



La Era Gigabit

5G, FTTx, G.Fast & DOCSIS 3.1

Caio Donega

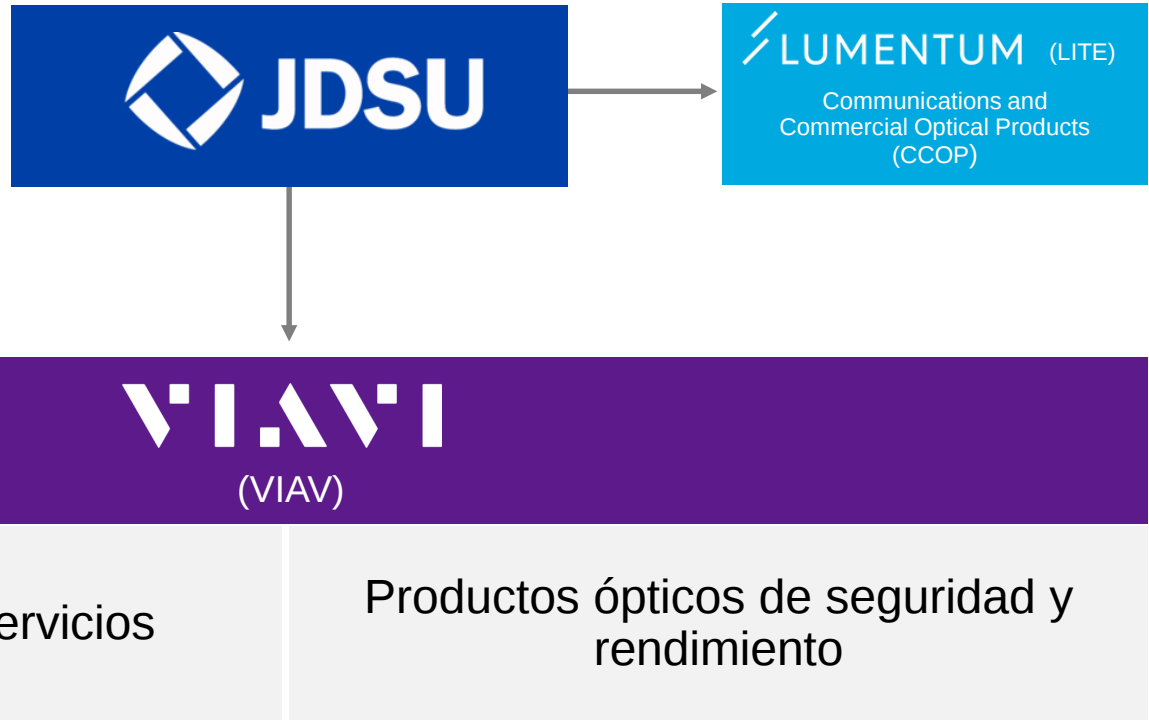
Gerente Regional – Sur America Latina

22 de Noviembre de 2017, Telesemana en Buenos Aires, Argentina.



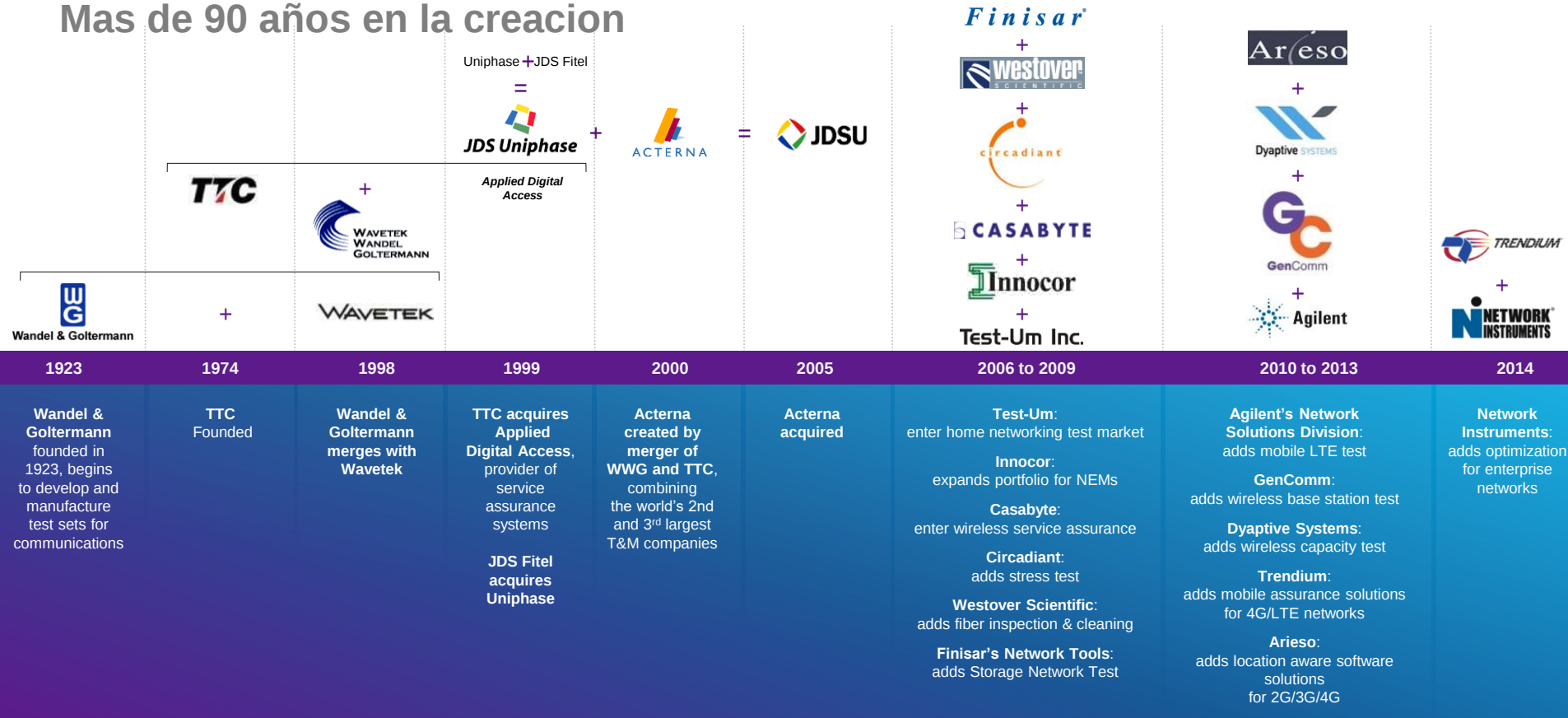
Viavi Solutions Creada

Agosto de 2015



Viavi Solutions, NSE (Activacion de redes y servicios)

Mas de 90 años en la creacion



Viavi Solutions - participación en la industria

Viavi Solutions contribuye activamente al desarrollo de normas bien definidas y armonizadas, pruebas de prueba de concepto y despliegues de campo en etapas tempranas.



Millimetre Wave Transmission
Network Functions Virtualization
Mobile Edge Computing



Intel® Network Builders



Viavi Solutions en numeros



Over 1,600,000
instrumentos en uso
alrededor del mundo



100,000
data centers confian en
VIAVI



200+
redes de proveedores de
servicios a traves de 7
continentes



1,617
patentes



49
global offices



\$1.1B
ingresos FY16



250
Socios

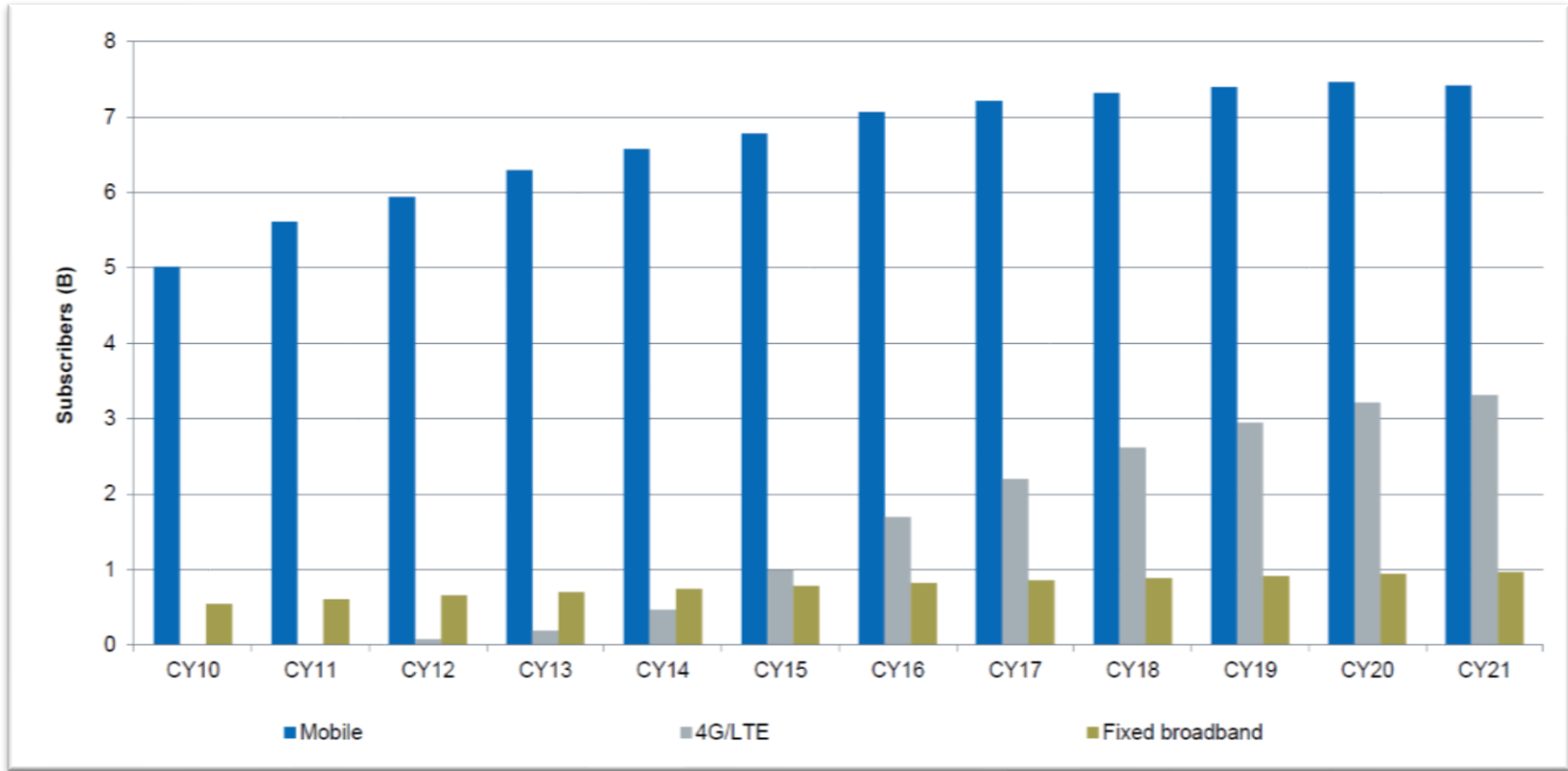


3000+
empleados



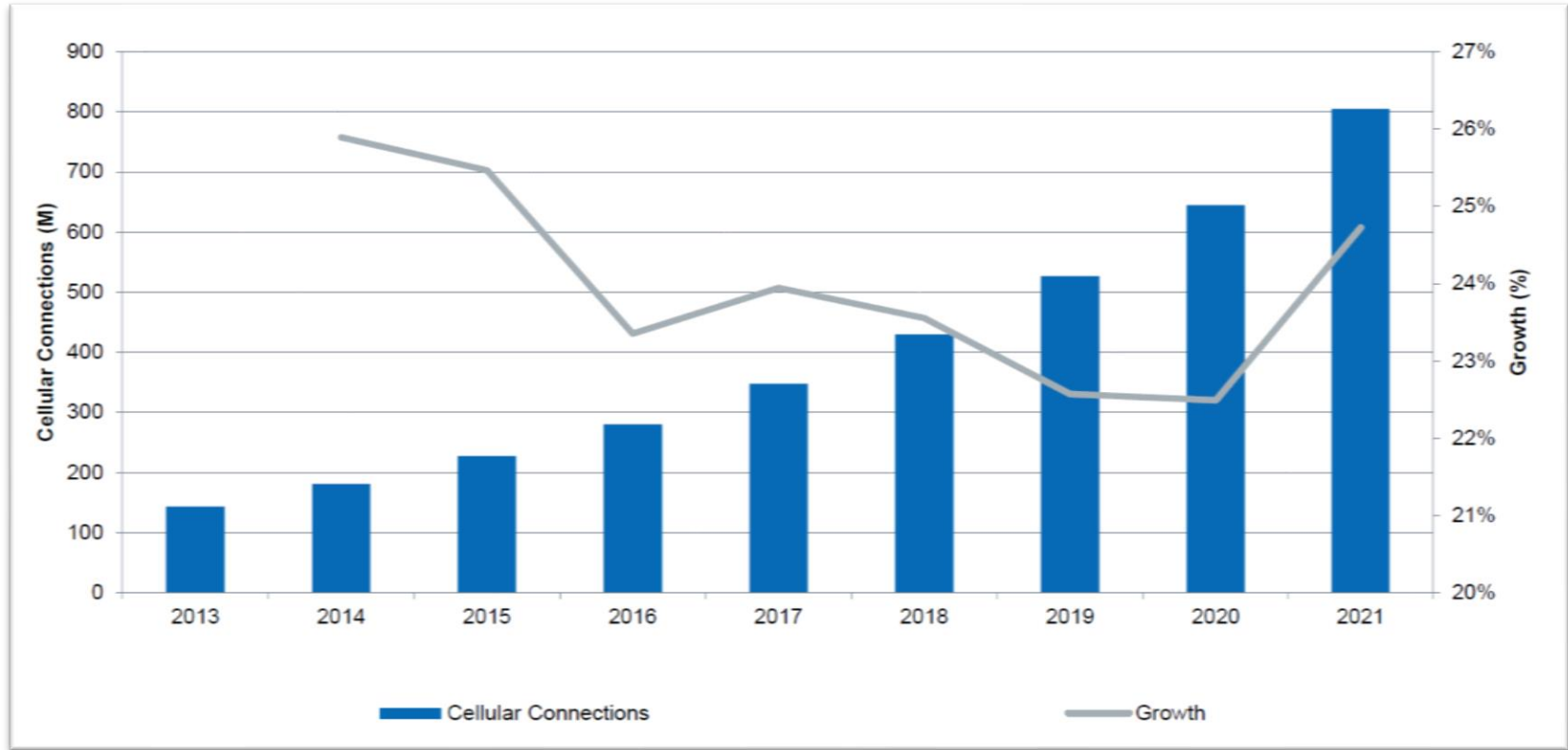
Móvil satura la tierra

La banda ancha móvil supera la banda ancha fija del pasado



Incesante crecimiento del tráfico

Aceleración de video, centros de datos, más suscriptores y IoT requieren cambios arquitectónicos



3.5%

percentage of
population
covered

43

countries have gigabit internet available

United States

#1 country for population coverage

Singapore

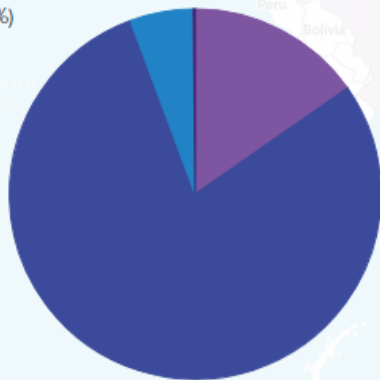
#1 country for percentage of population covered

Gigabit Despliegue actual

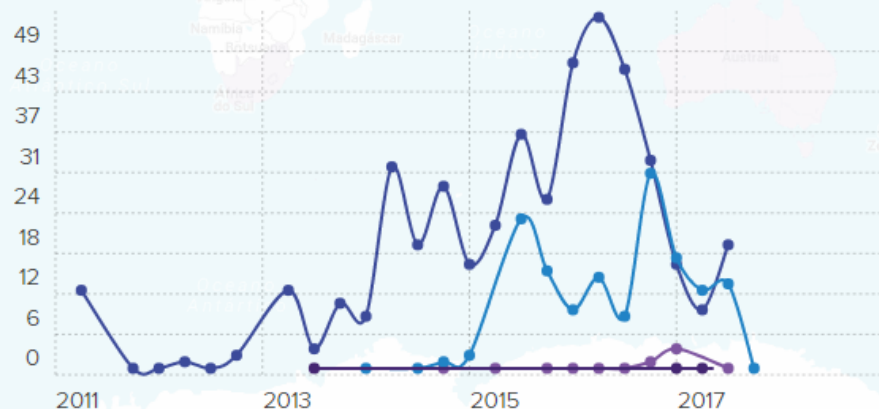
Data:
gigabitmonitor.com

Breakdown by technology

- Cellular (15.36%)
- Fiber (79.01%)
- HFC (5.53%)
- Wifi (0.10%)



Gigabit launches over time



Gigabit Países líderes

Data:
gigabitmonitor.com

Gigabit country leaderboard [Click the titles to switch results](#)

Rank	Country	Population Coverage (estimate)	Percentage Coverage (estimate)
1	Singapore	5,411,700	95%
2	South Korea	46,716,100	93%
3	Moldova	3,656,600	90%
4	Portugal	6,728,800	64%
5	New Zealand	2,883,100	63%
21	Spain	7,754,600	17%
22	Finland	785,000	14%
23	France	8,251,800	13%
24	Hungary	1,200,500	12%
25	Macedonia	243,000	12%
26	Thailand	7,856,700	12%
27	Israel	308,900	3.8%
28	Japan	4,293,000	3.4%
29	Estonia	40,000	3.1%
30	United Kingdom	1,917,800	3.0%
31	Poland	868,000	2.3%
32	Netherlands	163,200	0.96%
33	Brazil	1,975,000	0.94%



***Ha comenzado la Carrera
para la entrega de
conectividad a velocidad
de gigabit y para
satisfacer la demanda de
servicios intensos en
datos, conexión y/o
latencia***

Gigabit | Cambios tecnológicos exigen mas ancho de banda



Movilidad



**HDTV &
4KoIP**



**Hogares
Conectados**



IoT

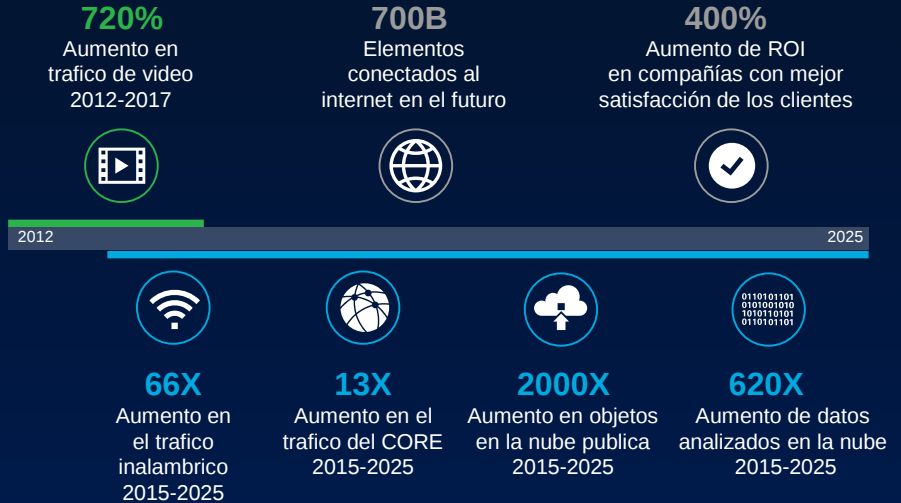


**Virtualización
y la nube**

Gigabit | Necesidad de LTE Avanzado y 5G (Radio Acceso Gigabit)

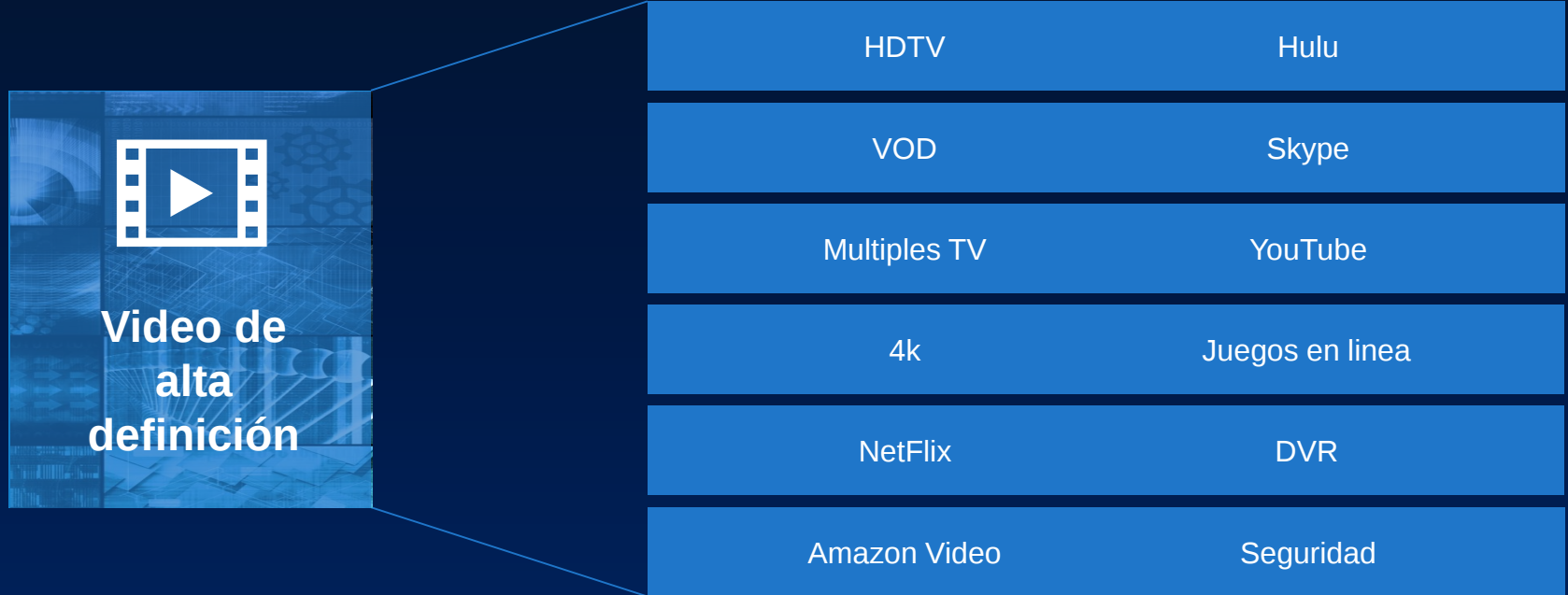


- Convergencia fija e inalámbrica
- Nubeficación del “Edge” basado en Ethernet C-RAN (Cloud-Radio Access Network)
- Nueva Radio: cmWave, mmWave
- Procesamiento de bordes E2E
- Programación: Numerología flexible



- Nuevos modelos de negocios
- Auto-configurable, Auto-optimizable, auto-correctiva
- Una red E2E automatizada y auto programable
- Solucion virtualizada basada en la nube

Gigabit | Necesidad de HDTV y definición 4K (Red fija/móvil Gigabit)



Gigabit | Necesidad de HDTV y definición 4K (Red fija/móvil Gigabit)



La cantidad de ancho de banda requerido dependerá de la calidad del flujo. Netflix proporciona una guía a sus usuarios:

- 500 Kbps - la velocidad más baja requerida para el “streaming”
- 1.5 Mbps - velocidad recomendada para ver la calidad
- 3 Mbps - Vídeo de definición estándar
- 5-8 Mbps - 720p y 1080p de alta definición
- 25 Mbps - 4K Ultra Alta Definición

Gigabit | Necesidad de HDTV y definición 4K (Red fija/móvil Gigabit)

HD
(1920x1080)



UHD
(3840x2160)



Gigabit | Necesidad de ancho de banda (Red fija Gigabit)



**Hogares Conectados
& IoT**

TV Difundida	Video de Alta definicion
Internet de alta velocidad	Transmision de Video sobre IP
Sistema de riego	Voz sobre IP
Refrigeradores	Video Conferencias
Control de Acceso, Cerraduras inteligentes	Manejo de Iluminacion y energia
Camaras de Seguridad	Control de Iluminacion

Gigabit | Necesidad de ancho de banda (Red fija Gigabit)

Gartner cree que habrá 500 dispositivos compatibles con IoT en todos los hogares para el 2022.

1. Camera Stream	MJPEG
2. Camera Resolution	10 Megapixels (3648 x 2752)
3. Video Quality	High
4. Frame Rate per Camera	30 fps
5. Number of Cameras	4
Calculate Bandwidth Needed	
Bandwidth Required:	
2.69 Gbps	



<http://www.gartner.com/newsroom/id/2839717>

Gigabit | Necesidad de ancho de banda (Red fija/móvil Gigabit)



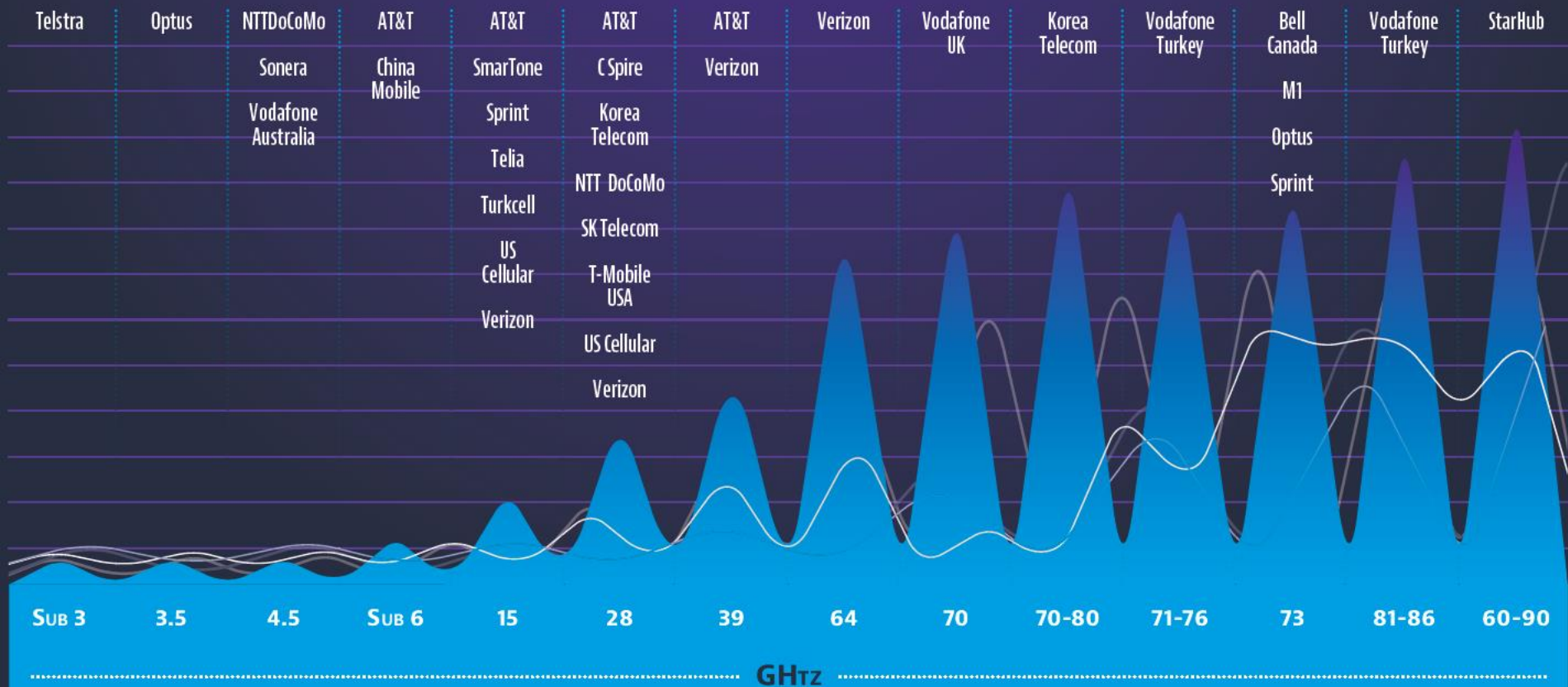
Espectro 5G a prueba

36 Gb/s	Arab Emirates	Etisalat
35.46 Gb/s	Catar	Ooredoo
35 Gb/s	Singapore	M1
35 Gb/s	Singapore	StarHub
35 Gb/s	Australia	Optus
20 Gb/s		Telstra
20 Gb/s		Vodafone UK
15 Gb/s		Telia
14 Gb/s		AT&T
12 Gb/s		T-Mobile USA
11.29 Gb/s		NTT DoCoMo
10 Gb/s		Vodafone Turkey
10 Gb/s		Verizon
10 Gb/s		Orange France

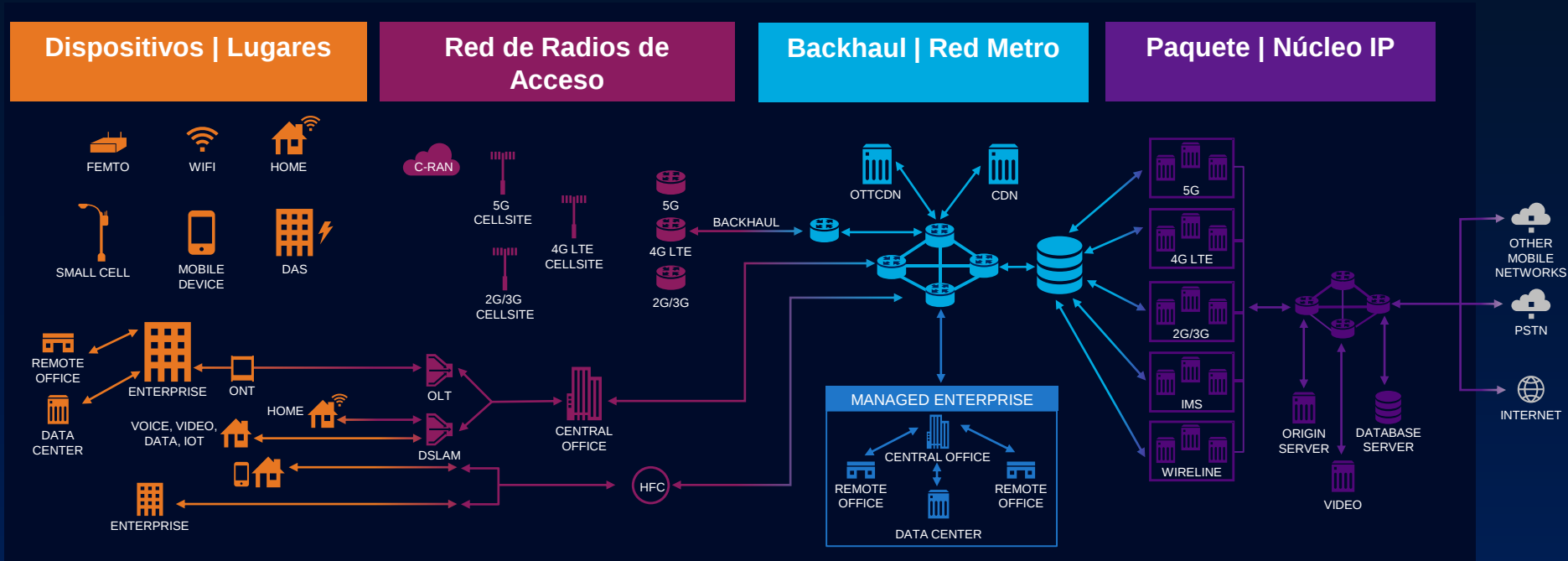
5G Trial Spectrum



Shows the spectrum used by operators during 5G trials, where disclosed



La Evolución de la red 2016-2018



Punto de inflexión del Tráfico móvil | Convergencia de redes y contenidos | La Red se convierte en TI

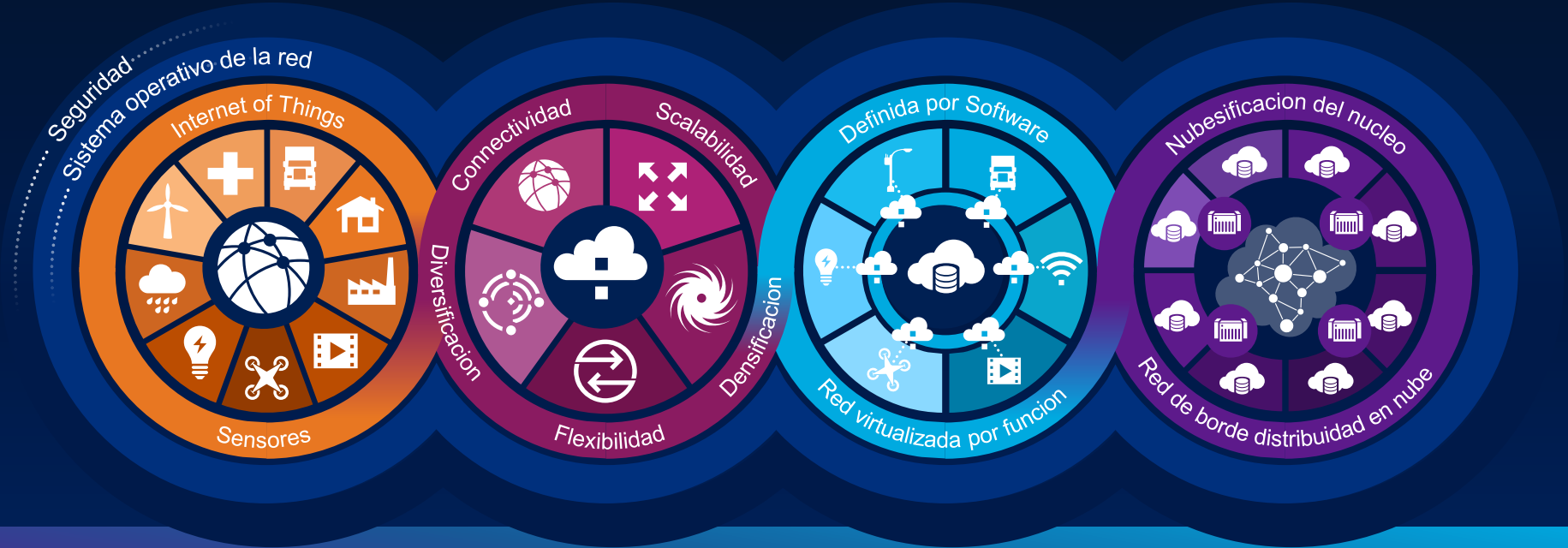
Revolución de la red 2019+

Dispositivos | Lugares

Red de acceso Radial
“RAN”

Backhaul | Red Metro

Paquete | Nucleo IP



Rebanadas de red automatizadas y programables | Requisitos únicos de rendimiento y recursos

Porque los clients piensan en fibra primero?

TURNING 5G INTO A REALITY



Fibra es la clave para el futuro

"We can't do it if we don't drive fiber deeper in the network"

CORNING TO SELL 12.4M MILES OF FIBER TO VERIZON EACH YEAR



"necesitamos 2-6 veces mas fibra para 5G que para FTTH"

FIBER DEAL WILL IMPROVE 4G LTE, SPEED DEPLOYMENT OF 5G



VERIZON, CORNING AGREE TO \$1.05B, 3-YEAR FIBER DEAL

Construir una nueva planta en fibra para cumplir con la demanda.

VERIZON CEO: FIBER DEAL WITH CORNING CRUCIAL TO 5G



Nadie tiene la fibra optica necesario hoy para entregar 5G

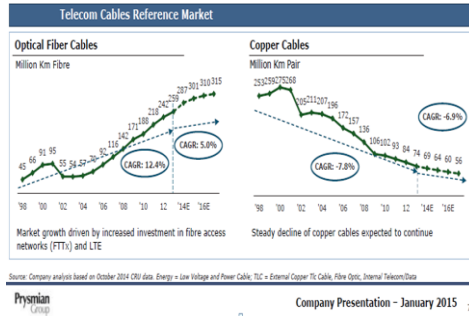
"Verizon la construira comenzando este año"

***Para que todo esto
funcione bien es
necesária una red de
acceso tan buena que
practicamente NO
EXISTE hoy***

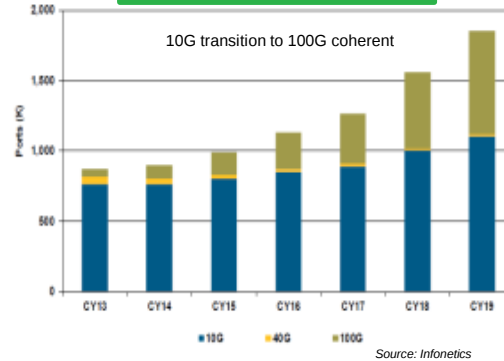


Impulsadores del crecimiento del mercado Fibra Optica

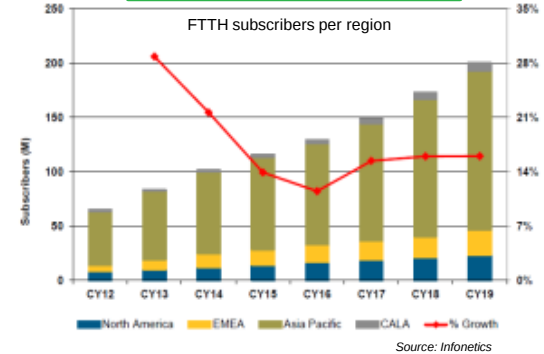
Fiber deployments: +5% CAGR (14-19)



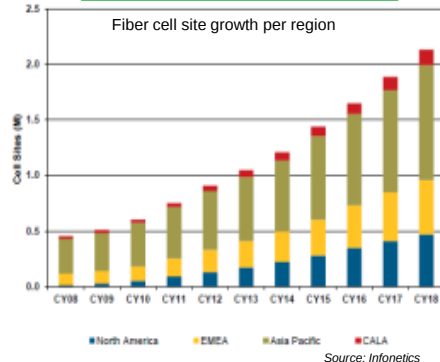
DWDM Metro/Core: Transition to 100G



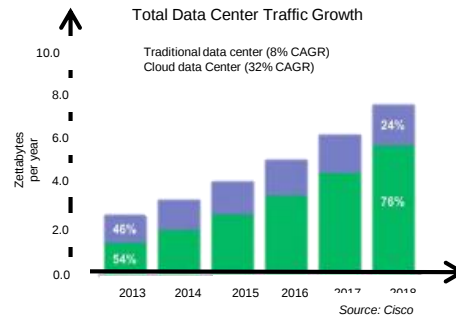
FTTH Subscribers +21% in CY14
Strong growth expected, with China leading



Mobile: Fiber cell site from 35% in CY13 to 44% in CY18



Enterprise-Data Centers, SAN, 100G
Mostly multimode connect. +23% CAGR



Puntos importantes:

- Aumento de instalacion de Fibra Optica: Metro Backhaul, FTTA, FTTx, Empresarial, Submarino
 - Migracion a 100G
 - Cuadrillas de fibra en aumento (Mobile, FTTx)
- CAGR~5% Mercado de Prueba de fibra optica



Requerimientos para el Gigabit ?

Gigabit | Las Tecnologías que permiten su entrega



5G

Móvil



FTTx

MSO



DOCSIS 3.1

Cable



G.Fast

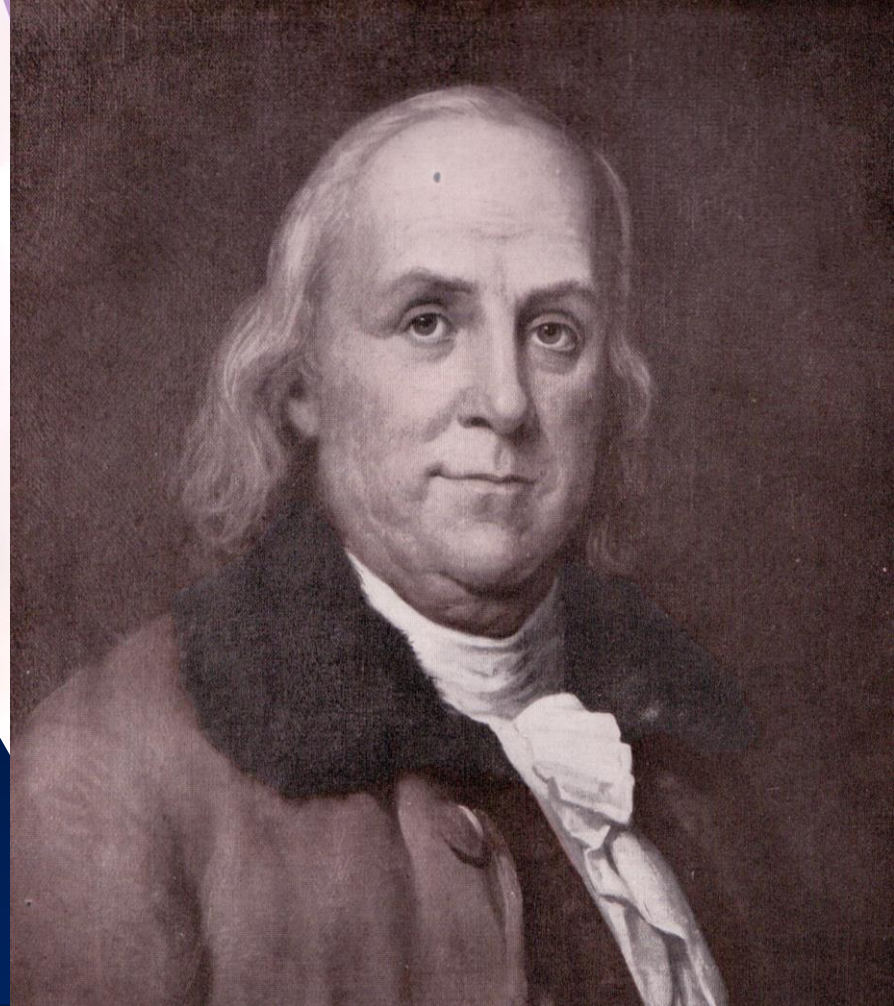
Telco



Virtualización
y
Aplicaciones
en la nube

***“By failing to
prepare, you are
preparing to fail.”***

Benjamin Franklin



Alcanzando velocidad del Gigabit

Muchos elementos pueden causar problemas entre la red y el equipo del cliente.

Para entregar velocidades de Gigabit, necesita:

- Eliminar las fallas ocultas
- Identificar problemas a través de arquitecturas híbridas complejas
- Ejecutar pruebas rápidas, consistentes y completas (para hacerlo bien la primera vez)
- Optimizar el flujo de trabajo y ejecución operacional



VI.VI

Café?



Desafios en Red Acceso Fibra con **FTTH/PON**

La Fibra!

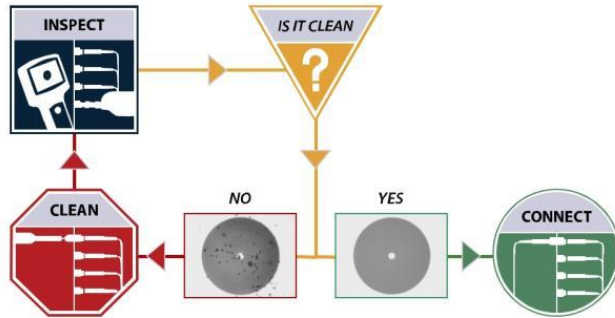
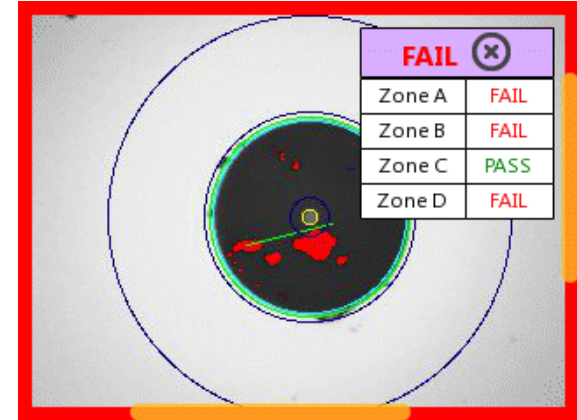
- Los conectores sucios causan el 80% de los fallos en las pruebas de campo
- Los desechos microscópicos degradan significativamente el rendimiento de la señal y pueden causar daños permanentes
- Los conectores sucios de acoplamiento pueden romperse, separarse y migrar partículas
- Una partícula de polvo típica es de 2 a 15 μm y sólo es visible con un microscopio

Prevención de Degradación de los conectores de la Fibra

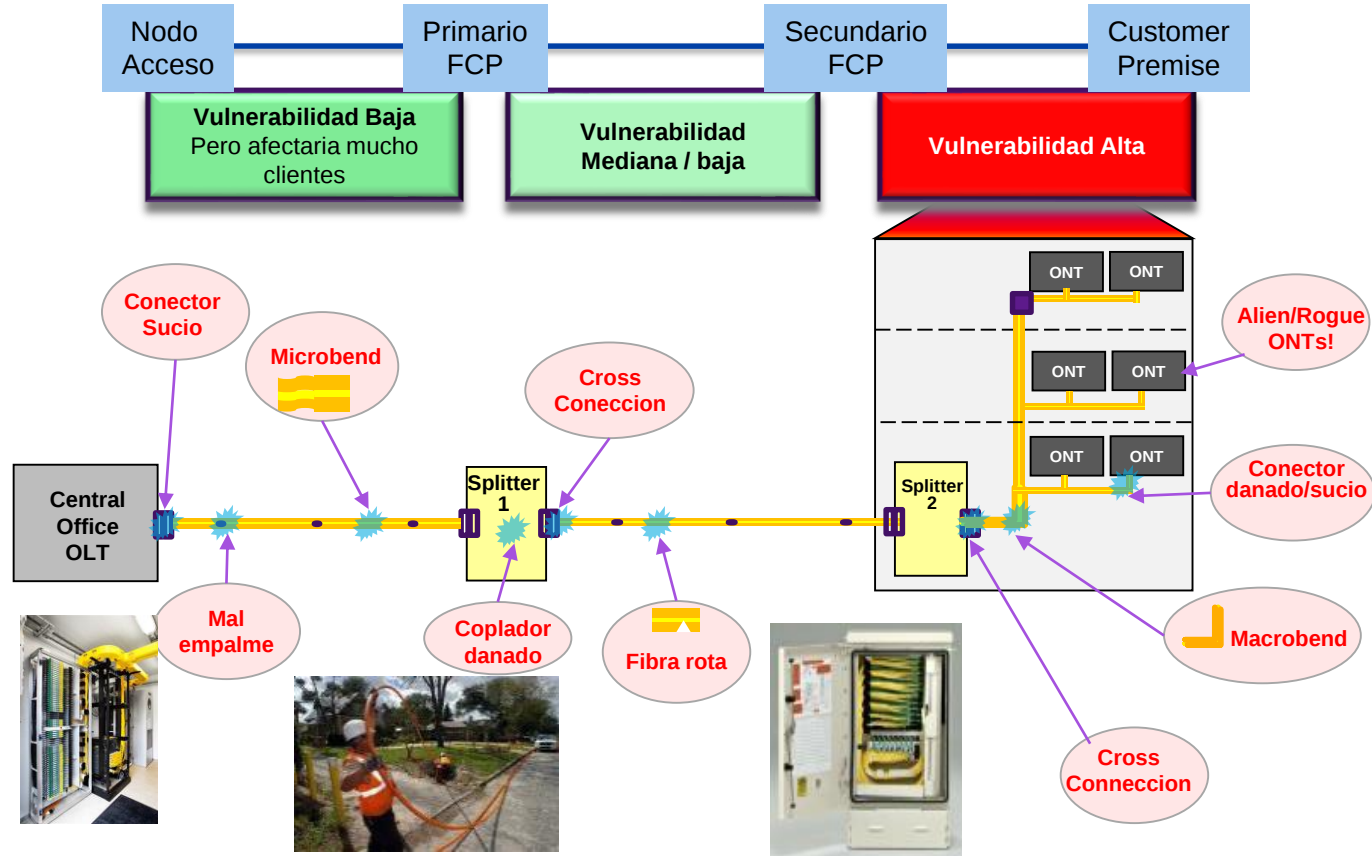
- **Desafío:** Están sus técnicos siguiendo las buenas practicas?

- ✓ Hay que contar con un microscopio de inspección que permita hacer análisis objetivo
- ✓ Que el resultado sea um simple PASA/FALLA

- Eso dirige a que los técnicos tengan que seguir las buenas prácticas de manejo de fibra



Puntos de vulnerabilidad en una red FTTH



Desafios que los operadores encuentran en FTTx

- Generales

- Falta del número de expertos necesarios para manejar fibra;
- Conectores sucios;
- Falta de certificados de nacimiento confiables para probar la calidad de la instalación;

- Técnicos

- Mediciones incorrectas de calificación de nivel segundo estándares;
- Están las ONTs conectadas en el punto correcto?
- Has la ONT se entrado en operación correctamente?
- Hay dispositivos Rogue o Alien poniendo en riesgo de baja mi servicio ?

- Que necesitan

- Mejorar la eficiencia para crecer la rapidez del despliegue al mismo tiempo que aseguran tener informaciones confiables de los despliegues hechos;

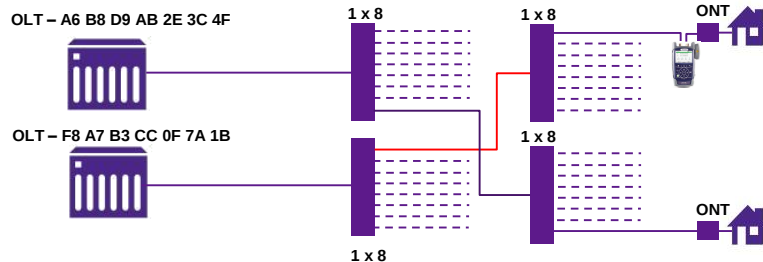
- Solución

- Uso de un activador completo de servicios PON

“First-time right” service activation-> Correct Fiber Connection

Challenge: No or incorrect labeling of fiber cables in splitter cabinet can lead to wrong customer/ONT connection. How making sure the ONT is connected to the right OLT?

- ✓ Identify the type of OLT (G-PON or non G-PON) and detects the OLT-ID at any network location
 - Ensures the right fiber cable is connected to the right ONT.
 - Enables handling installation error tickets more easily



TruePON		09:23 AM
PASS		
OLT	G-PON	F8 A7 B3 CC 0F 7A 1B
ONU/ONT	Activated	A L C L - F8 A8 0C A1
	G-PON U/S	1310 nm
	G-PON D/S	1490 nm
	RF Video	1550 nm
	ODN Loss	OLT>ONU
ODN CLASS ▾		LOCATION ▾
B+ Auto		ONU

PON-ID carries OLT-ID

ONT provisioning-> Verify ONU/ONT operation

Challenge: When installing a new ONU/ONT in a PON network, the device needs to be activated from the OLT to join operations on the PON. Until now this could only be done by logging into the PON management system. How making sure that the ONU/ONT is activated and properly working?

- ✓ Identify ONT's serial number and extracts service parameters from the OLT that indicate the activation status of the ONU/ONT:
 - Activated = operations OK
 - Deactivated = Rogue ONU/ONT operations stopped
 - Unregistered = serial number not known at OLT operations stopped
 - Alien = not compliant to standards operations stopped

TruePON		09:23 AM	
PASS			
OLT	G-PON	F8 A7 B3 CC 0F 7A 1B	
ONU/ONT	Activated	A L C L - F8 A8 0C A1	
	G-PON U/S		G-PON D/S
1310 nm	1490 nm		RF Video
		1550 nm	ODN Loss
		OLT→ONU	
ODN CLASS ▼		LOCATION ▼	
B+ Auto		ONU	

TruePON		09:23 AM	
FAIL			
OLT	G-PON	No PON ID	
ONU/ONT	Unregistered	L C L - F8 A8 0C A1	
	G-PON U/S		G-PON D/S
1310 nm	1490 nm		RF Video
		1550 nm	ODN Loss
		OLT→ONU	
ODN CLASS ▼		LOCATION ▼	
B+		ONU	

GPON data provides ONU/ONT status

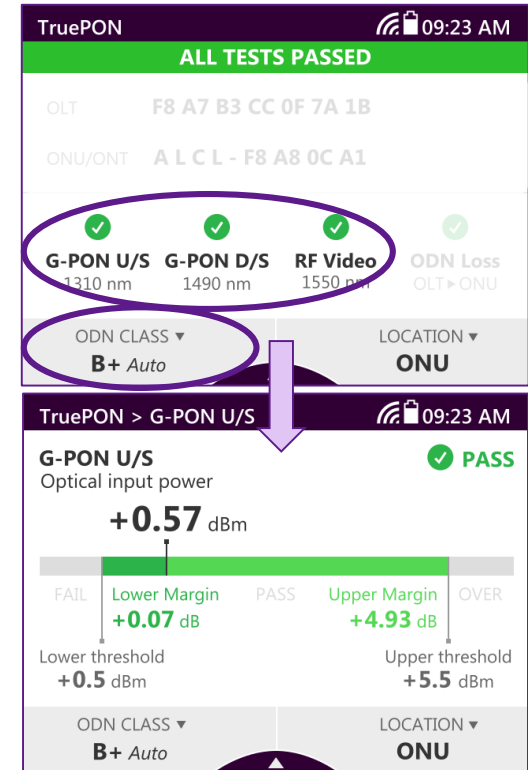
“First-time right” service activation-> Automatic Certification

Challenge: While performing a power-level verification at a customer ONT, how can I certify the service meet the specifications?

Need to perform:

- ✓ Downstream and upstream PON power level measurements (1310/1490nm and 1550nm)
- ✓ Auto setting of pass/fail thresholds in GPON systems with PON-ID

- Certification fully automatic -> No manual user interaction to select or enter pass/fail thresholds



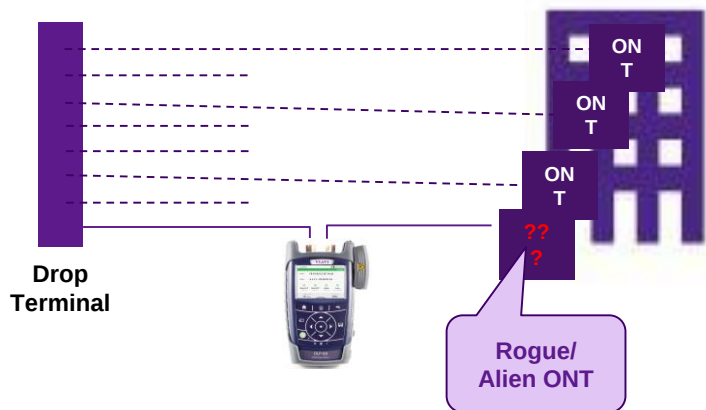
PON-ID carries ODN Class Information

Avoid service failure -> Rogue/Alien ONU/ONT detection

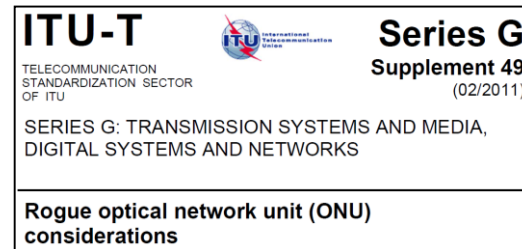
- **Challenge:** How can I easily identify and localize a Rogue ONU (ITU-T G 49) that degrades or disables the service of other customers?

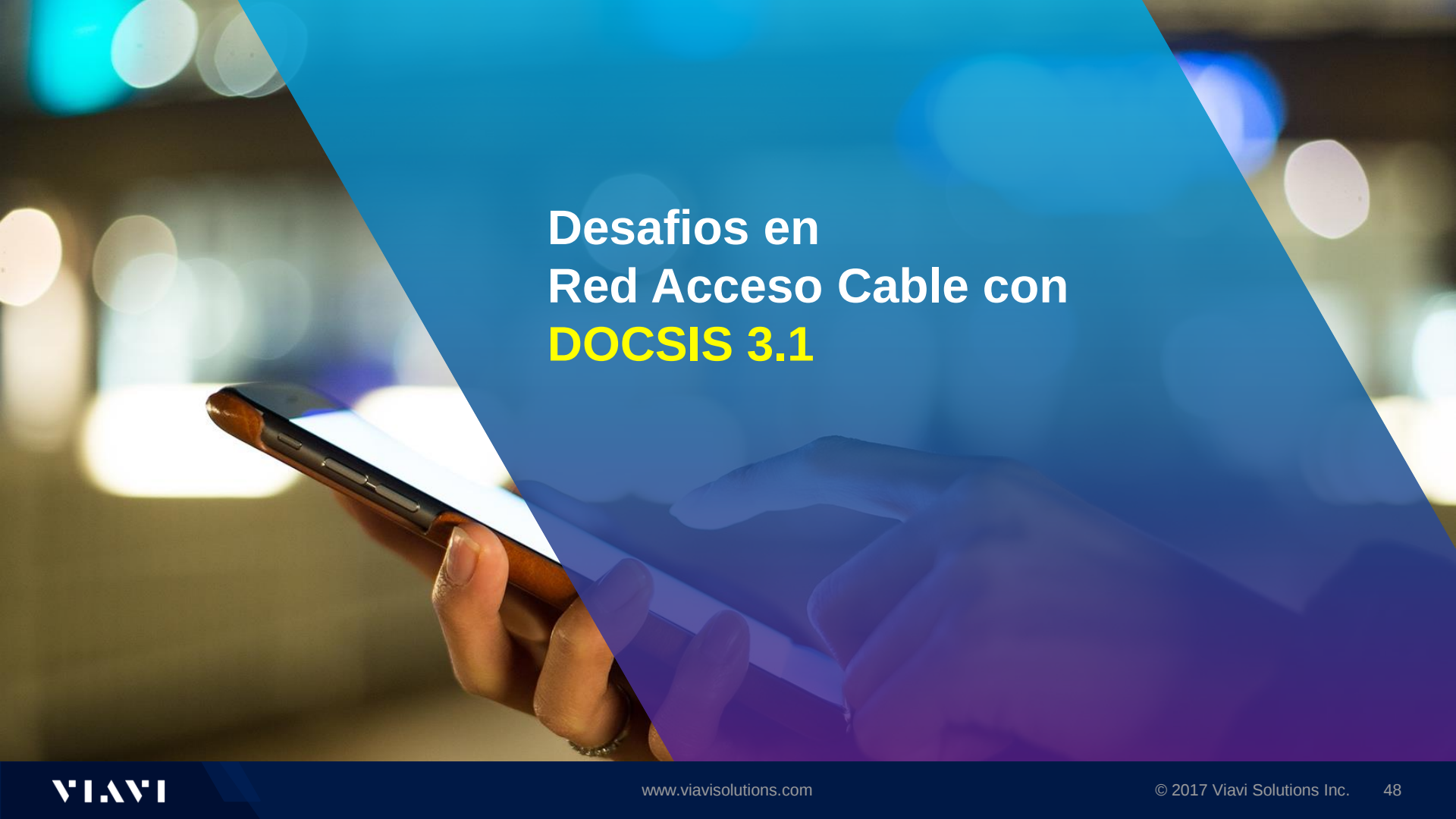
✓ Detect the presence of a Rogue or Alien ONU/ONT

- Facilitates service recovery by isolating the faulty ONU/ONT and replacing it in time.



- ✓ Detection of non standard ONUs/ONTs (Rogue or Alien)



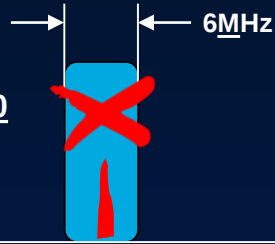
A hand holding a smartphone is visible on the left side of the frame. A large, semi-transparent blue triangle overlays the right side of the image. The background is a blurred city night scene with bokeh lights. The title text is centered within the blue triangle.

Desafios en Red Acceso Cable con **DOCSIS 3.1**

Adopción de DOCSIS 3.1

Sacar casi 100% mas “bits” de cada Hz del espectro

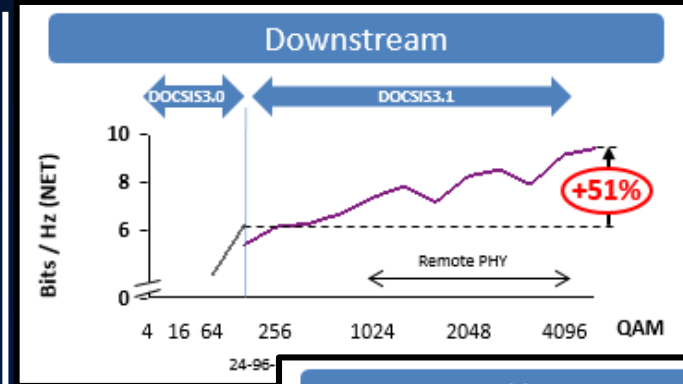
DOCSIS 3.0



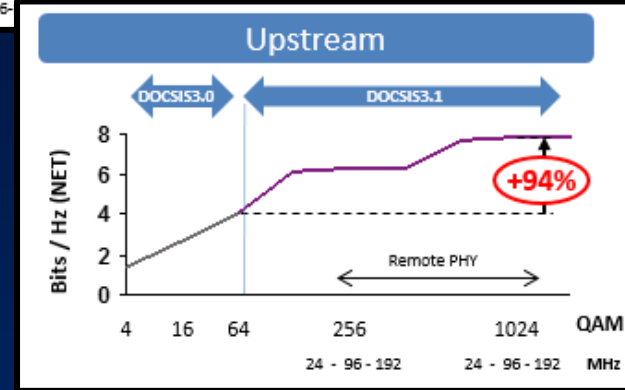
DOCSIS 3.1



192MHz



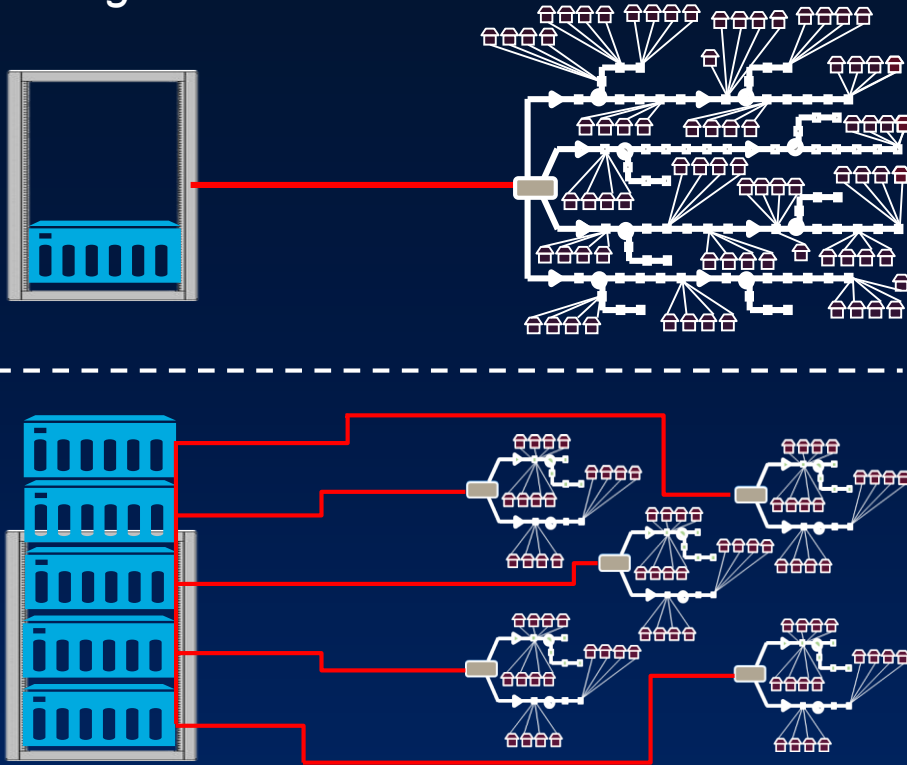
Resultado:
Mayor capacidad de la red



Source: Hans Wambach - SCTE Expo 2015 International Breakfast

Adopción de Arquitectura de Acceso Distribuido

Permite crecimiento exponencial de nodos sin importar el espacio y el consume energético de los “hubs”



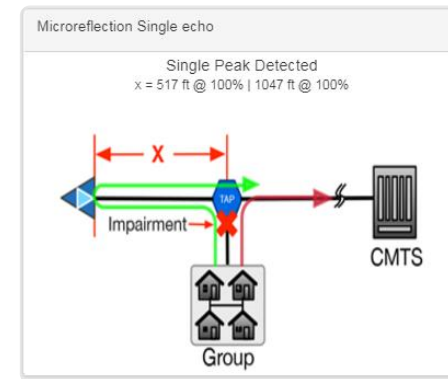
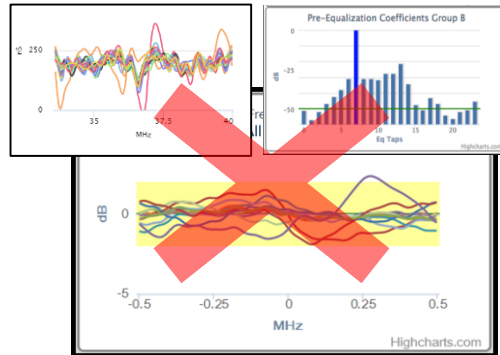
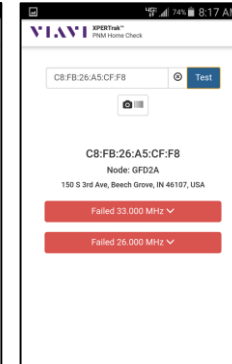
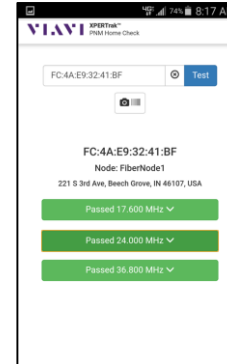
DAA Benefits/Challenges

- Vencer las limitaciones por espacio/energía
- Menor costo total de adquisición
- Enlace óptico mas robusto
- Flexibilidad – profundidad Ethernet
- Interrumpe el mantenimiento de HFC

Tools Tailored To The Specific Needs Of Field Techs

Truck rolls are still required, how to maximize effectiveness of each

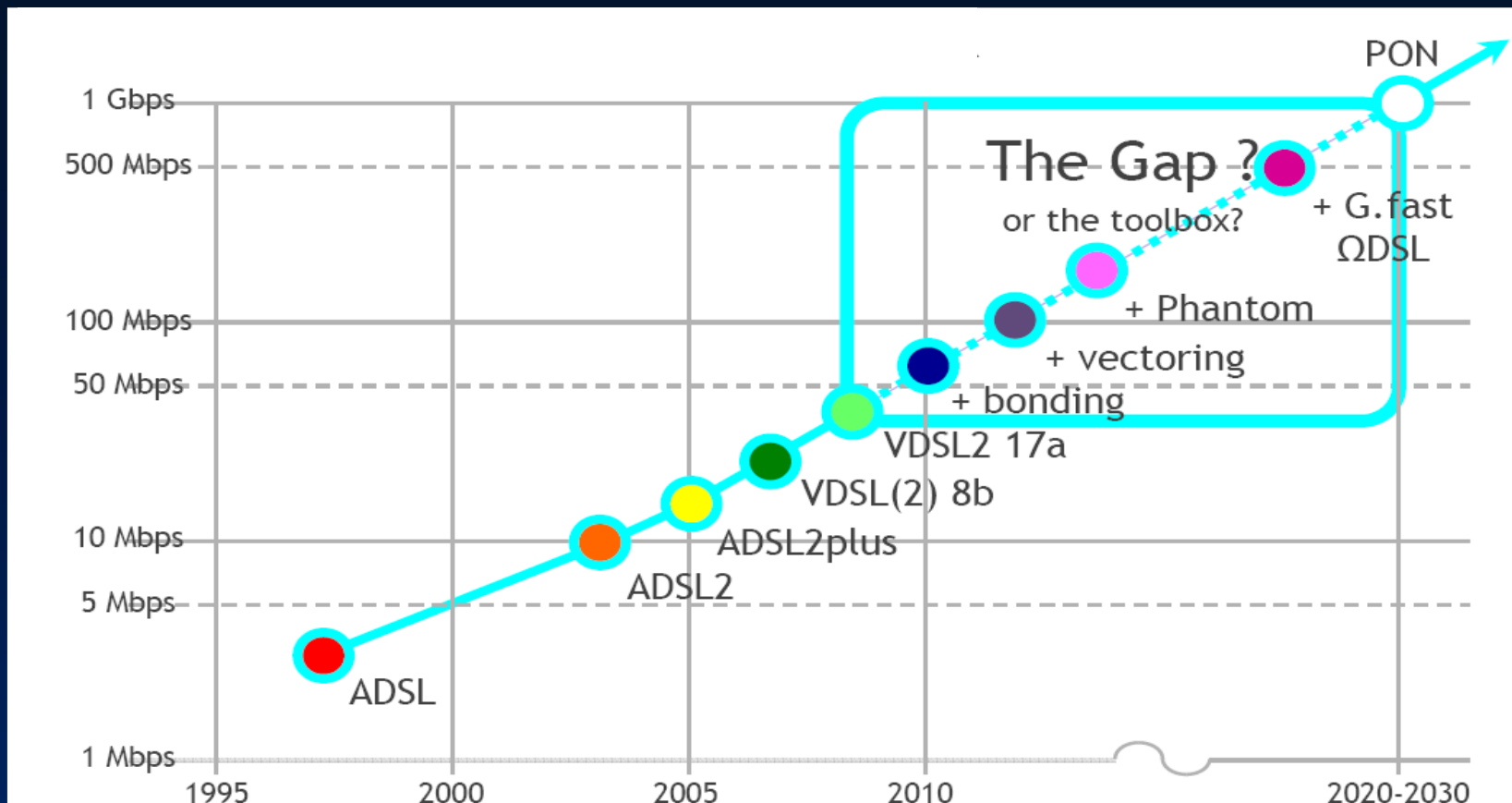
MAC Address	Street Address	SNR	Tx Level	MTC (dB)	NMTER (dMIR Level)	eTDR (ft)	preMTT	postMTT	Delay (ms)
00:26:5E:8D:19:3601	N 9TH AVE, TUCSON, AZ, 85726	33.6	55.5	0.41	-10.157	0.9	86	-12.634	-13.777 195.313
C8:FB:26:A5:04	3708 N 7TH AVE, TUCSON, AZ, 85726	33.9	45.8	0.064	-18.342	0.42	0	-20.203	-22.922 0
C8:CB:38:A6:24	1120 E BENSON RD, TUCSON, AZ, 85726	32.3	37.9	0.155	-14.564	0.436	0	-16.201	-19.594 0
00:1F:E1:A1:C1	3612 N 10TH AVE, TUCSON, AZ, 85726	32.5	54	0.269	-12.241	0.906	86	-16.995	-13.98 195.313
BC:4D:FB:CC:94	3507 N 9TH AVE, TUCSON, AZ, 85726	33.2	51.3	0.544	-9.293	1.016	86	-11.199	-13.788 195.313
20:3D:66:05:46	3506 N 8TH AVE, TUCSON, AZ, 85726	33.9	49	0.433	-10.229	1.034	86	-12.962	-13.536 195.313
AB:4E:3F:3F:99	3700 N 8TH AVE, TUCSON, AZ, 85726	32.3	46.5	0.039	-20.453	0.419	0	-22.029	-25.619 0
00:FC:8D:59:37	3001 N CLIFF AVE, TUCSON, AZ, 85726	36.1	49.8	0.022	-23.879	1.214	599	-27.217	-24.874 1,353.86
00:15:A4:83:28	3702 N 9TH AVE, TUCSON, AZ, 85726	34.7	52	0.516	-9.507	1.071	86	-12.982	-12.098 195.313
00:24:28:00:69	3316 N 9TH AVE, TUCSON, AZ, 85726	29.9	49.2	0.318	-11.513	0.702	0	-13.848	-15.323 0
BC:4D:FB:78:79	3301 N 8TH AVE, TUCSON, AZ, 85726	36.1	37.5	0.372	-10.859	0.89	0	-13.066	-14.857 0
60:2A:D0:8A:50	3401 N 8TH AVE, TUCSON, AZ, 85726	32.3	45.5	0.361	-10.982	1.003	86	-13.916	-14.069 195.313
50:39:55:44:F8	3416 N 8TH AVE, TUCSON, AZ, 85726	34.3	52.5	0.164	-18.334	0.398	0	-22.374	-20.512 0
20:3D:66:09:88	3708 N 8TH AVE, TUCSON, AZ, 85726	34.7	48.8	0.461	-9.97	0.935	86	-12.803	-13.164 195.313
BC:8:10:85:A7	3719 N CLIFF AVE, TUCSON, AZ, 85726	34.7	44.8	0.19	-13.69	0.64	0	-15.494	-18.378 0
00:15:CE:4C:AC	3617 N 9TH AVE, TUCSON, AZ, 85726	34.7	54	0.429	-10.263	0.984	86	-12.668	-13.976 195.313
7C:82:18:0A:E1	3801 N CLIFF AVE, TUCSON, AZ, 85726	34.7	38.5	0.167	-14.243	0.358	0	-15.461	-20.359 0
18:59:33:45:6A	3503 N 9TH AVE, TUCSON, AZ, 85726	33.6	42.5	0.454	-10.036	1.029	86	-13.124	-12.971 195.313
00:23:BE:08:F4	3705 N 9TH AVE, TUCSON, AZ, 85726	34.7	43	0.063	-18.426	0.499	0	-20.091	-23.394 0
00:FC:8D:47:77	3700 N 4TH AVE, TUCSON, AZ, 85726	33	46.3	0.081	-17.344	0.843	0	-20.255	-20.456 0
00:23:BE:DC:19	3740 N 4TH AVE, TUCSON, AZ, 85726	29.9	48.2	0.094	-16.684	1.043	0	-19.403	-20.006 0
00:15:D0:44:FE	3504 N 10TH AVE, TUCSON, AZ, 85726	31.4	52	0.332	-11.332	0.779	0	-13.447	-15.473 0
DC:47:3D:86:03	3700 N 4TH AVE, TUCSON, AZ, 85726	33.9	47.2	0.087	-17.264	0.871	0	-19.214	-21.681 0



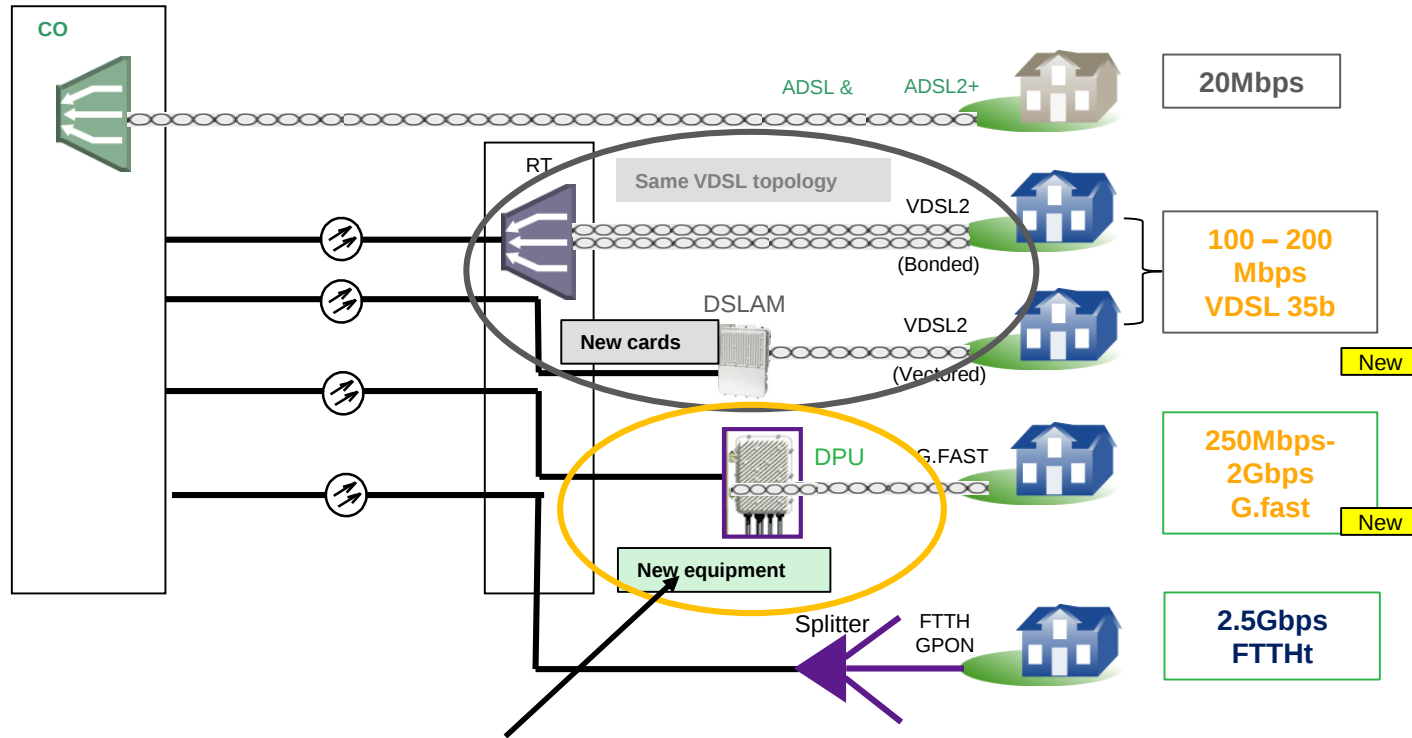
A hand holding a smartphone is visible in the lower-left corner. A large blue diagonal overlay covers the right side of the image. The background is a blurred bokeh of city lights.

Desafios en Red Acceso Cobre con **G.fast**

Repaso tecnológico



xDSL and FTTH Network Topologies with Speeds



Extended fiber, new DPU, and G.fast over short copper loop over pristine line (820ft/250m)

Maximizing Profit for G.fast Rollouts



Promises: Premium Service and Speed for Less Cost than FTTH

- Aggregated speeds up to 2Gbps with 10Gbps on the horizon
- Dynamically set up and downstream bandwidth via Dynamic Timeslot Assignment
- Great option for apartment dwellings

Pitfalls: OPEX Spikes and QoE issues **IF** Procedures Are Inefficient

- Realizing speed across hybrid architecture and CPE to the WiFi client
- High speed transmissions are more sensitive to physical faults
- Staff need to learn new technologies/tasks and should minimize hand-offs
- Copper expertise is diminishing while network complexity is increasing
- Unresolved/hidden issues can reduce profit by increasing repeat calls

Automated test procedures eliminate interpretation errors and repeats

A hand holding a smartphone is visible on the left side of the image. A large, semi-transparent blue triangle covers the right side of the image, containing the main text. The background is a blurred city scene at night with bokeh light effects.

Hay que mejorar la Eficiencia de los trabajos en la Red!

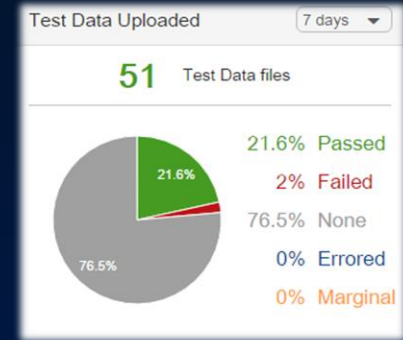
Que es el flujo de trabajo y porque es importante?

- **Rastreo y Reporte en:**

- # de ordenes asignadas a un tecnico (o grupo, o region, etc)
- #/% de ordines de trabajo completadas
- #/% de pruebas que pasaron y/o fallaron

- **Why It Matters:**

- Identificar tecnico de bajo desempeño, corregir
- Comparar desempeño en regiones
- Detectar tendencias rapidamente, corregir la raiz de la causa
 - Configuraciones incorrectas ocasionan alto gasto en prubar la red
 - Geograficar areas de problemas (problemas de planta externa)
 - Identificar problemas sistematicos y sus patrones.



Common Challenges: Service Provider

Multi-Contractor Data Management

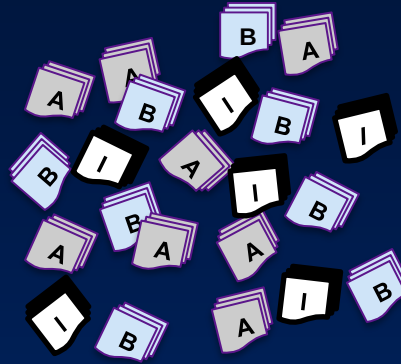
Service Provider A



How can I keep track of data from multiple contractors plus my internal Tech's?

Needs

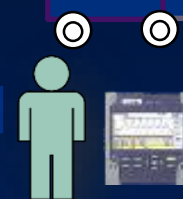
- Test Data Exchange(TDE)
- Simplify receipt and organization of test data from contractors
- Single point of access for Internal Tech and Contractor test data



Contractor A



Contractor B



Internal Tech

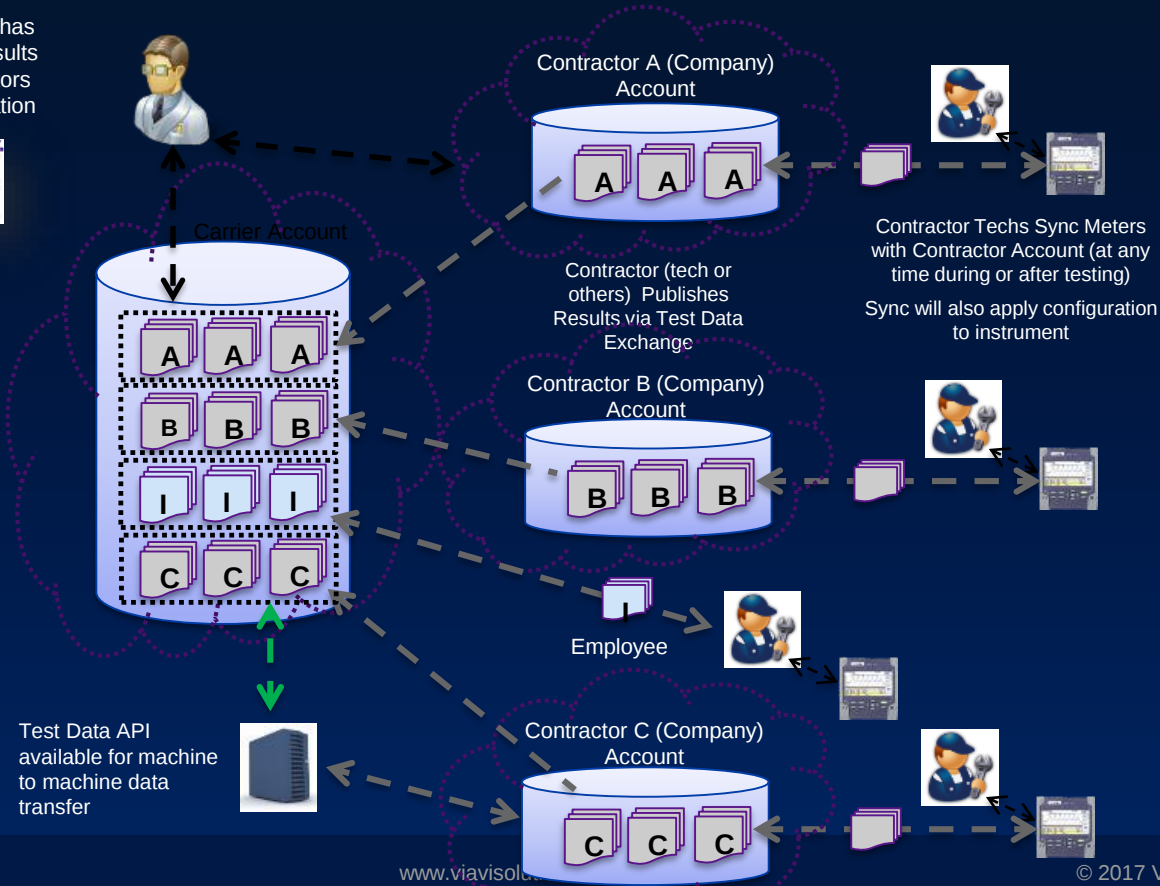


Test Data Exchange Use Case

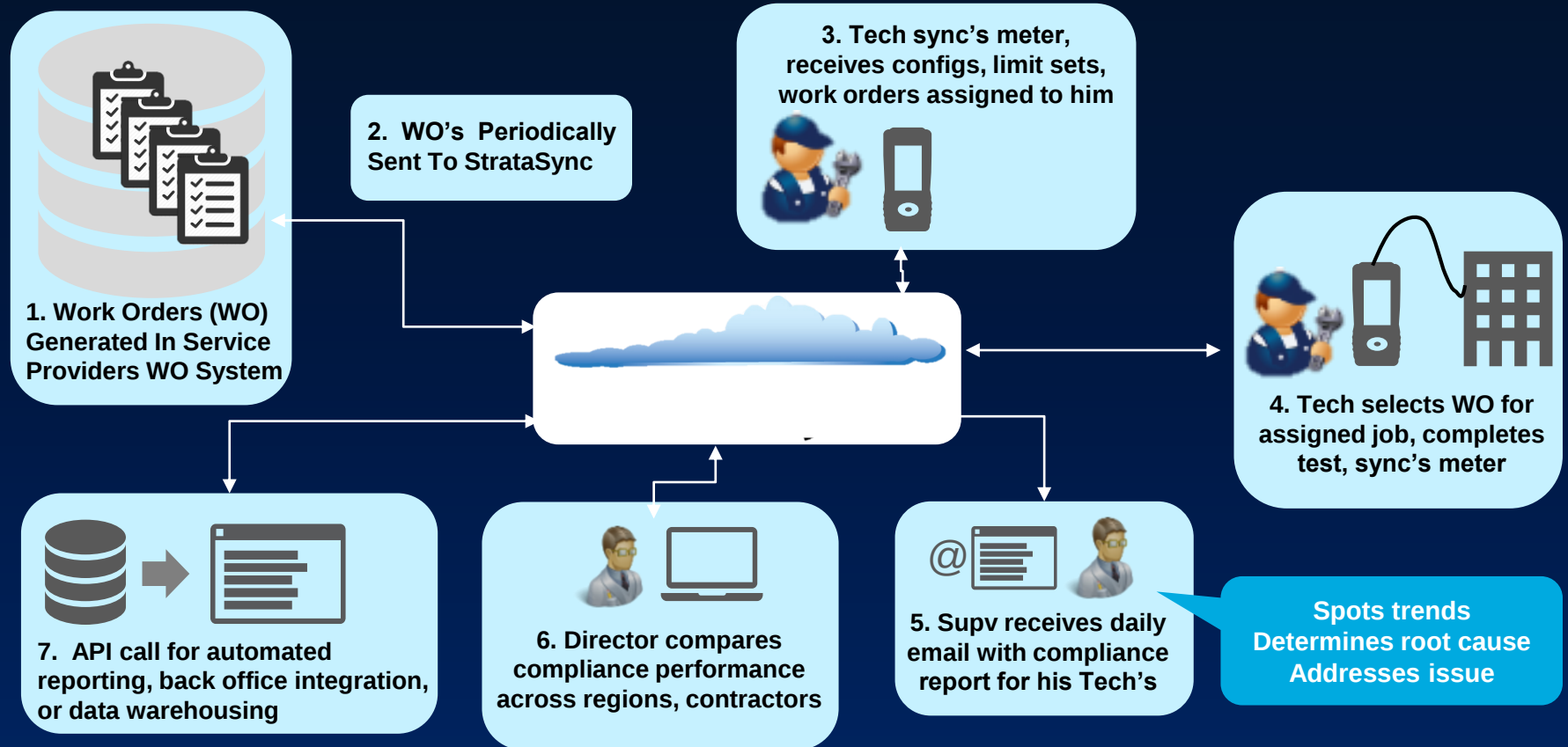
Carrier Account has complete test results from all contractors with Job Information



Test Data can be accessed through dynamic UI with export capabilities and plug into Workbook



Ejemplo de proceso de flujo de trabajo en funcion



Recursos en VIAVI (Gigabit)

- [Gigabit Monitor](#): a web-based tool intended to showcase the state-of-play of gigabit internet provision across the world, based on publicly available data.
- [Race is on to Deliver Gigabit Broadband Services to the Home](#): Learn more about the future of gigabit services and how VIAVI can enable deployment and testing over any network.
- [Do You Inspect Before You Connect? \(Poster\)](#): Contamination — The #1 Reason to Troubleshoot Optical Networks. Learn what you need to do before connecting.
- [Understanding OTDR \(Poster\)](#): Learn how to interpret OTDR results.
- [Optimizing DOCSIS 3.1 Performance \(Poster\)](#): Learn valuable tips on how to optimize DOCSIS 3.1 performance, including OFDM and profiles, testing and turn-up, and optimizing service.



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