Continuous Integration and Kamailio

Automating builds, deployments and tests for fast-moving projects

About me

- 15 years “in the ~~trenches~~ cubicles”
- Developer of RTC (VoIP, IM, WebRTC) solutions
- Often dealing with DevOps topics
- Founder of **RTCSoft** in 2015
- Working with Orange Libon Voice Team

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Material for the Workshop

- https://github.com/giavac/kamailio_ci
  - rtpengine_build
  - kamailio_testing
- (You can start preparing the base Docker images)

Kamailio and the need for CI

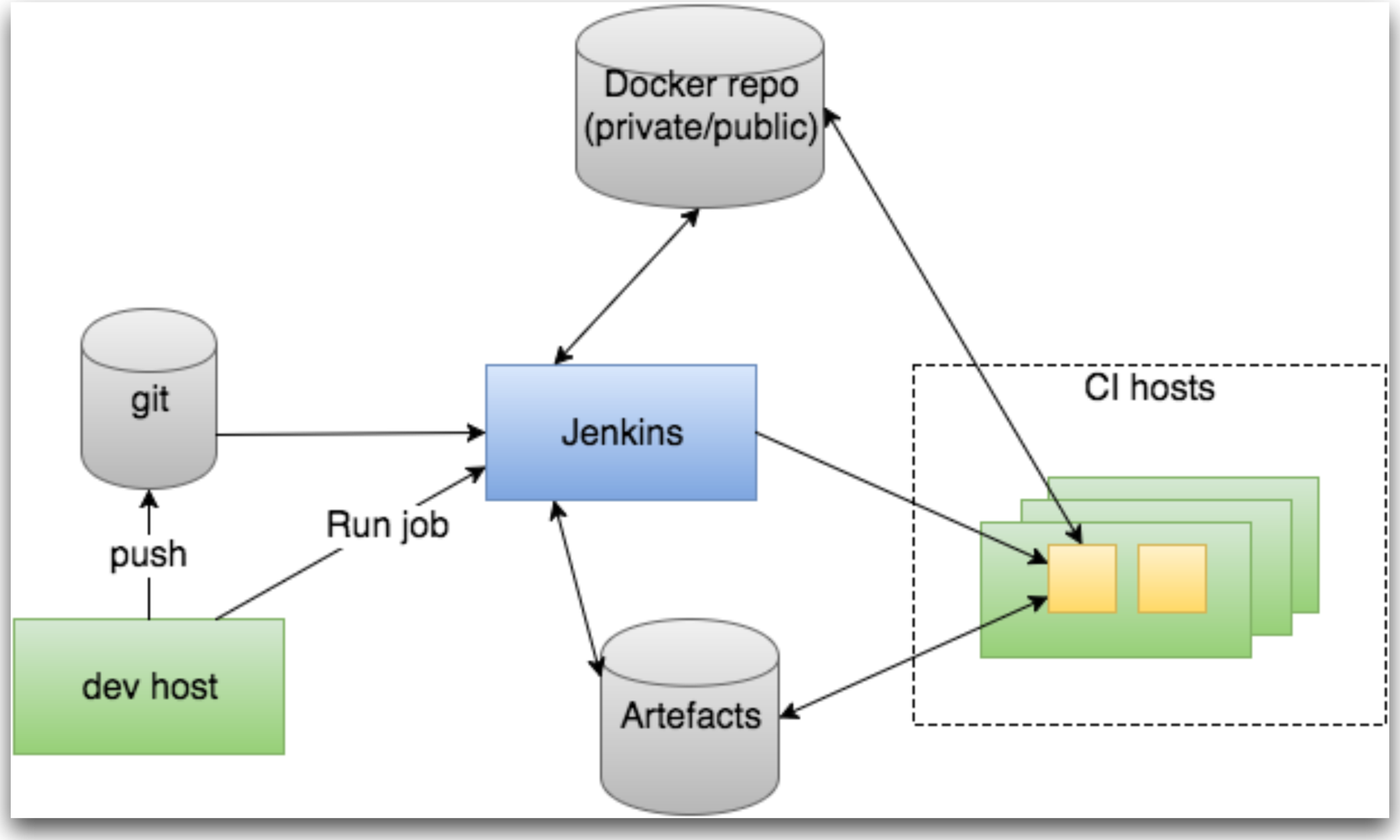
- Several developers working on the same code base
- Not everybody uses stock packages (in-house builds)
- Save time (test continuously, so that the uncertainty on QA is low)
- Save money (reduce costs of building/testing machines)
- Release more often, with lower risks

CI servers

- Most used CI platforms are OSS: Jenkins, Travis
- Automation of Build, Test, Deployment
- Integration with git and other tools
- Jenkins: typical for private CI infrastructures
- Travis: designed for Open Source projects

Build automation

CI infrastructure for builds



Build environments

- Personal VM/Dedicated dev machine
- Jenkins with dedicated build machine (slave)
- Jenkins with Docker-based slaves
  - Docker plugin
  - Mesos cluster management

Artefacts

- Packages, tarballs, Docker images, other files to be uploaded
- Private and public repos
- Use existing artefacts to reduce build time and improve consistency
  - Build once, use many times
- Careful (and possibly unique) versioning

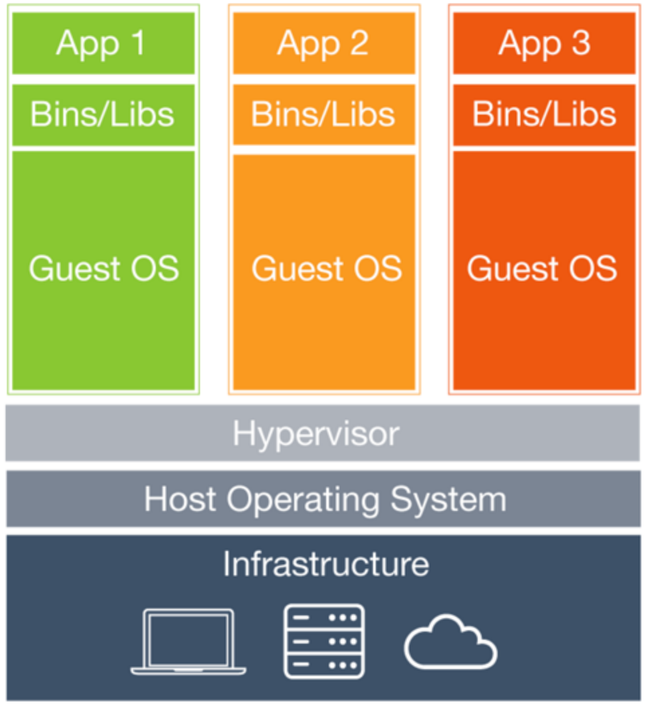
How clean is your build environment?

- Full control of build requirements:
  - Not sharing environments across apps
  - Not reusing polluted environments (keep releases predictable)
- Clean up the build environment or…
- Create a new environment for each build
  - Containers as light-weight “build machines”
- Build once, test until production (“non-event releases”)

A huge opportunity: Docker

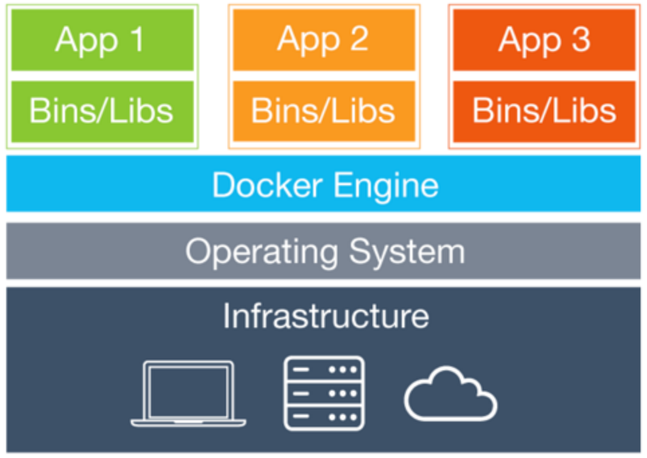
- Quick introduction to Docker
  - Simulate a specific Linux distribution in seconds
  - Virtualise, while keeping the host performances
- “A few dedicated build machines” vs “Many disposable build containers”
- Keep builds reproducible by always creating clean environments

Container-level virtualisation



Virtual Machines

Each virtual machine includes the application, the necessary binaries and libraries and an entire guest operating system - all of which may be tens of GBs in size.



Containers

Containers include the application and all of its dependencies, but share the kernel with other containers. They run as an isolated process in userspace on the host operating system. They're also not tied to any specific infrastructure – Docker containers run on any computer, on any infrastructure and in any cloud.

Source: https://docs.docker.com/

Base build images for kamailio

- Pre-requirements
- Keeping the images small
- Many different distributions
- (Beware of container re-use)

Dockerfile for base CentOS kamailio

```
FROM centos:7

RUN rpm -Uvh http://dev.mysql.com/get/mysql-community-release-el7-5.noarch.rpm && \
    yum install -y gcc make bison flex libcurl libcurl-devel libunistring-devel \
                   openssl openssl-devel pcre-devel zlib-devel lua-5.1.4-14.el7 \
                   lua-devel-5.1.4-14.el7 mysql-community-devel-5.6.26-2.el7 \
                   libxml2-devel perl-ExtUtils-Embed net-snmp-devel memcached \
                   cyrus-sasl-devel && \
    yum clean all
```

Dockerfile step by step

- Define base image (FROM)
  - Change this to the distribution needed, or to other base images
- Install dependencies packages (RUN - rpm/yum)
- Clean up yum configuration (limit image size)

Build base image

```
$ cd kamailio_async_centos7/
$ docker build -t gvacca/kamailio_async:centos -f Dockerfile.centos7 .
$ docker images |grep kamailio_async
gvacca/kamailio_async   centos7             3fa45a9c3c1e        3 days ago          393.8 MB




($ docker build -t USER/IMAGE:TAG [-f DOCKERFILE] .)
```

This base image will be used later as build host for kamailio

Good practices when using containers

- Avoid git checkout inside containers
- Do not copy sensitive data into images
  - Make data available indirectly (volumes)
- Clean up after yourself: keep images small
  - Limit the number of instructions (RUN)
  - Careful about the caching system
- Define the “base build image”, to be reused
  - Reduce unnecessary re-builds
  - Ensure same pre-requisites are enforced
  - Be careful about container re-usage (e.g. “life time” in a Mesos cluster)

Building kamailio

Build instruction:

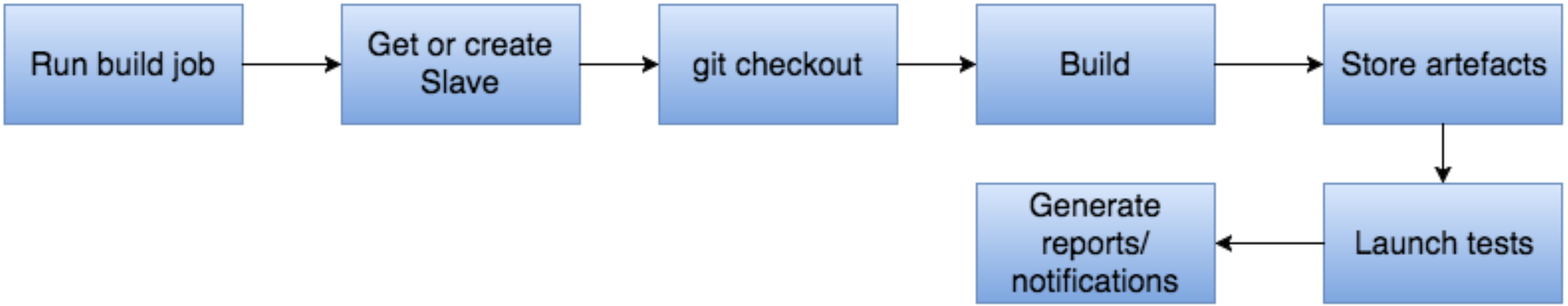
```
$ docker run -t --name kamailio_async_built_debian_4.4.1 -v ~/git/kamailio-devel/
kamailio:/root/kamailio -v $PWD/kamailio_async_debian/scripts:/root/scripts gvacca/
kamailio_async:debian /root/scripts/build.sh

($ docker run -t --name ${BUILT_KAMAILIO} -v ${KAMAILIO_SRC}:/root/kamailio -v $PWD/
kamailio_async_${TEST_DISTRIBUTION}/scripts:/root/scripts ${TEST_USER}/
kamailio_async:${TEST_DISTRIBUTION} /root/scripts/build.sh)
```

/root/scripts/build.sh:

```
make distclean
make cfg include_modules=http_async_client
make all
# or create tarball/rpms
# and store artefacts
```

Build job

- Uses the “base build image” as slave
- Maximise reproducibility of builds: re-use slaves carefully



Base build images for rtpengine

- Stronger restrictions on the host kernel
  - But doesn’t need to have the same as the target host
- Ensure the right **kernel headers** are in place
- Build and prepare artefacts as for other cases

Dockerfile for rtpengine base image

```
FROM centos:7

RUN yum install -y make glib2-devel zlib-devel kmod hiredis-devel \
                   openssl-devel xmlrpc-c-devel iptables-devel git \
    && yum clean all
```

Building rtpengine

```
$ cd $SRC
$ git clone https://github.com/sipwise/rtpengine

$ cd $PROJECT/rtpengine_build/
$ docker build -t gvacca/rtpengine:centos -f Dockerfile .

$ docker run -t --name rtpengine_built -v $PWD/:/root -v $SRC/rtpengine:/root/rtpengine \
gvacca/rtpengine:centos /root/build.sh

$ docker ps -a|grep rtpengine
78edf9e7412c        gvacca/rtpengine:centos             "/root/build.sh"         2 minutes ago
Exited (0) 27 seconds ago                                   rtpengine_built

$ docker logs -f rtpengine_built
```

Deployment automation

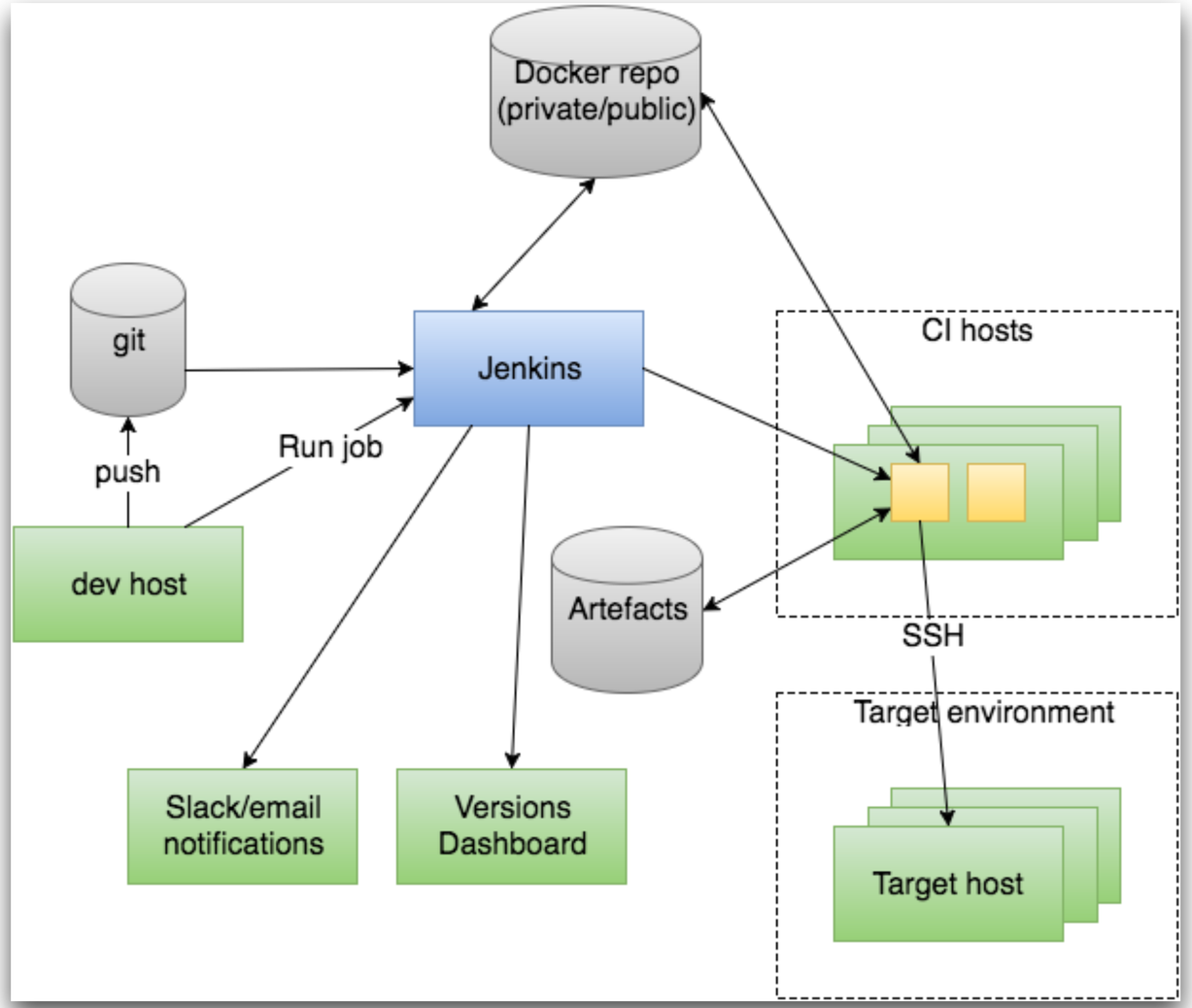
Deploying from a CI platform

- Deploy on Production or other environments (dev, staging, etc)
- Deploy on test beds for the specific purpose of **testing**
- Validate release candidates with automatic tests after deployments

Jenkins + Fabric + Puppet

- Puppet master is the ideal/common scenario
- Puppet standalone for **“push” deployments**
- **Fabric** to transfer Puppet manifests and execute remote deployment
  - Good idea: clean up manifests after the application (as Ansible)
- Docker to host Fabric, its config and Puppet manifests for fast use and encapsulation
- See brand new Puppet module for **Homer**: https://github.com/sipcapture/homer-puppet

From source to deployment



Test automation

A CI inftrastucture comes handy for…

- Unit testing
- Component testing
- Integration testing
- Load testing

We'll see an example later of component/integration testing

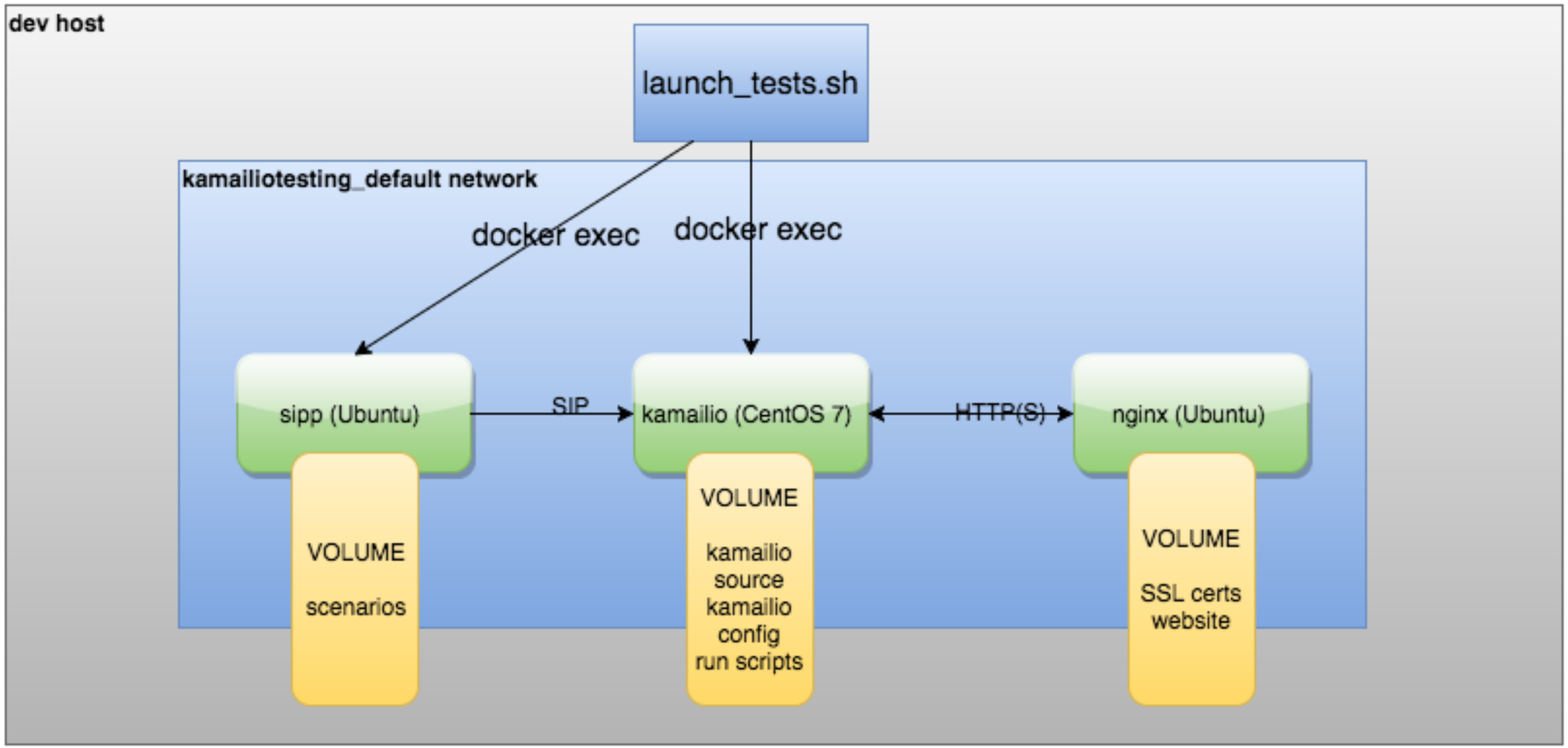
Putting it all together

Case study: testing http_async_client

Asynchronous HTTP client for Kamailio, http://www.kamailio.org/docs/modules/devel/modules/http_async_client.html

- Dockerise all the components (can be run anywhere)
- Test on multiple distributions
- Simulate web servers
- Trigger tests with sipp

Test architecture for http_async_client



Docker Compose to abstract the test architecture

- Docker Compose helps you defining a multi-container architecture
- Containers are “services”
- YAML to define base images, volumes, ports, commands, etc
- Internal naming system: no need to use IP addresses (like e.g. ‘docker network’), just use the service name
- docker-compose.yml supports natively environment variables

docker-compose.yml

```
version: '2'
services:

  nginx:
    image: $TEST_USER/nginx_ssl
    volumes:
      - ./nginx_ssl/website/:/var/www/html/website/
      - ./nginx_ssl/nginx/ssl/:/etc/nginx/ssl/
    ports:
      - 443:443

  kamailio_async:
    image: ${TEST_IMAGE}
    volumes:
      - $PWD/kamailio_async_${TEST_DISTRIBUTION}/scripts:/root/scripts
    ports:
      - 5060/UDP:5060/UDP
    command: /root/scripts/run.sh

  sipp:
    image: $TEST_USER/sipp
    volumes:
      - ./sipp/scenarios/:/root/sipp/
    command: tail -f /dev/null
    depends_on:
      - kamailio_async
```

docker-compose.yml - Variables

- $TEST_USER
- $TEST_IMAGE
- $TEST_DISTRIBUTION

kamailio.cfg under test

```
#!KAMAILIO
mpath="/usr/local/lib64/kamailio/modules/"
loadmodule "pv.so"
loadmodule "tm.so"
loadmodule "tmx.so"
loadmodule "textops.so"
loadmodule "xlog.so"
loadmodule "http_async_client.so"

modparam("http_async_client", "connection_timeout", 10000)
modparam("http_async_client", "tls_verify_host", 0)
modparam("http_async_client", "tls_verify_peer", 0)

debug=2
log_stderror=no
pv_buffer_size=4096

request_route {
   xlog("L_ALERT", "Processing request...\n");
   if ($rm eq "MESSAGE") {
      if(t_newtran()) {
         xlog("L_ALERT", "$ci: requesting $hdr(P-Url)\n");
         http_async_query("$hdr(P-Url)", "http_reply");
      }
   }
}

route[http_reply] {
   if ($http_ok) {
      xlog("L_INFO", "route[HTTP_REPLY]: status $http_rs\n");
      xlog("L_INFO", "route[HTTP_REPLY]: body   $http_rb\n");
      set_reply_body("$http_rb", "text/plain");
      append_to_reply("P-Http-Status: $http_rs\r\n");
      xlog("L_ALERT", "received response $http_rs <$http_rb> for trans $T(id_index):$T(id_label)\n");
      t_reply("200", "Ok");
   } else {
      xlog("L_INFO", "route[HTTP_REPLY]: error  $http_err)\n");
      t_reply("500", "Something is wrong");
   }
}
```

Preparing base images for http_async_client

```
cd nginx_ssl/
docker build -t USER/nginx_ssl .

cd ../sipp/
docker build -t USER/sipp .

cd ../kamailio_async_centos7/
docker build -t USER/kamailio_async:centos7 -f Dockerfile.centos .
```

Prepare and run tests

```
$./prepare_built_kamailio.sh gvacca debian ~/git/kamailio-devel/
kamailio 4.4


$ ./launch_tests.sh gvacca/kamailio_async:debian_4.4.1


$ docker logs -f kamailiotesting_kamailio_async_1
```

Containers and network

```
$ docker ps
IMAGE                           COMMAND                  PORTS                                NAMES
gvacca/kamailio_async:ubuntu    "sh /root/build_run.s"   0.0.0.0:5060->5060/udp               kamailiotesting_kamailio_async_1
gvacca/nginx_ssl                "/bin/sh -c nginx"       80/tcp, 0.0.0.0:443->443/tcp         kamailiotesting_nginx_1
gvacca/sipp                     "tail -f /dev/null"                                           kamailiotesting_sipp_1


$ python inspect_docker_network.py kamailiotesting_default
29d589f5db0c6f32973c58c05678094cf1f1f83d8dfcf43c4850a8fa3a3ccb39 '/kamailiotesting_sipp_1': 172.18.0.3/16
75a8139ea6b3102a844ee8becbc9ba7a26df86bb70a2f31589bfad8f86114032 '/kamailiotesting_nginx_1': 172.18.0.2/16
b9472f70cccdc968cc1d61c9caca02118ed2c1957fd13f2bb18fe2eaefd0e310 '/kamailiotesting_kamailio_async_1': 172.18.0.4/16
```

Conclusions/future

- kamailio, as other apps, will run inside containers
  - “Service Discovery” tools will be key
- Emulation of entire infrastructures on top of container-based platforms
- Lightweight distributions as simple containers infrastructure
- Continuous Integration/Delivery will be the norm

Q&A

References and useful sources

- https://www.kamailio.org/w/2015/11/building-kamailio-in-docker/
- “The Docker book”, J. Turnbull, http://www.amazon.co.uk/Docker-Book-Containerization-new-virtualization-ebook/dp/B00LRROTI4
- “Using Docker”, A. Mouat,https://www.amazon.co.uk/Using-Docker-Adrian-Mouat/dp/1491915765
- “Continuous Delivery”, J. Humble, http://www.amazon.com/Continuous-Delivery-Deployment-Automation-Addison-Wesley/dp/0321601912
- “Building Microservices”, S. Newman, http://shop.oreilly.com/product/0636920033158.do
- "Docker Networking and Service Discovery", https://www.nginx.com/resources/library/docker-networking/

More presentations on this topic

- “Docker and Puppet for CI”, http://www.slideshare.net/GiacomoVacca/docker-and-puppet-for-continuous-integration
- “Automatic Kamailio Deployments with Puppet”, Kamailio World 2014, http://www.slideshare.net/GiacomoVacca/automatic-kamailiodeploymentswithpuppet-33085423

Thanks!

- Federico Cabiddu
- Camille Oudot
- Victor Seva

Additional slides

Docker inside docker

- Manage an environment of containers inside a container
  - Powerful
  - With disadvantages
- Consider the “sibling” approach, rather than the nested one
  - Build networks of containers and command some of them via the socket API