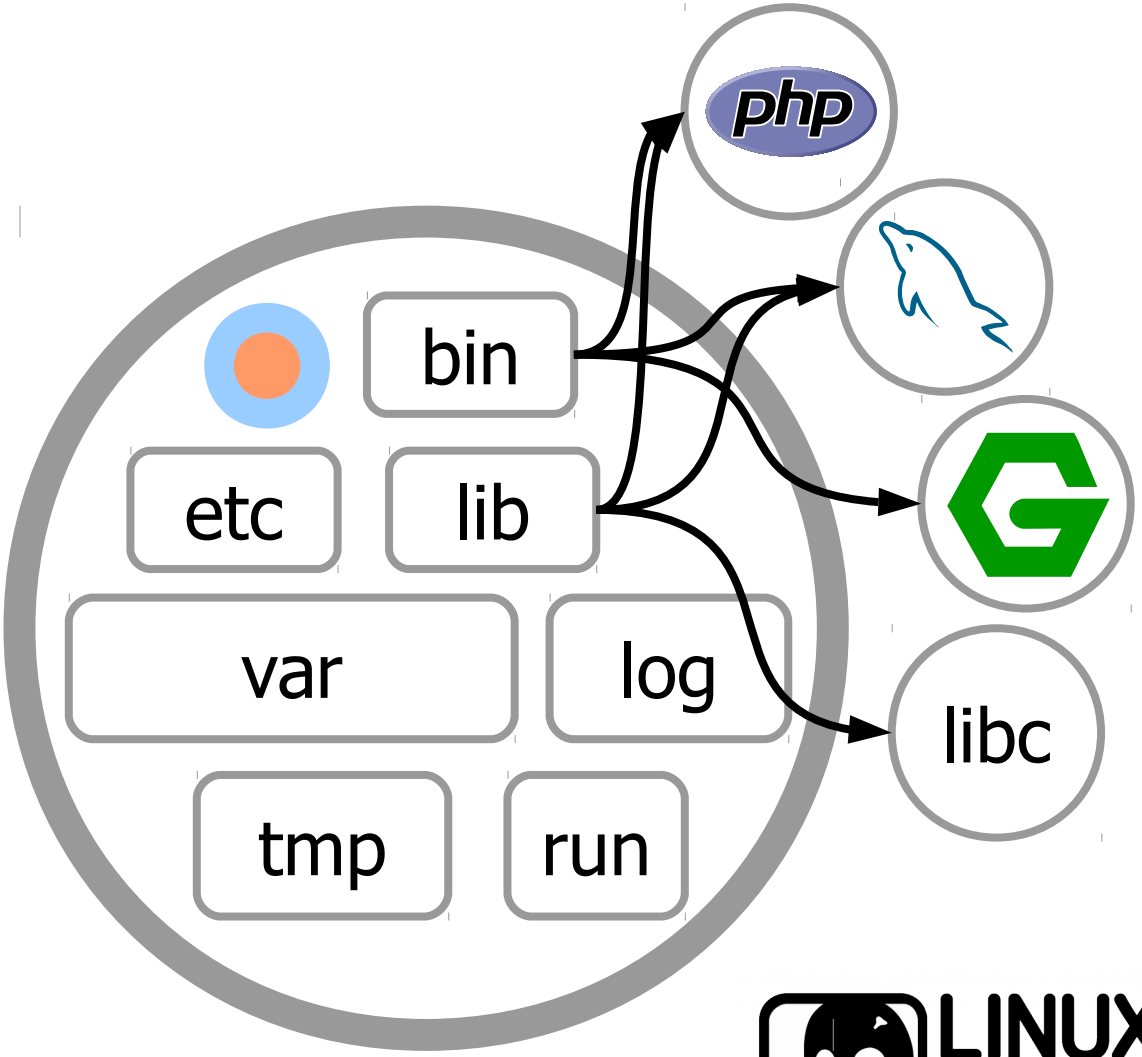
Jetware — export into environment

Immutable data

- Only minimum
- **bin, lib**
- symlinks



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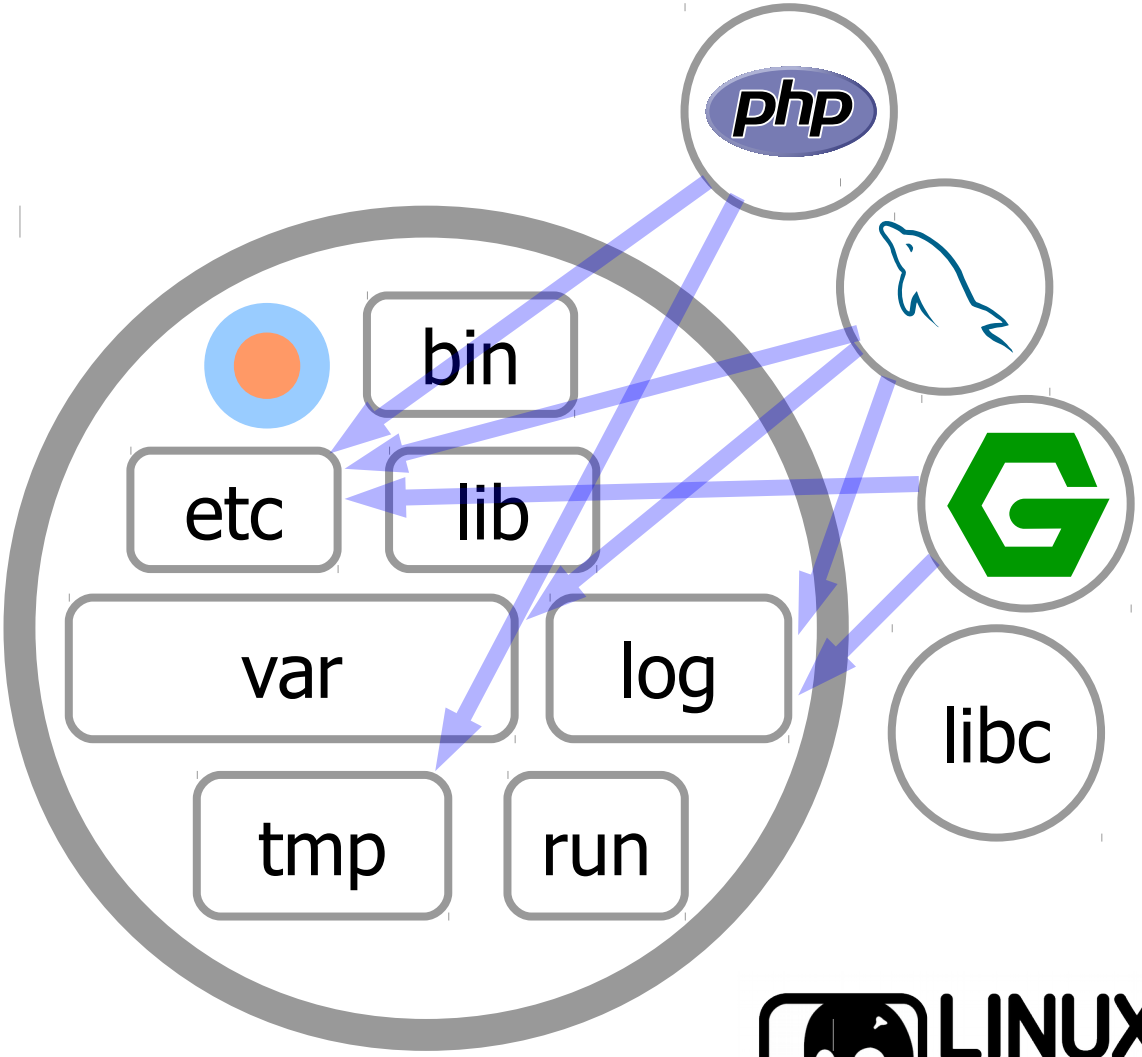
Jetware — export into environment

Changeable data

- Copied
- Separate sections
- Own FHS



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Packages self-integration

Data export to another packages

Relations, files or API

Example

package **mysql** exports own C-headers into **cc** package

Settings value for another packages

Example

mongodb_tuning assigns `mongodb.port=22333`

Easy rider

Demo implementation with Jetware

- Builds by dependencies, versions
  - Own subprojects and third-party components
- Repositories with testing → staging flow
- Docker-container creation
  - 40 — 500 packages
  - 1.5 — 20 seconds

Expected

- ~ ~~180~~ 120 own machines (CI — 30, 90 — SaaS)
- < ~~200~~ 0 machines from AWS

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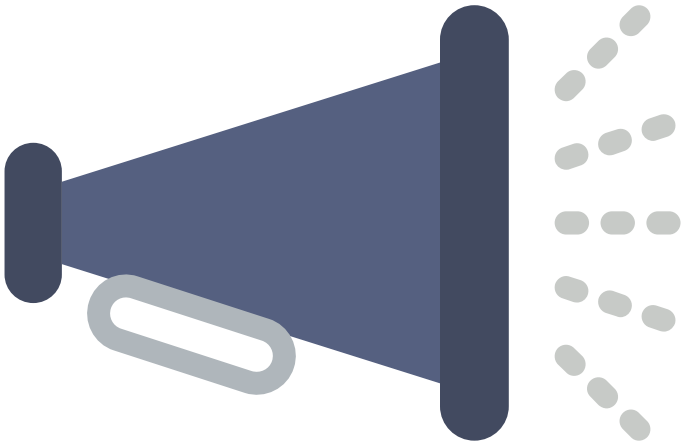
The evolution of distributed systems management

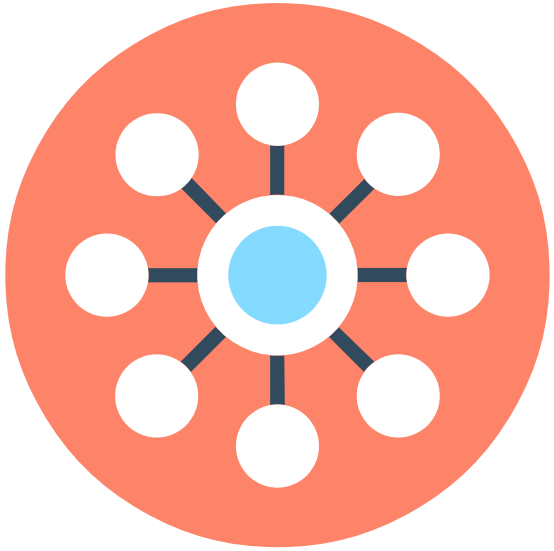
Macro-level

Orchestration



Micro-level

Self-constuction



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What’s next?

Systems management fusion both on macro-level and micro-level

~ 1 — 3 years

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Life cycle of a service

Developer

1 Source code + libraries

2 Compiling, building

3 Dependencies integration

4 Testing

5 Export to image

6 Deployment

7 Put into operation

???

Orchestration

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Does the program need OS?

Program needs

- Kernel for syscalls
- File system
- Runtime environment
  - Libraries and executables
  - Another data — resources

OS environment — not needed

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Must the program be implanted to OS?

To access the program we need

- To know where it is placed
- To feed the data input
- To accept the data output

The program can be anywhere — OS is not needed

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Tight binding of OS and application

Historical heritage

Influence of Linux distributions

Self-constructing autonomous program

Is not bound to OS

Describes

- Runtime dependencies (packages, services)
- Interface
  - Consuming and suppling resources (port, stdin/stdout etc)
- Build rules (optional)
  - Sources
  - Build dependencies

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Management on macro-level

Scheduling object

- Application: package and version

Starting an application

- Package building or retriving from a repository
- Runtime environment construction
- Service deployment and execution
- Publishing interface data for service discovery

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Service package description

```
postgresql-cluster-user-geotags-5.1
 requires:
  postgresql-9.1
  postgresql-cluster-config-2.1
  storage-ssd-1:
   env:
    volume: user_geotags
    size: 1gb
```

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Versions and updates

Developer releases the version

- commit in repository tagged with version

Another service has reference on package-version

- service is building and executing

No reference on package-version

- garbage collector stops the service

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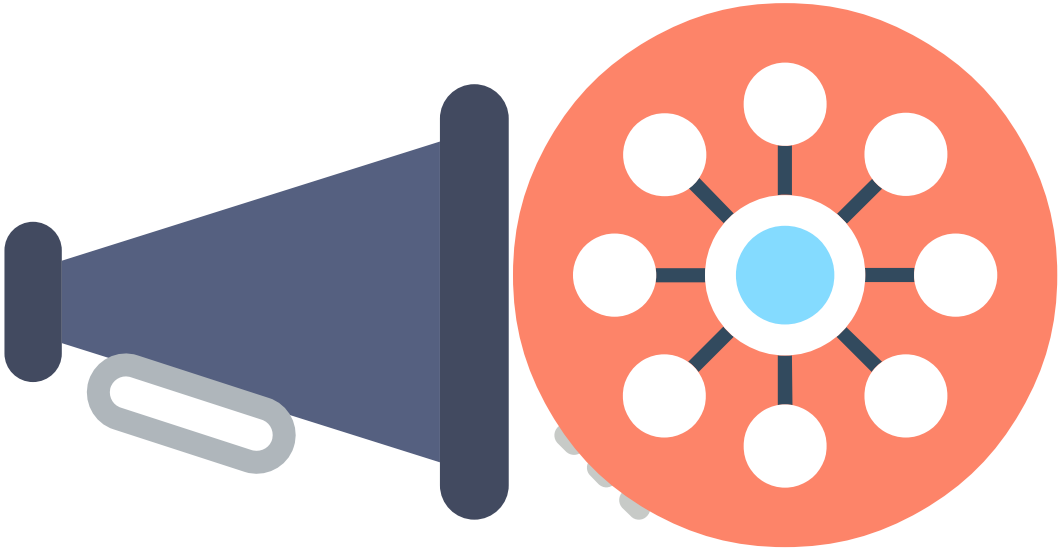
The evolution of distributed systems management

Macro-level and micro-level fuse



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Robots replacing devops

Developers and sysadmins returning to the more intellectual work

And then?

Some years later

The fifth stage of evolution - self-organization

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How devops exhausts itself, and what will happen next

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