



# Routing Algorithms in NDN Networks

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# Plan

## Internship Environment

CISCO & PIRL

Goals and objectives

## Ideas and Strategies

ICN Brief Introduction

Virtualization and Linux Containers

Virtualization and Linux Containers

Routing Strategies

## Routing Algorithms Results

TreeOnConsumer

TreeOnProducer

MinCostMultiPath

Maximum Flow

## Conclusion



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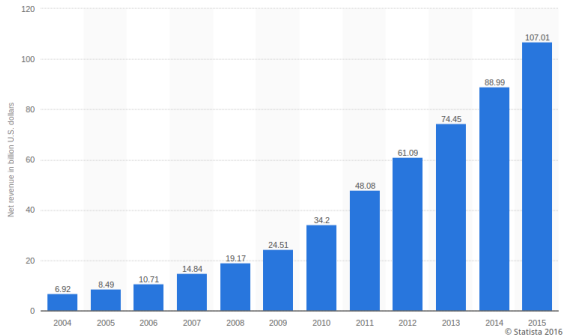
## CISCO & PIRL

Cisco Systems France.



## Goals and objectives

### Net Revenue for Video Delivery Applications



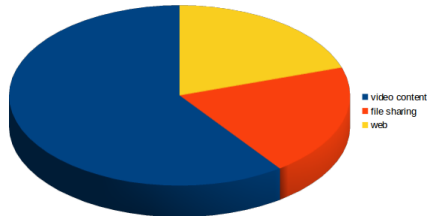
## Goals and objectives

In 2016, More than 96 % of internet traffic is content.

Video → 60%

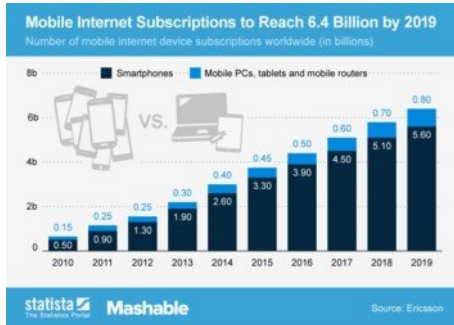
File sharing → 20%

Web → 20%



## Goals and objectives

Mobile vs PC Internet Traffic user → 5G mobile networks





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**Ideas and Strategies**

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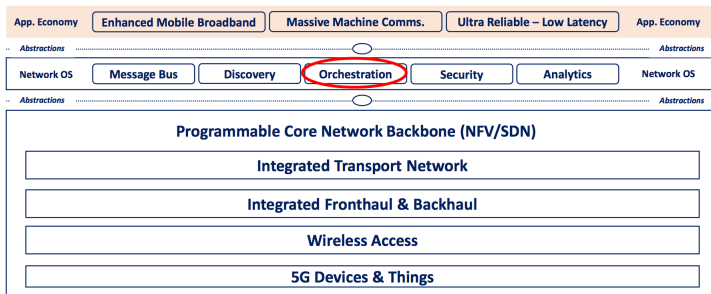
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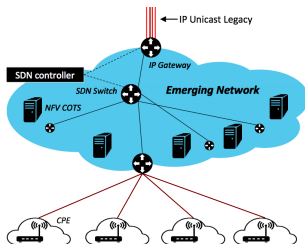
## Named Data networking (NDN)

- ▶ Named Data Networking  $\Rightarrow$  **Name** base Philosophy vs TCP/IP **Calling** Networking.
- ▶ V.Jacobson et al proposition, *Networking Named Content* 2009.
- ▶ A Good fit network desiging for Video Delivery Applications in **5G**.

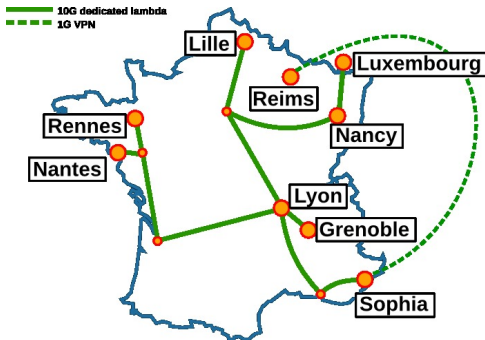


## Named Data networking (NDN)

- ▶ **Lurch** is an orchestrator originally developed for ccnx.
- ▶ We developed Lurch:
  - ▶ For NFD (NDN forwarder).
  - ▶ New Routing Strategies.
  - ▶ Different interfaces to interact with strategies at run time (Client, Repositories, forwarding strategies, ...)

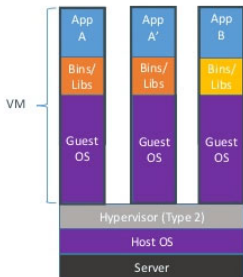


## Named Data networking (NDN)

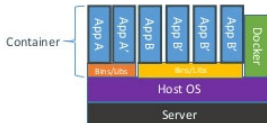


# Virtualization and Linux Containers

Virtual Machines (VM) vs Linux Containers.



Containers are isolated, but share OS and, where appropriate, bins/libraries



## Routing Strategies

We proposed 4 different routing strategies for different situation of networks which can cover all of needs:

- ▶ **TreeOnConsumer** : N clients searching the same content from one repository detected by Lurch (Multicast mode).
- ▶ **TreeOnProducer**: One client who gets the packet from N Repositories of needed data.
- ▶ **MinCostMultiPath**: Using different paths with Equal Cost to retrieve the data using a proper forwarder strategy (load-balancing).
- ▶ **MaxFlow**: Allow to maximize the throughput using paths based on maximum flow algorithm between clients and repositories.

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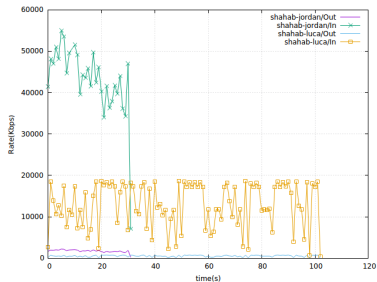
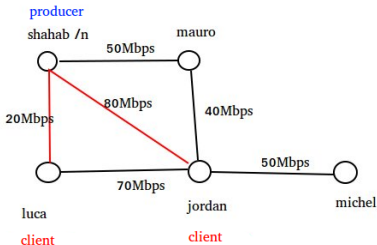
**Routing Algorithms Results**

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TreeOnProducer  
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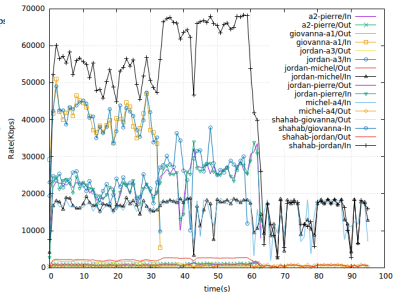
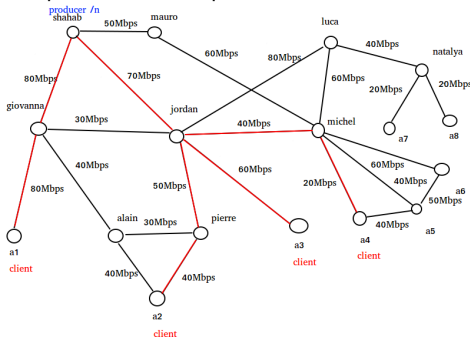
# TreeOnConsumer

One producer to multiple consumer.



# TreeOnConsumer

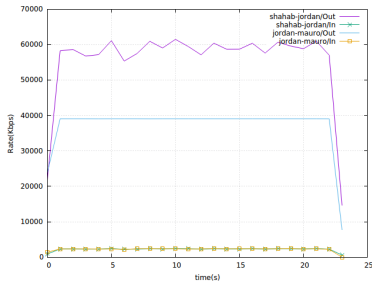
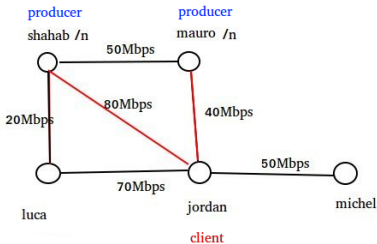
One producer to multiple consumer.





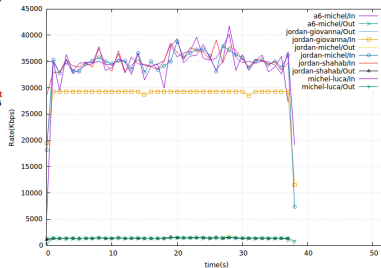
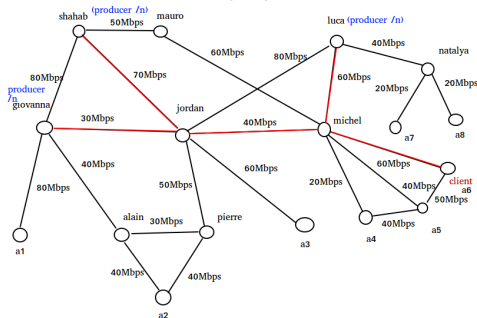
# TreeOnProducer

One Consumer to multiple producer.

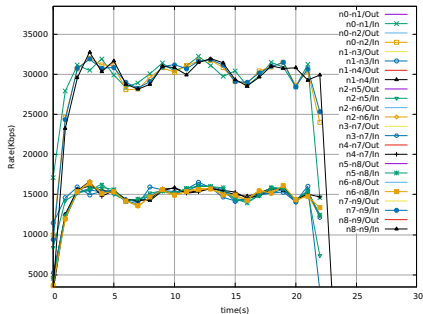
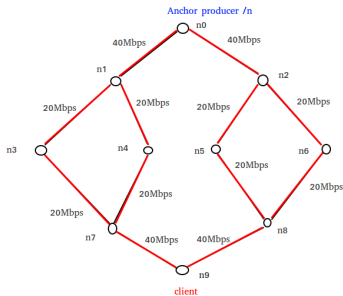


# TreeOnProducer

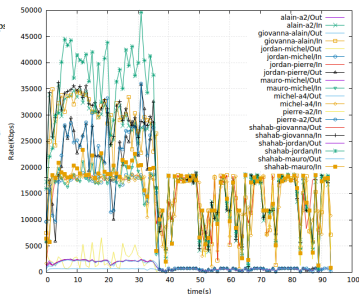
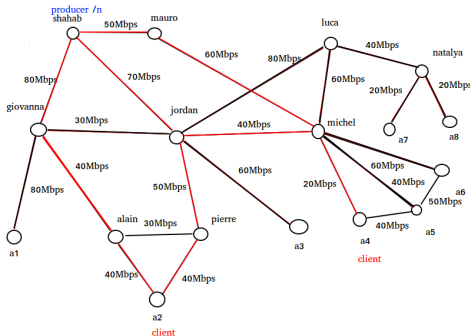
One Consumer to multiple producer.



# MinCostMultiPath

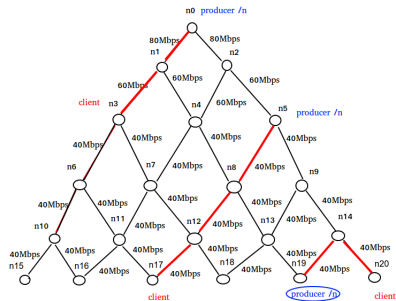
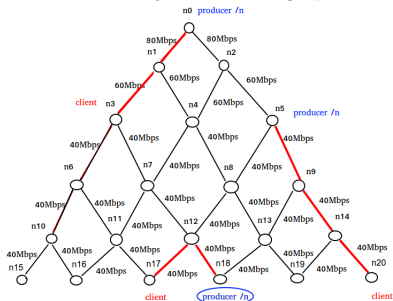


# MinCostMultiPath



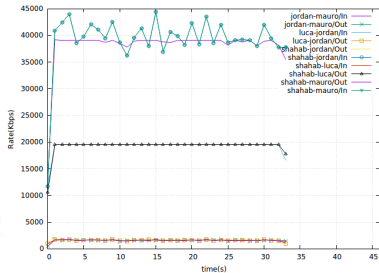
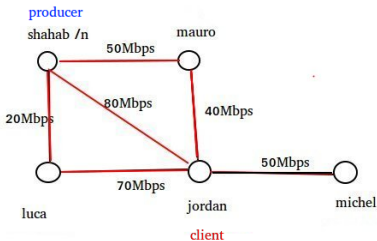
# MinCostMultiPath

Producer Mobility with Routing update.



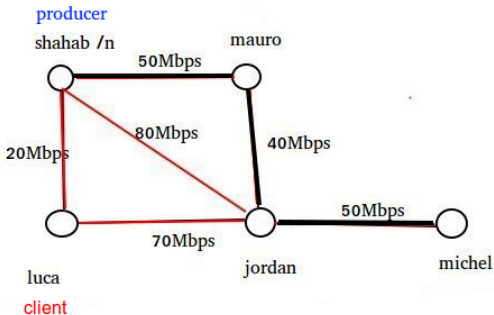
## Maximum Flow

Maximum Flow algorithm chooses the path which maximizes through from consumer to producer.



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## Conclusion

- ▶ There is always some limitations in practical against pure theoretical works which can be seen when you work experimental..
- ▶ ICN is one of the most challenging domain who has a lot of passion in research and development.
- ▶ Software Define Networking is beautiful idea which allows to interact with your network on data centers and to shift heavy calculations.
- ▶ Coding is one of way that you can realize your system.

