Routing Algorithms in NDN Networks

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Plan

Plan

Internship Environment
- CISCO & PIRL
- Goals and objectives

Ideas and Strategies

Conclusion

CISCO & PIRL

Cisco Systems France.

PIRL

Paris **I**nnovation and and **R**esearch **L**aboratory.

Alain FIOCCO
Director CTO

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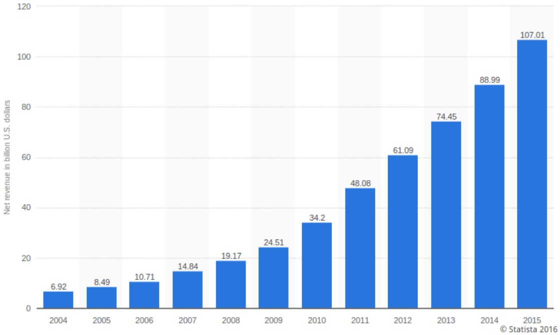
Principle Engineer

Me
Intern Student

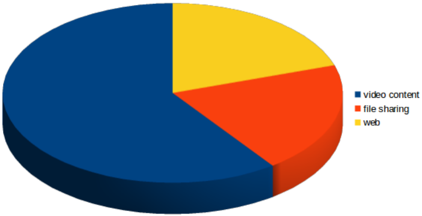
Goals and objectives

Net Revenu for Video Delivery Applications



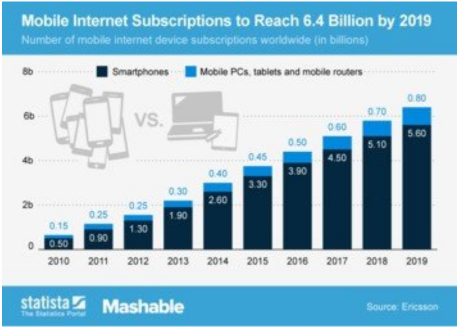
Goals and objectives

In 2016, More than 96 % of internet traffic is content.
Video $\longrightarrow$ 60%
File sharing $\longrightarrow$ 20%
Web $\longrightarrow$ 20%



Goals and objectives

Mobile vs PC Internet Traffic user $\longrightarrow$ 5G mobile networks



Plan

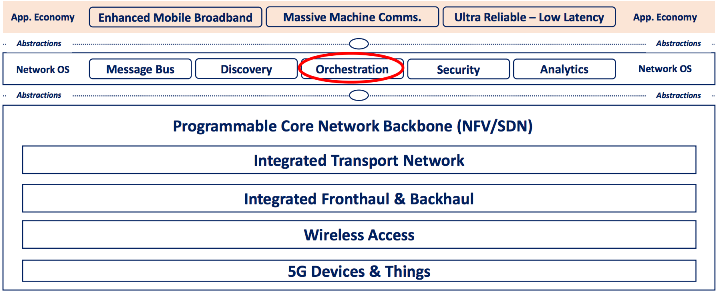
Internship Environment

Ideas and Strategies
- ICN Brief Introduction
- Virtualization and Linux Containers
- Routing Algorithms

Conclusion

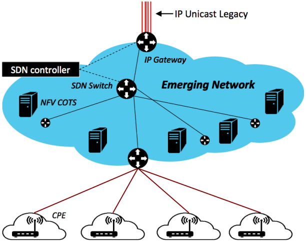
Named Data networking (NDN)

- **N**amed **D**ata **N**etworking $\Rightarrow$ ***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**.



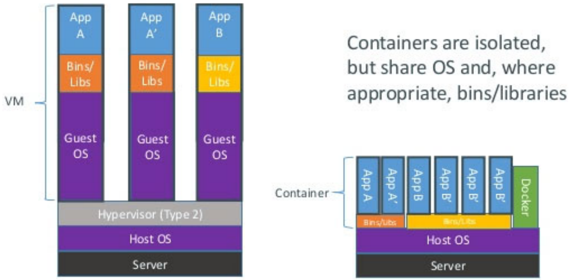
Named Data networking (NDN)

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



Virtualization and Linux Containers

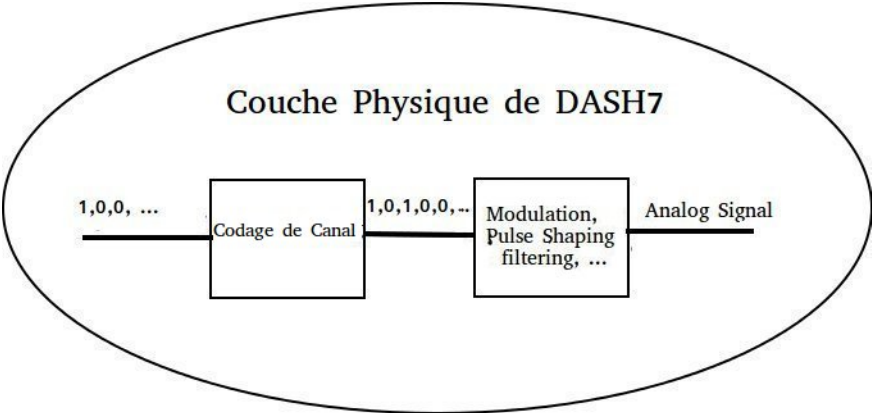
Virtual Machines (VM) vs Linux Containers.



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 wants get the packet from N Repositories (feed) 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.


Couche Physique de DASH7
1,0,0, ...
Codage de Canal
1,0,1,0,0,..
Modulation,
Pulse Shaping
filtering, ...
Analog Signal

Codages du Canal

- Les Codes de Contrôle d'erreur

- Codage à Détecter les erreurs (CRC, CheckSum, Parité, ...).
- Codage à Détecter et Corriger les erreurs(LDPC, Convolutif,Turbo, RS, BCH, ...).

Le Concept Principal de Notre Proposition

Header + Payload + CRC (Convolutif) $\rightarrow$ Header (**RS**), Payload (**LDPC**) + CRC

- Header: RS $\rightarrow$ La longeur petite
  -RS(60,28)
  - Encodage: Structure algébrique des polynomials ($g(x)$).
  - Décodage: Error Trapping.
- Payload: LDPC $\rightarrow$ Pourquoi?

Header	Payload	CRC16
$28Bit$	$16 - 255Byte$	$2Byte$

LDPC vs Convolutif dans les expériences et Handbooks ...

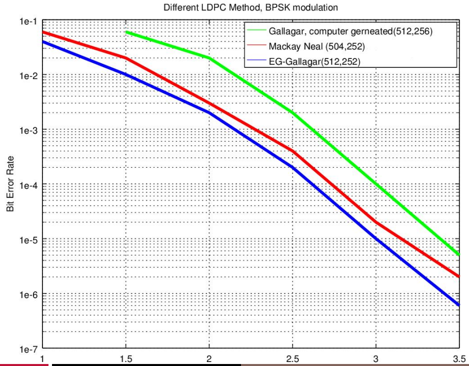
Pourquoi LDPC?

- Très proche à la limite de Shannon (0.042dB).
- Augmentation la taille de Matrice Parité Check → Meilleur Performance.
- Pour changer le taux on peut juste modifier les lignes.
- Ils ne sont pas brevetés et très répandu.
- Application Réseau: 5G, Wi-Fi, IEEE 802.16 (WiMAX), 10GBase-T de Ethernet, DVB-S2, ...

LDPC

Choix de LDPC (Méthodes Aléatoires)

- En vert: Gallagar,Computer generated, 1963 $\rightarrow$ Dégradation, *girth* $=$ *4-cycle* $\rightarrow$ Matrice de **Génératrice** (Encodage: non complèxe)
- En rouge: Mackay-Neal, 1996 [1]$\rightarrow$ Eviter les 4-cycles $\rightarrow$ Matrice **Génératrice** (Encodage: complèxe)

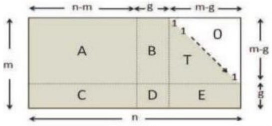


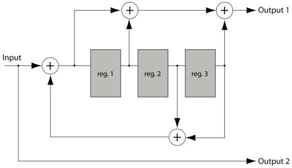
$$\mathbf{H} := \begin{pmatrix} 1 & 0 & 1 & 0 & 1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 1 & 1 & 1 & 1 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{pmatrix}_{4,8}$$

LDPC (1/2) vs Convolutif (1/2)

LDPC Contre Convolutif (Encodage)

- **LDPC Mackay-Neal**: Complèxe $\rightarrow$ Algorithm de Richardson-Urbanke $\rightarrow$ Diréctement a travers de **H** — $O(n^2) \rightarrow O(n + g^2)$.
- **Convolutif**: Circuit de Shift Register.





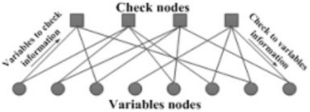
LDPC (1/2) vs Convolutif (1/2)

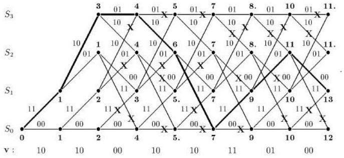
LDPC Contre Convolutif (Décodage)

LDPC:

- Hard: Algorithme de Bit flipping → Graph Tanner (iteration = 10) .
- Soft: Algorithme de Log-DomainSimple (Version simplifiée de l'algorithm SPA) → Probabilité a priori (ML) (iteration = 10)

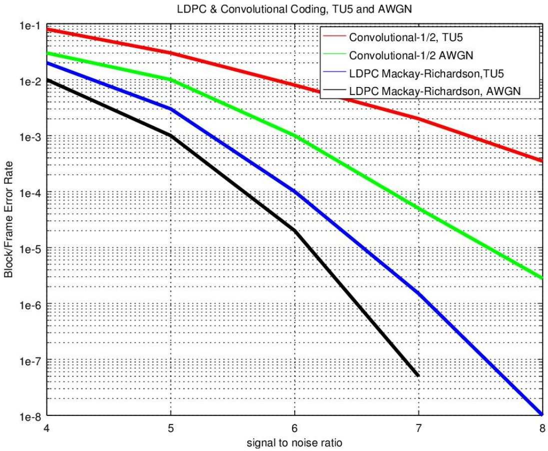
- **Convolutif**: Algorithm de Viterbi → Graph Trellis





LDPC (1/2) vs Convolutif (1/2)

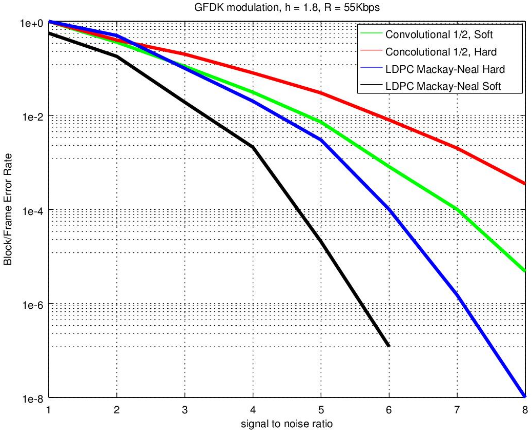
LDPC vs Convolutif



LDPC (1/2) vs Convolutif (1/2)

LDPC(1/2) vs Convolutif(1/2)

Modèle de canal: AWGN & TU5 (Typical-Urban)→ Jakes algorithm



Plan

Conclusion

- Les Travaux de recherche dovient avoir toujours à la tête les aspects et contraintes pratiques.
- La Simulation est un trés bons moyen pour avoir un preuve théorique Mathèmatique.
- Les Nouvelle Propositions des canaux et Nouveaux Codage du canal peut utiliser au sein de protocole de DASH7.
- Les Autres développements peut se faire au future comme avoir un Relay, Egaliseur, Software Defined Radio ... .


MERCI

Shu Lin, Daniel J.Costello, Jr. *Error Control Coding*. (Second Edition), 2004.