Gigabit WiFi = 802.11ac

Point technologique

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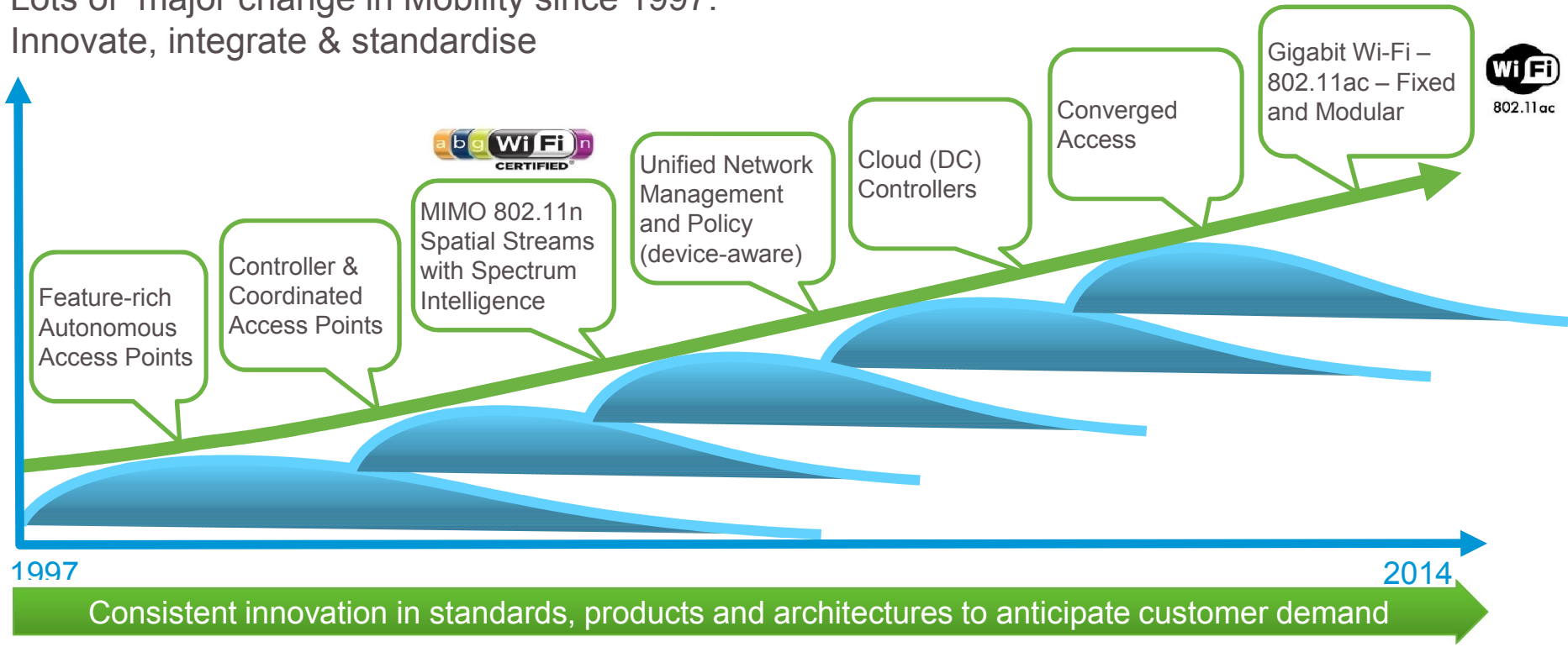
WiFi is Evolving (very) fast

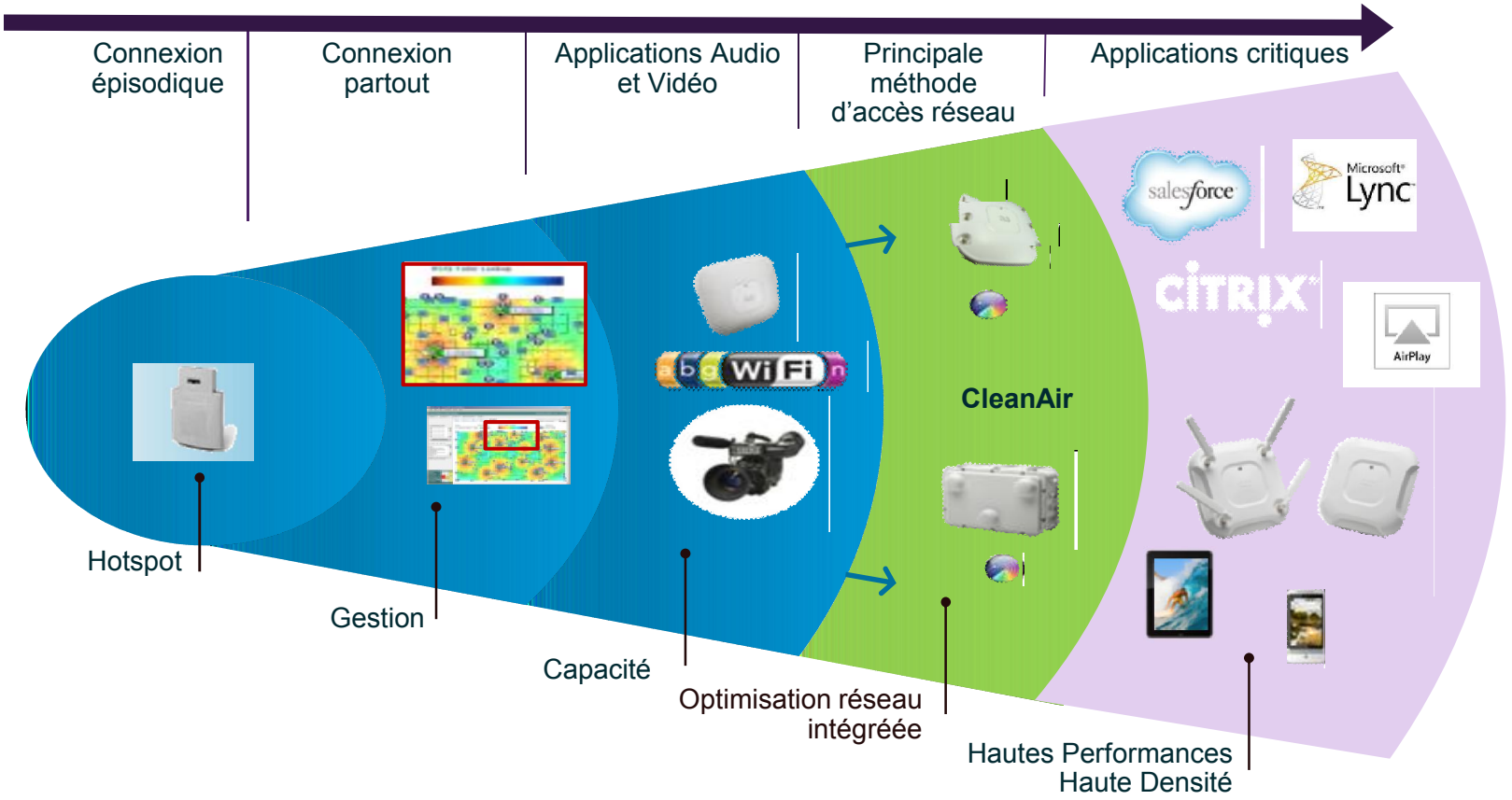
Lots of major change in Mobility since 1997.
Innovate, integrate & standardise



“Le challenge du WiFi aujourd’hui n’est plus tant la taille de la cellule couverte, mais la densité d’équipements connectés dans cette zone de couverture et leur interaction dans un environnement half-duplex, sans scheduling, & sur fréquences partagées non soumises à license d’utilisation…”

Evolution de l'environnement WiFi

Du hotspot à la connexion principale, résiliente et haute-densité



“La nouvelle normalité?”

Combien de temps pour transmettre un même paquet?

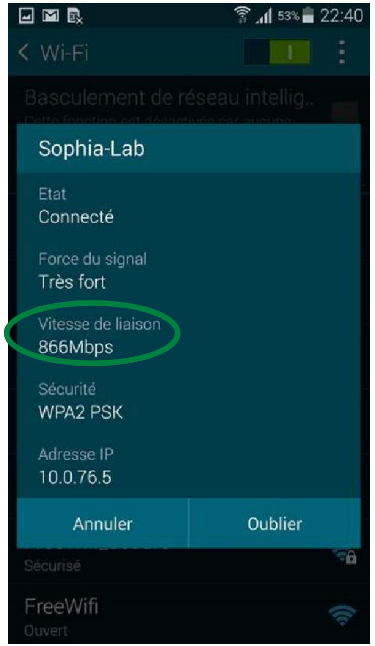
A 11 mbps (802.11b)?

A 54 mbps (802.11a ou g)?

A 300 mbps (802.11n5:2SS)?

A 866 mbps (802.11ac:2SS)?

Le Samsung Galaxy S5 supporte MIMO 2x2:2SS 802.11ac pour la première fois sur mobile (866 mbps)!



Combien de paquets à cette vitesse puis-je transmettre, comparé aux autres vitesses?

Pourquoi 802.11ac est important aujourd'hui?

802.11ac arrive en 2 vagues: Wave-1 (maintenant) et Wave-2 (mi-2015)

De nombreux équipements 802.11ac sont déjà sur le marché, surtout dans les téléphones mobiles et les tablettes.

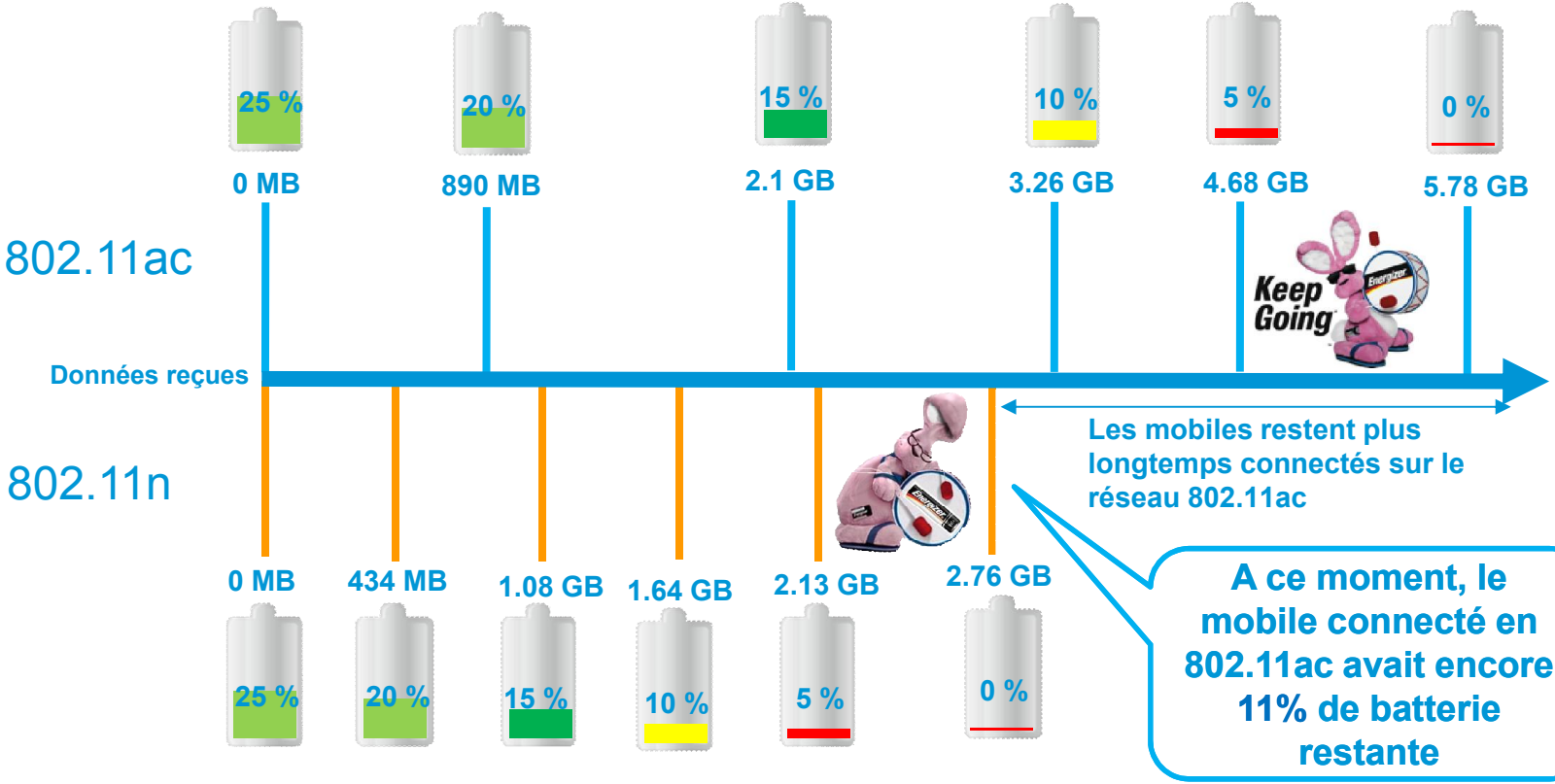
Il y a une grande demande pour plus de performances et de densité WiFi de la part des consommateurs.

iPad Air 2 / iPad Mini 3

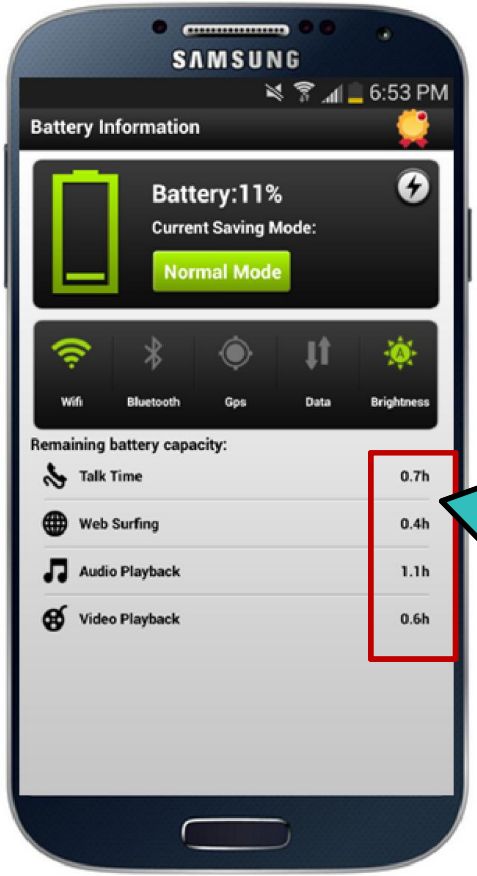
iPhone 6/6+

IDENTIFIEZ LES CLIENTS 802.11AC EXISTANTS en consultant la liste suivante:
https://wikidevi.com/wiki/List_of_802.11ac_Hardware#Mobile_general_purpose_computers_.28non-PC.29

Avantage batterie: 802.11ac comparé à 802.11n



Avantage batterie: 11% restants représentent:



42 minutes d'appel en plus, 66 minutes de musique en plus, etc.

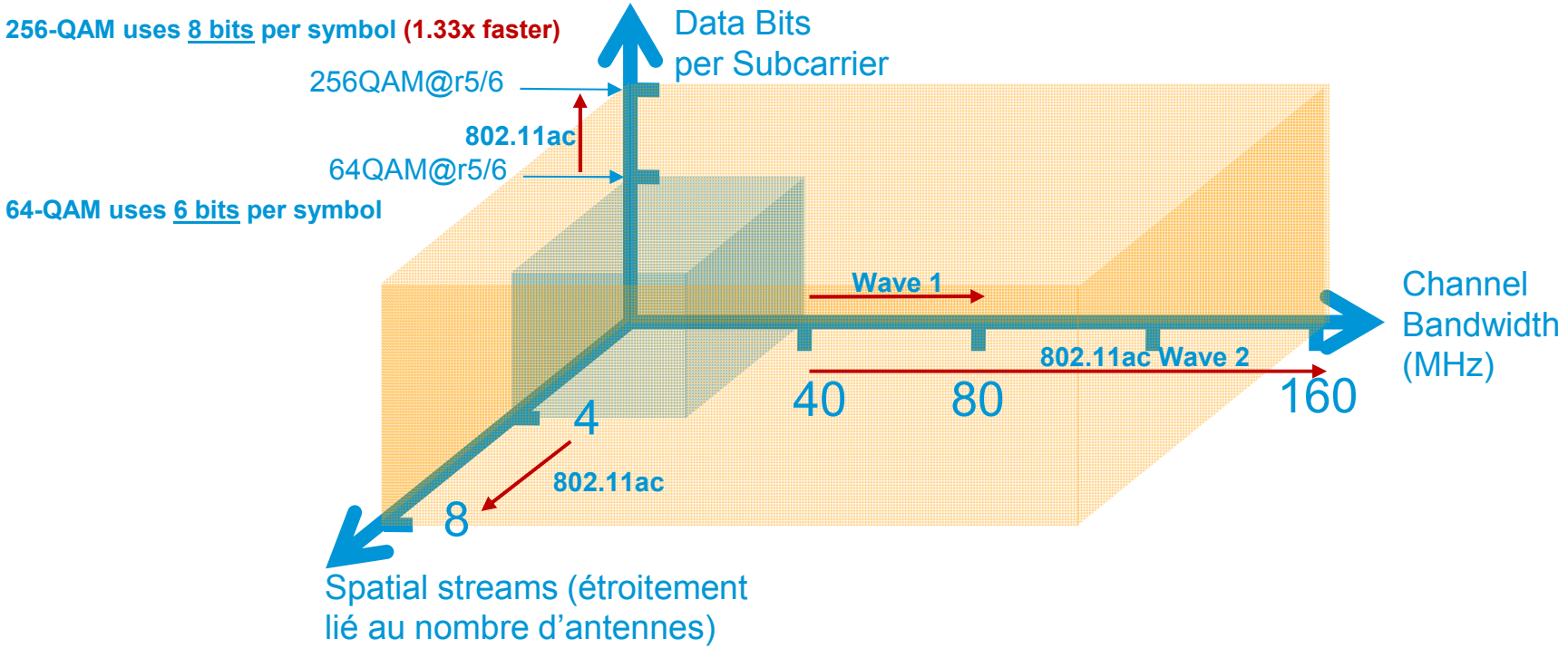
C’est quoi 802.11? C’est quoi exactement ‘WiFi’?

- Les produits Wi-Fi sont conçus autour d’une mise en oeuvre des différents standards de l’industrie IEEE-802.11 et sont garantis interopérables par le logo de la WiFi-Alliance
- La technologie 802.11 a grandement évolué depuis ses débuts, et les améliorations au standard initial utilisent une lettre, comme 802.11a, 802.11b, etc.
- **Il y a déjà eu 5 générations principales de 802.11**, la dernière étant 802.11ac Wave 1, mais elle est toujours half-duplex (oui, comme un hub)
- Chaque génération definit des améliorations de performances, soit dans la bande 2,4 GHz, soit en 5 GHz, soit dans les deux.
- La Sixième génération étendra les fréquences à de nouvelles bandes

  (3,5 GHz, 750 MHz, 60 Ghz etc.) selon la région

IEEE Technology	Frequency Band	Bandwidth or Maximum data rate
802.11b	2.4GHz	11 Mbps
802.11a	5GHz	54 Mbps
802.11g	2.4GHz	54 Mbps
802.11n	2.4GHz and 5GHz	450 Mbps
802.11ac	5 GHz	6900 Mbps

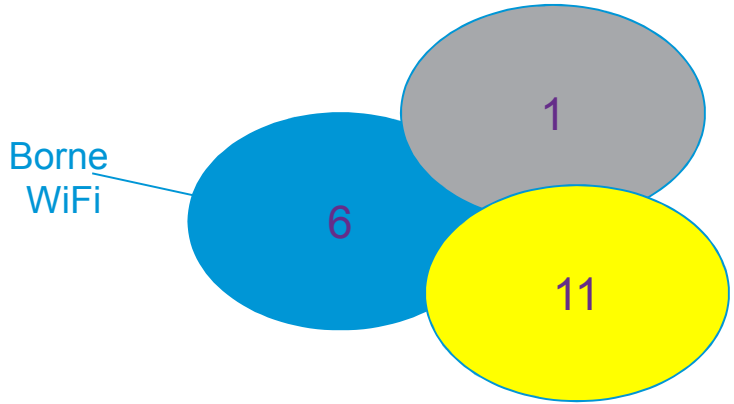
802.11ac va plus vite que 802.11n grâce à plus de bits par sous-porteuse, plus de largeur de bande par canal et plus de transmissions parallèles (spatial streams)



Réutilisation de fréquences dans le réseau

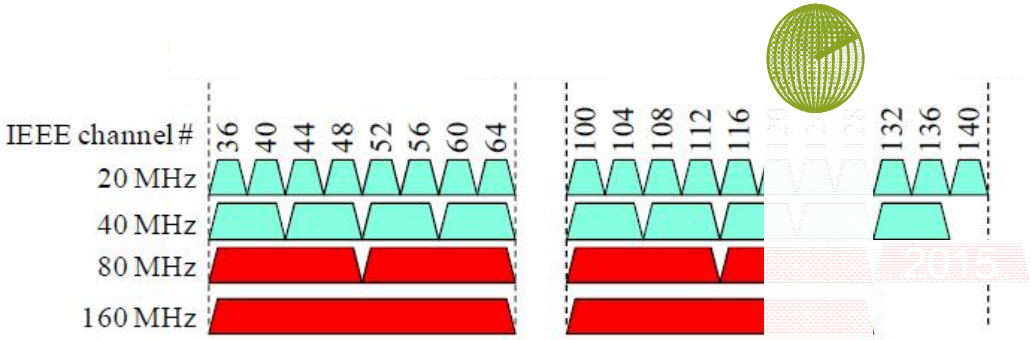
Bornes adjacentes utilisant des fréquences différentes pour réduire les interférences entre elles:

En 2.4 GHz, le “modulo” est de 3:



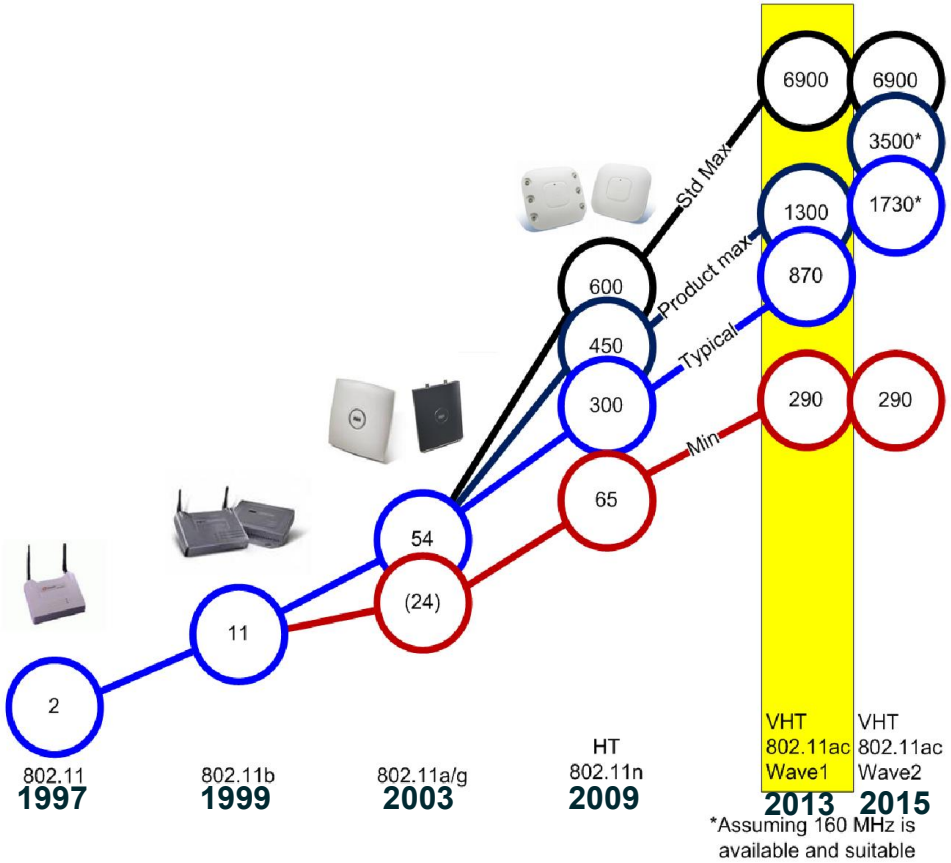
802.11b / 802.11g / 802.11n

En 5 GHz, le “modulo” varie en fonction de la largeur de bande par canal:



802.11a / 802.11n / 802.11ac

Fact: 802.11ac is here - is your network ready?



1997 – 2 mbps of data rate = 1 SD video flow max.
(level 2: 352x288, 30 img/sec, Extended profile H.264)

2013 – 870 mbps = 400+ SD video flows, or 50+ HD video flows
(Level 3.1: 1280×720, 30 img/sec, Extended profile – 14mbps peak)

WFA & IEEE Timelines

Wi Fi CERTIFIED Wave 1

IEEE 802.11ac Ratification

Wi Fi CERTIFIED Wave 2

CY 2012				CY 2013				CY 2014			
Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4

Consumer class devices from Linksys and Netgear

Linksys 1x1 AC USB

802.11ac mobile devices

Samsung S 4

ZTE Grand Memo

HTC One

Intel® Dual Band Wireless-AC 7260 shipping

Cisco 802.11ac Module for AP3600

Apple release MacBook Air with 11ac

Apple release MacBook Pro Retina with 11ac

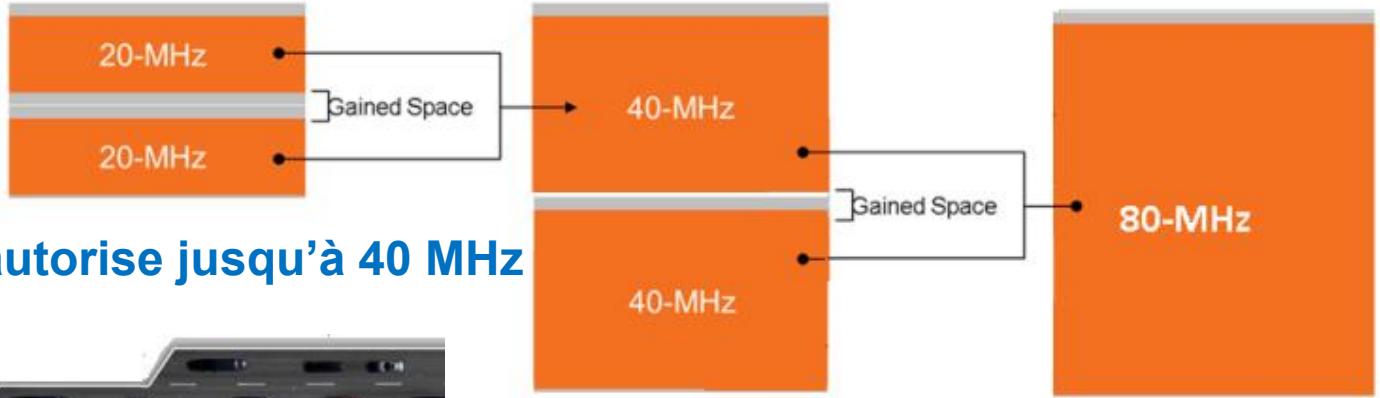
AP3700 Dual-band 802.11ac Wave 1

802.11ac Wave2 Starts to Roll 1H 2015

Mécanismes 802.11ac – Evolutions de 802.11n

C’est quoi le channel bonding (fusion de canaux)?

Wave-1 permet jusqu’à 80 MHz par canal



802.11n autorise jusqu’à 40 MHz

Aujourd’hui, c’est devenu une autoroute à 8 voies…

802.11ac teste jusqu’à 80 MHz (Wave-1)

***et testera jusqu’à 160 MHz en Wave-2**

But why is channel bonding so important?

MCS rates @ 1 Spatial Stream in Mbps

MCS	Modulation	Ratio	20 MHz channel	40 MHz channel	80 MHz channel WAVE-1
			400 ns GI	400 ns GI	400 ns GI
0	BPSK	1/2	7.2	15	32.5
1	QPSK	1/2	14.4	30	65
2	QPSK	3/4	21.7	45	97.5
3	16-QAM	1/2	28.9	60	130
4	16-QAM	3/4	43.3	90	195
5	64-QAM	2/3	57.8	120	260
6	64-QAM	3/4	65	135	292.5
7	64-QAM	5/6	72.2	150	325
8	256-QAM	3/4	86.7	180	390
9	256-QAM	5/6	N/A	200	433.3

Phones such as the HTC One & Samsung S 4 have support for 802.11ac Wave-1 and 1-SS

More than 1-SS requires that the client have more radios which draw more power.

The goal is to enable devices to have more throughput with less battery draw

Most mobile devices will use 1-SS

Tablets & laptops can use 2-SS or more

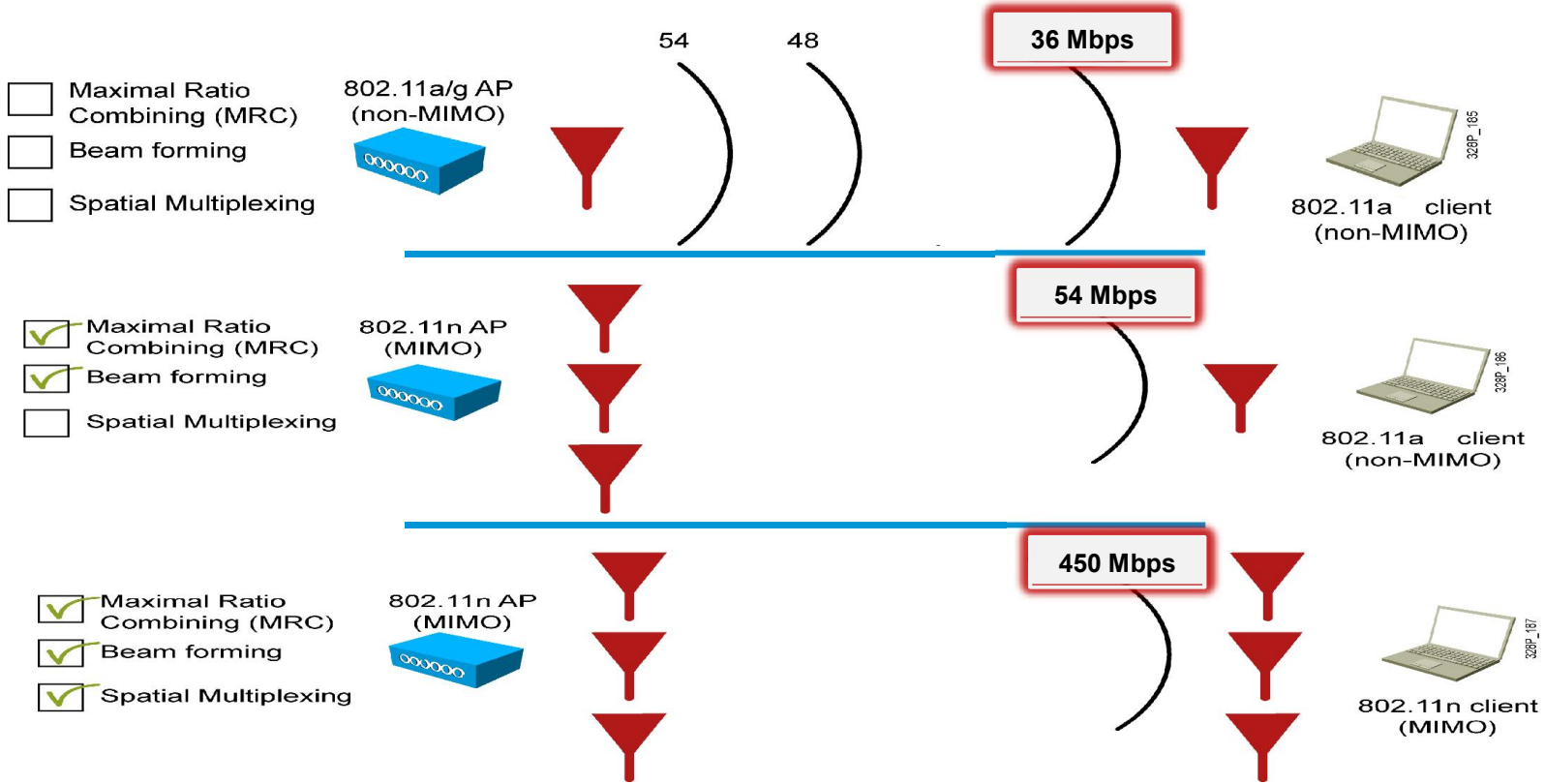
Future phones such as the Samsung Galaxy S5 will even support 2x2 MIMO 802.11ac for the first time on Mobile devices

Fusion des canaux Wave-1 et Wave-2: les chiffres

.11ac MCS Rates @ 1-spatial stream -- (Wave1) typically supports up to 3-ss

MCS	Modulation	Ratio	20 MHz channel		40 MHz channel		80 MHz channel WAVE-1		160 MHz channel WAVE-2	
			800 ns GI	400 ns GI	800 ns GI	400 ns GI	800 ns GI	400 ns GI	800 ns GI	400 ns GI
0	BPSK	1/2	6.5	7.2	13.5	15	29.3	32.5	58.5	65
1	QPSK	1/2	13	14.4	27.	30	58.5	65	117	130
2	QPSK	3/4	19.5	21.7	40.5	45	87.8	97.5	175.5	195
3	16-QAM	1/2	26	28.9	54	60	117	130	234	260
4	16-QAM	3/4	39	43.3	81	90	175.5	195	351	390
5	64-QAM	2/3	52	57.8	108	120	234	260	468	520
6	64-QAM	3/4	58.5	65	121.5	135	263.3	292.5	526.5	585
7	64-QAM	5/6	65	72.2	135	150	292.5	325	585	650
8	256-QAM	3/4	78	86.7	162	180	351	390	702	780
9	256-QAM	5/6	N/A	N/A	180	200	390	433.3	780	866.7

Les Techniques de Beamforming enfin en standard!



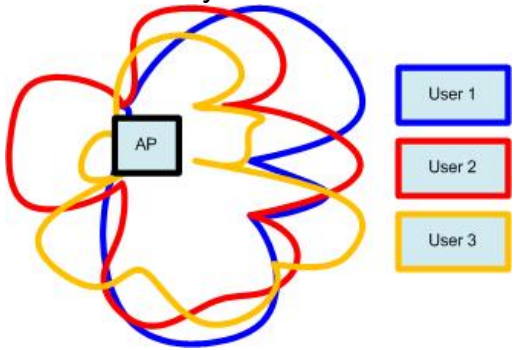
Les mêmes mécanismes s'appliquent à 802.11ac pour atteindre 1.3Gbps plus souvent

Vous avez dit Multi-User MIMO (MU-MIMO)?
ou même WiFi commuté? → pas exactement…

Testé par WFA en Wave 2 seulement et optionnel

- **802.11ac MU MIMO is like 802.11n MIMO, except instead of one client, there are up to four clients**
  - AP does pre-coding for all the clients within the MU group simultaneously
  - In MU pre-coding, when AP beam-forms space-time streams to one client, it simultaneously null-steers those space-time streams to the rest.
  - All users' MPDUs are padded to the same number of OFDM symbols

- **MU-MIMO is technically risky and challenging:**
  - Needs precise channel estimation (CSI) to maintain deep nulls
  - Precise channel estimation adds overhead
  - Rate adaptation is more difficult
  - Throughput benefits are sensitive to MU grouping



Null-steering:To send data to user 1, the AP forms a strong beam toward user 1, shown as the top-right lobe of the blue curve. At the same time the AP minimizes the energy for user 1 in the direction of user 2 and user 3. This is called "null steering" and is shown as the blue notches. Same logic applies to red and yellow beams.

Une taille de cellule similaire entre .11n and .11ac

Using a 802.11n radio on an AP, we performed cell size characterization with .11n rates using several .11n clients.

Switching to 802.11ac clients and a .11ac radio module, it performs similar @40 MHz with clients having a cell size similar to the .11n clients.

Take-away 11n/11ac are similar in range, but of course @80 MHz and 256-QAM, you get a significant data-rate boost

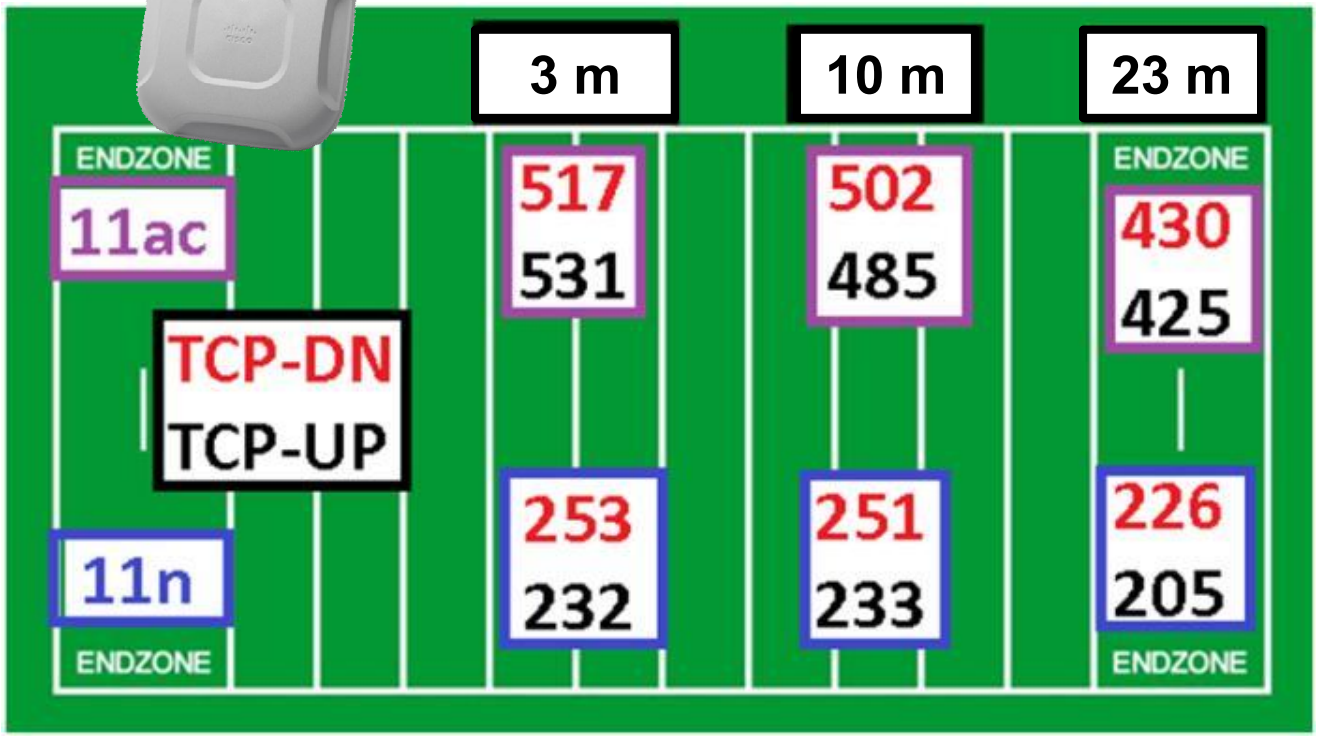
Et en termes de comparaisons réelles de débit ?

Comparons **802.11ac** et **802.11n avec des clients 3-SS:**

11ac client
Dell E6430 en
Broadcom 3-ss

contre

11n client
Apple 3-ss
Macbook Pro



Un client 802.11ac @ 3-ss transmet donc globalement 2 fois vite plus qu'un client 802.11n à distance équivalente en environnement réel

Conclusion: IEEE 802.11ac – La nouvelle génération du Wi-Fi

Quelles caractéristiques?

- Most efficient Wi-Fi standard to date
- Optimized for high bandwidth applications
- Backwards compatible with 802.11n and .11a
- Provides better coverage in dense environments
- Optimized for better client battery life

Quelles fonctions?

- Wider Channels and More Spatial Streams than 802.11n
- Data rates Up to 1.3 Gbps (Wave 1) & 2.6/3.5 Gbps (Wave 2)
- Operates in 5GHz Band only
- Multi-user MIMO mode (Wave 2)

Wi Fi
802.11ac

Qu'attendre de 802.11ac dans un réseau d'accès sans-fil?

- **Noticeably faster connectivity enabling an enhanced Quality of Experience for the end user**
- **Wired-like experience at higher speed**
- **Significantly better client battery life**
- **Much higher client density because of greater efficiency for the entire cell**

What are Some WiFi Typical Challenges?

- Interference from other WiFi networks in the venue
- Interference from non-WiFi systems operating in the same band
- Co-channel interference: Many APs in the venue, but effectively no more capacity

- Clients operating at low data rates (ex. 802.11b) pull down the performance of the network
- Clients mistakenly choose a 2.4 GHz radio (louder signal) instead of 5 GHz (less load)
- Sticky Clients: Clients mistakenly stay on the same AP, even when the person has moved from one end of the venue to another

- Limitations on mounting assets. Hard to put APs where you want them
- Probe storms: 2.4 GHz clients probe on all 13 overlapping channels
- Ad Hoc Viruses: Clients forming bogus ad hoc networks such as "Free Public WiFi"

All of these require more than just a great Adaptive Algorithm for channel and power

Des questions ?


Merci.