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DTN tests run in a Dockerised environment:

A Blessing or a Curse?

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GÉANT Infoshare - Data Transfer Nodes: How Fast can your Data Travel?

In this presentation, we will cover

1. What is Docker
2. Docker architecture
3. Containers vs Virtual Machines
4. Data Transfer Nodes (DTNs) meet Docker
5. Docker Installation with DTN Software Containers in GTS
6. Results of GÉANT Testbed Service (GTS) Dockerised DTN Tests
7. Scripts and Manuals provided for Dockerised DTN test
8. Demonstration

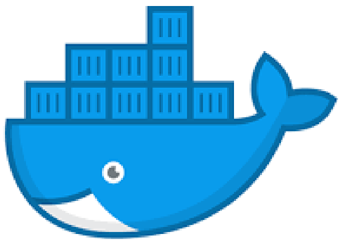
What is Docker

- ***Docker*** is a ***set of Platforms as a Service*** (PaaS) products that uses ***OS-level virtualisation*** to ***deliver software*** in ***packages*** called ***containers***.

- ***Containers*** are ***isolated*** from ***one another*** and bundle ***their own software, libraries and configuration files***; they ***can communicate with each other through well-defined channels***

- All ***containers*** are ***run*** by a ***single operating system kernel*** and therefore use ***fewer resources*** than ***virtual machines***

- The ***service*** has both ***free*** and ***premium tiers***. The ***software that hosts*** the ***containers*** is called ***Docker Engine***.

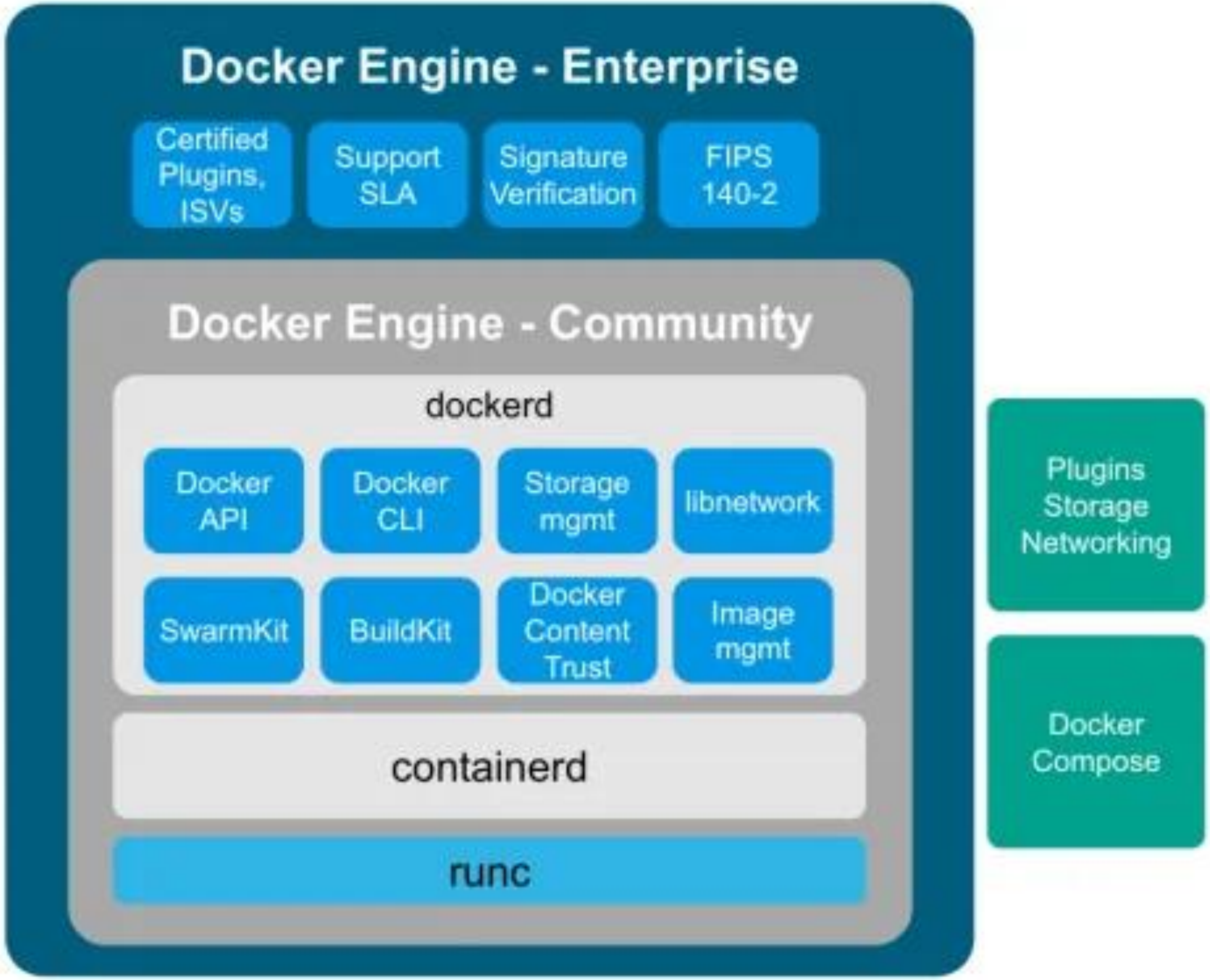


Docker architecture

The Docker architecture it is a ***client-server architecture***. The ***client communicates*** with ***the Docker daemon for***:

- ***Building*** of containers
- ***Execute/run*** the containers
- ***Distribute*** the containers

The ***Docker client and daemon communicate*** using a ***Rest API, over UNIX sockets or a network interface***

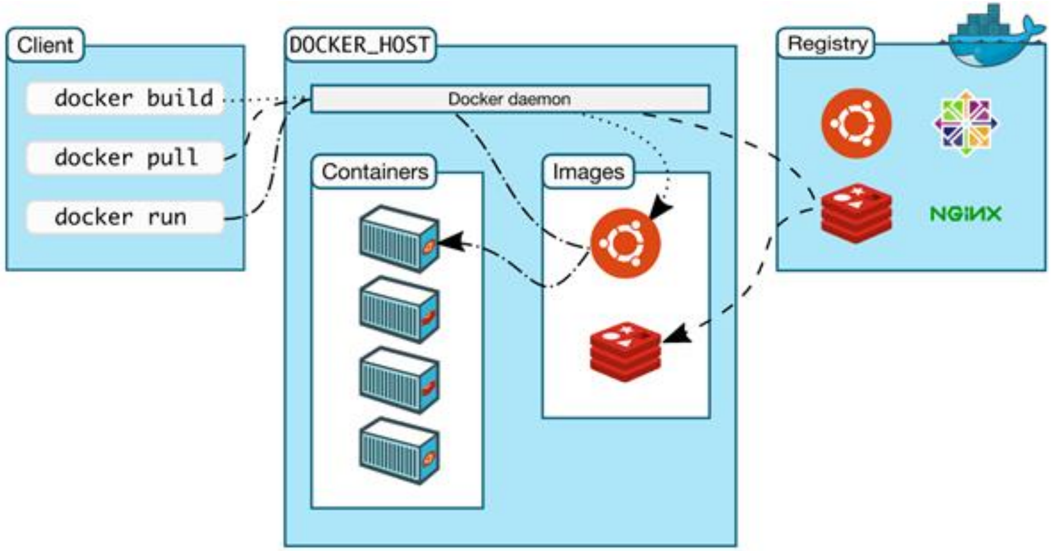


https://www.docker.com/blog/introducing-docker-engine-18-09/

Docker architecture

The Docker Architecture consists of the following components:

- ***Docker daemon*** (service)
- ***Docker client*** (***client manager*** for the ***service***)
- ***Docker registry*** for storing Docker images
- ***Docker objects***. The aforesaid components are handled as objects by Docker. Additionally, the following components reside in Docker as objects:
  - ***Image***: is a read-only ***template with instructions for creating a Docker container.***
  - ***Container***: is a ***runnable instance of an image***.



Client

docker build

docker pull

docker run

DOCKER_HOST

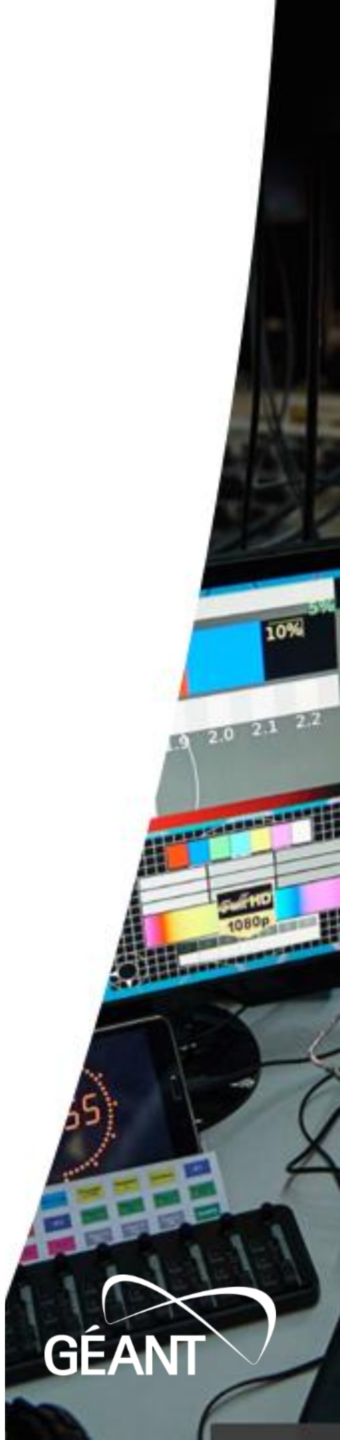
Docker daemon

Containers

Images

Registry

https://docs.docker.com/get-started/overview/

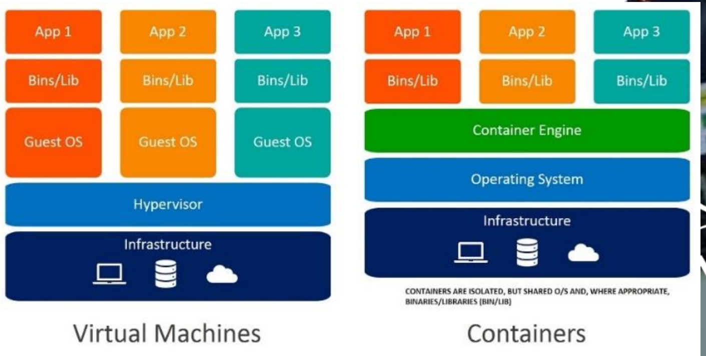


Containers vs Virtual Machines

Containers vs ***VMs differences*** are in terms of ***scale*** and ***portability***:

- ***Containers*** are ***small in disk size***. They don’t package anything bigger than an app and all the libraries and files fundamental to run it. The **lightweight** nature of containers with the use of a a ***shared operating system*** makes the ***move across multiple environments effortless (Disaster Recovery)***. ***Containers*** provide a ***technique to virtualise an OS*** so that ***different workloads can run*** on a ***solitary OS instance***.
- ***VMs*** are relatively ***huge in disk size***. They ***include their own OS***, permitting them to perform ***numerous resource-intensive functions*** at once. The ***expanded resources offered to VMs permit them to abstract, split, duplicate, and emulate*** entire servers, OSs, desktops, databases, and networks. In ***VMs***, the ***hardware*** is ***being virtualised*** to run ***multiple OS instances***.

Containers’ speed, agility, and portability make containers an important tool for technology deployments.



[https://www.weave.works/assets/images/bltb6200bc085503718/containers-vs-virtual-machines.jpg]

DTN meets Docker in GTS

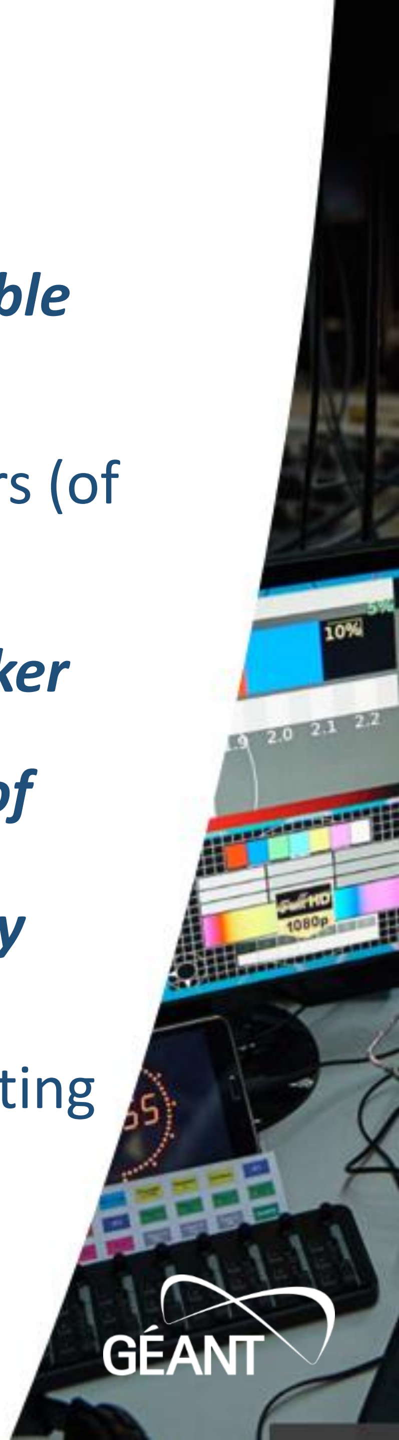
Why run DTNs on Docker?

Because Docker supports the following:

- ***Setup containers with specific services*** (DTN Services) that can be ***accessible*** though the **host IP address**
- ***Common sharing folder*** among host and containers
- ***Unrestricted CPU, Memory and bandwidth*** (interface) access to containers (of course this is ***restricted to hardware limitations*** of the host)
- ***Containers*** are ***light*** in terms of ***resource consumption***.
- We can ***have multiple services*** (each service will be a container) on a ***Docker Host***
- ***Docker*** is written in the ***Go*** programming language and ***takes advantage of several features*** of the ***Linux kernel*** to ***deliver its functionality***.

Docker is constructed with the vision to provide ***flexibility, dynamicity and easy integration of updates on containers***. Therefore, a DevOps engineer can easily ***update the DTN software to another container, push the container to the live system and delete the old container.*** This functionality is important for DTN testing and integration, but the overmentioned functionality will ***reduce the risk when updating the DTN services and software***.

GTS is selected because it can provide the necessary resources to setup and maintain a Dockerised environment. This is also shown with the results.



DTN meets Docker at GTS

The following DTN software and Services are installed as a *separate container* in Docker:

- ***GridFTP***
- ***FDT***
- ***XrootD***

The selection of DTN software and service is done based on the following factors :

1. ***Linux support*** (Docker on Linux supports Linux Images)
2. ***All are Open Source Projects***
3. ***Good comment***s from users on the ***web*** regarding ***fast data transfer***.
4. They ***provide service and client*** in order to support ***huge file transfers***
5. ***Isolated software without dependency*** on Linux O/S and on Hardware.

The above characteristics make the ***installation of DTN over Docker on GTS very easy, with the use of scripts***.

Docker Installation with DTN Software Containers at GTS

- The group has run several tests in a ***virtualised environment*** using ***containers with Docker***. The focus was on the ***implementation of Dockerised environments*** to ***support specific file transfer services*** (i.e. XrootD, GridFTP and FDT).

- **Dockerised DTN test** are based on the ***client/server logic***. The client can be a separate machine with only ***Linux Base Installation***, the user can run a ***script that it will install the required packages.*** Also, the ***server*** that provides the services can be a ***Linux Base Installation.*** To ***setup*** the ***services*** on the server, it is needed to ***run one script that executes the setup of the Dockerised environment*** and afterwards ***another script*** that will ***setup the container/services***.

- Once this code is ***ready for testing by NRENs***, after the ***setup of the Dockerised environment*** and ***the installation of the containers*** by the participating NRENs who have servers, the participating NRENs will be able ***immediately to do the initial testing*** and evaluation of ***the DTN software*** with the use of a client script, which would include criteria like:
  - ***Performance*** of data transfers for different data workflow characteristics: large bulk transfers, lots-of-small-file transfers, and streaming data transfers.
  - ***Ease of use*** for end users.
  - ***Trust negotiation between the end hosts and security of the transfer.***

Docker Installation with DTN Software Containers on GTS

- ***Within containers in docker*** you can ***manage*** the ***memory consumption and CPU consumption***. However, the ***group containers have a preset CPU and Memory value,*** but if ***they need more***, they can ***directly request it from the host Server***.

- ***Containers configured*** with the services of ***gridFTP, XrootD and FDT*** with ***other ports than the default ports***.
  - "***ctop***" is used for ***getting statistics*** from ***containers*** (bandwidth used, CPU used, memory used).

- ***Client script is monitored*** with the use of "***bmon***" and "***iftop***" tools for ***measuring bandwidth*** usage of the links.
  - During the process we used ***iperf*** for link testing

Results of GTS Dockerised DTN Tests

Hardware testing	Docker		Bare Metal Servers		
	R430	R430	R430	R520	R430
Nodes/Tools	HAMB-PRA	LON-PRA	HAMB-PRA	LON-PRA	LON-PRA
iperf	9.2 Gb/s	9.0 Gb/s	9.41 Gb/s	9.32 Gb/s	9.43 Gb/s
gridFTP	8.53 Gb/s	8.50 Gb/s	8.58 Gb/s	3.30 Gb/s	8.52 Gb/s
FDT	8.87 Gb/s	8.70 Gb/s	9.39 Gb/s	4.12 Gb/s	9.39 Gb/s
XrootD	8.00 Gb/s	8.00 Gb/s	8.00 Gb/s	3.13 Gb/s	7.99 Gb/s

- ***Minor difference*** of results ***between server and client with larger and smaller distance/RTT***
- ***Minor difference*** of results between ***Dockerise with non Dockerise environment***
- ***Minor difference*** of results ***during late morning hours and the rest of the day*** (GTS)
- ***Disk to Disk transfers*** where ***slower than Disk to buffer*** and ***Buffer to disk***

The Tests repeated ***with Centos 7*** and the results where the ***similar to*** the results on **Ubuntu 18.04 .**

Therefore, Dockerised DTN is a Bless!

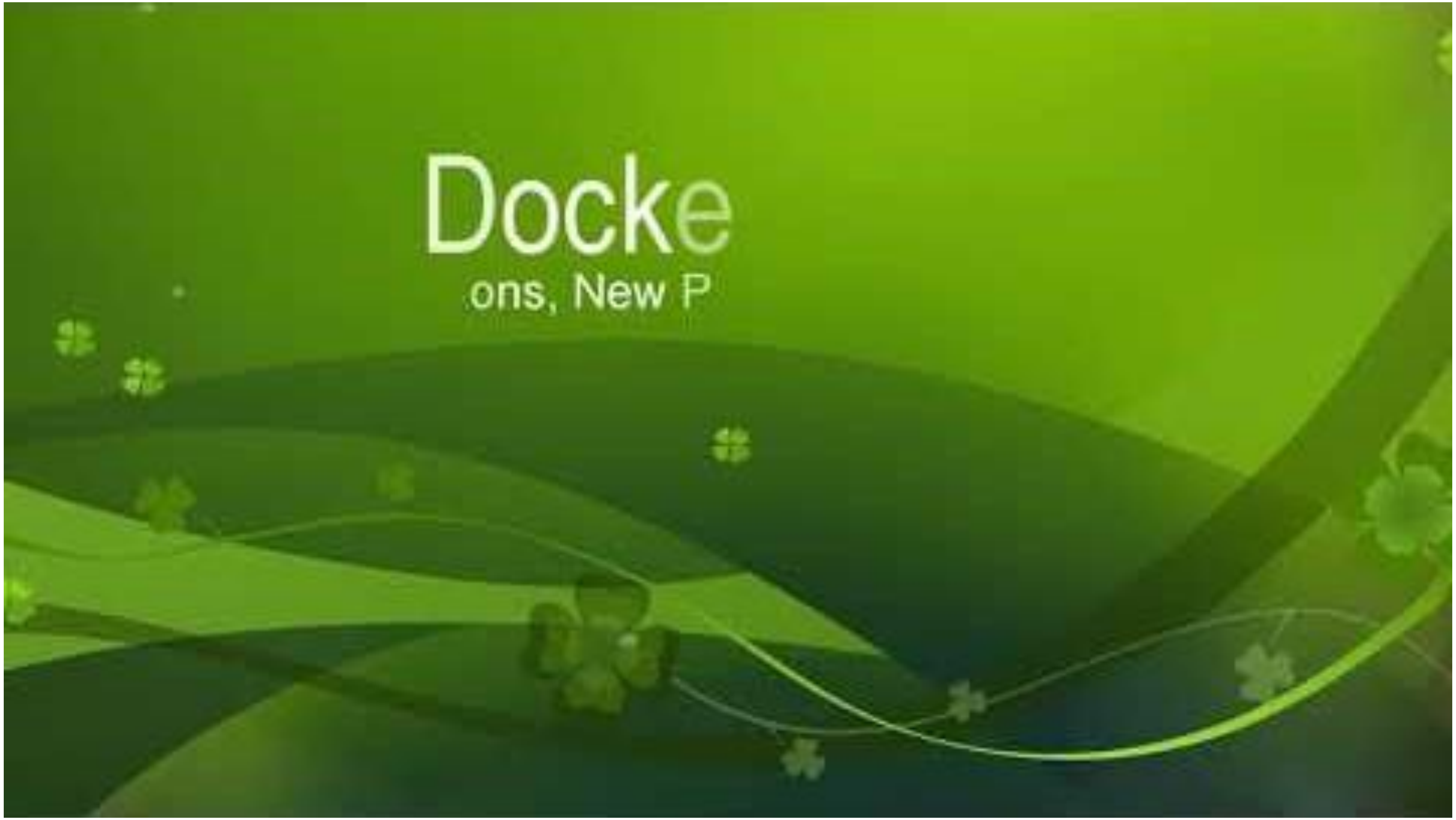
Scripts and Manuals provided for Dockerised DTN test

- The ***scripts*** are ***fully tested*** on ***GTS*** and they are ***fully automatic*** for any O/S (Centos/Ubuntu)
- The following ***Scripts*** and ***Manuals*** are prepared:
  - ***Docker installation scripts and Manuals (Centos/Ubuntu)***
  - ***Docker container installation scripts and Manuals (Centos/Ubuntu)***
  - ***Client script for testing a DTN on another machine (Centos/Ubuntu)***

All are shared at GÉANT project’s public DTN Wiki site

https://wiki.geant.org/display/DTN

Demo



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Thank you

Any questions?

Or email us:

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