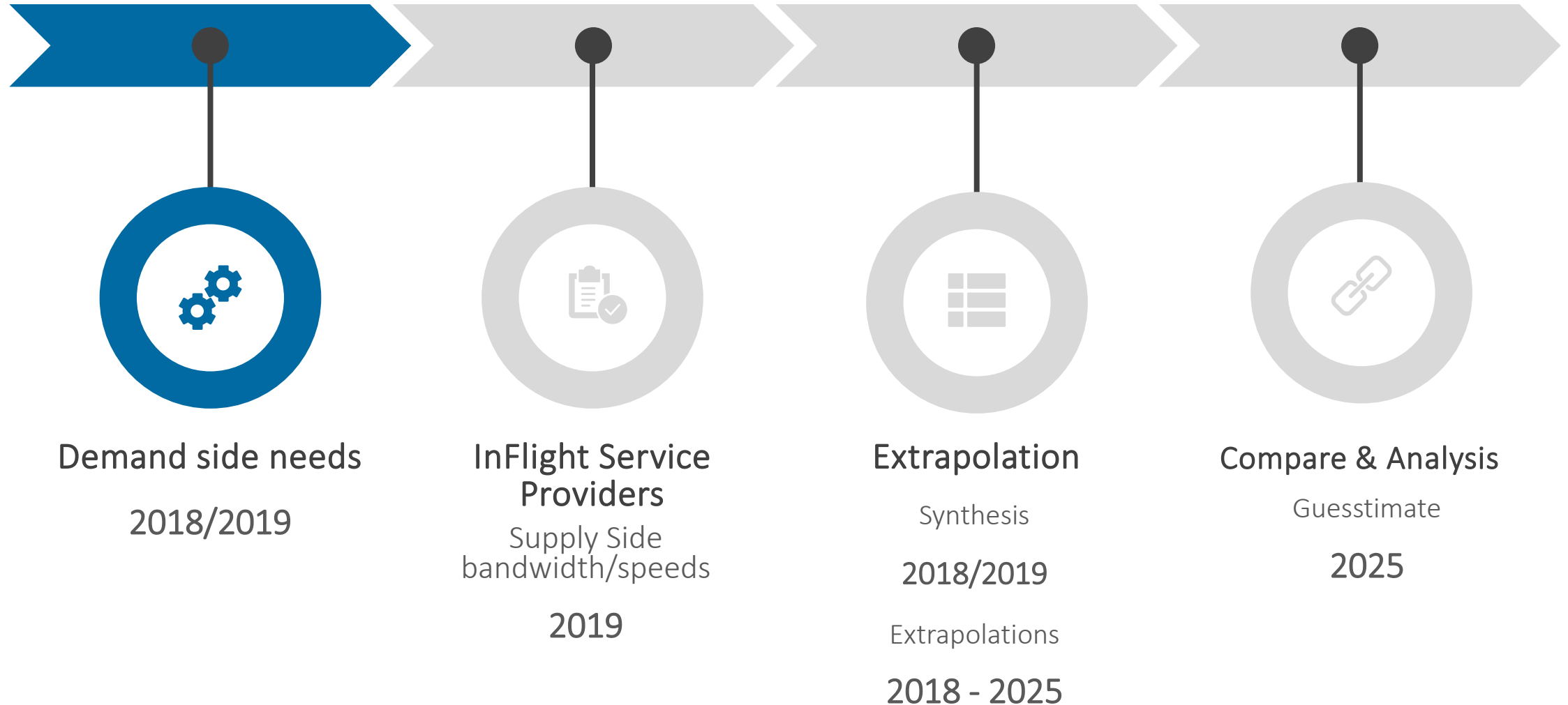# Aircraft InFlight Connectivity in 2025 – A Guesstimate

Mohan Prabhu Selvaraj, Intern, MS-IoT, INSA
Hugues Favin-Leveque, Connectivity Roadmap, AIRBUS

SECTION-1

Demand side needs

2018/2019

InFlight Service Providers

Supply Side bandwidth/speeds

2019

Extrapolation

Synthesis

2018/2019

Extrapolations

2018 - 2025

Compare & Analysis

Guesstimate

2025

METHOD-1

5G Academic Research
International Journal for Electronics & Communication
2018
Demand: Avg 84 – 92 Mbps/Cell

Supply Side - Avg 5G Cell throughput (Mbps)

	No. of Users	2018
		Total (Mbps)
A320	180	84
A321	250	86
A330	440	90
A350	480	90
A380	575	92

2018 Trendline for 100 – 600 users
84 – 92 Mbps

Number of Users Vs Average Cell Throughput (Mbps)

■ 28GHz ■ 38GHz ■ 60GHz ■ 73GHz ▬ 73GHz (Logarithmic) R² = 0.861
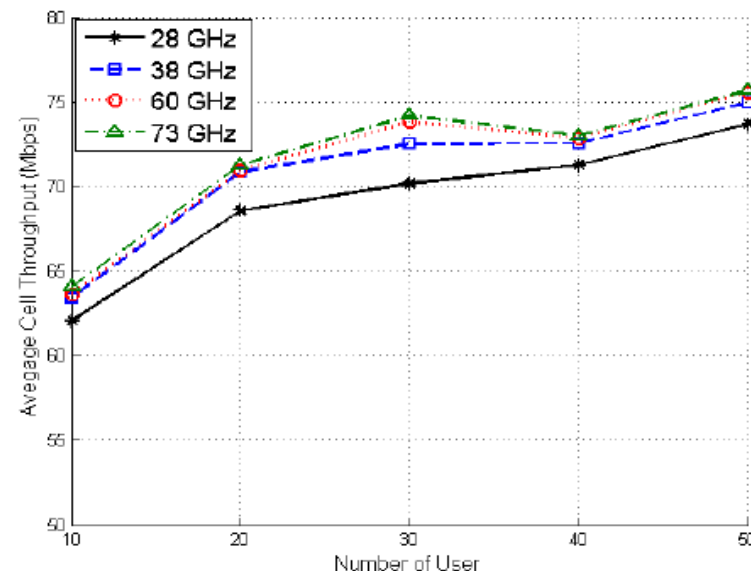
No of users

Fig. 3. Number of User vs Average Cell Throughput

Avegage Cell Throughput (Mbps)

— 28 GHz
— 38 GHz
— 60 GHz
— 73 GHz

Number of User
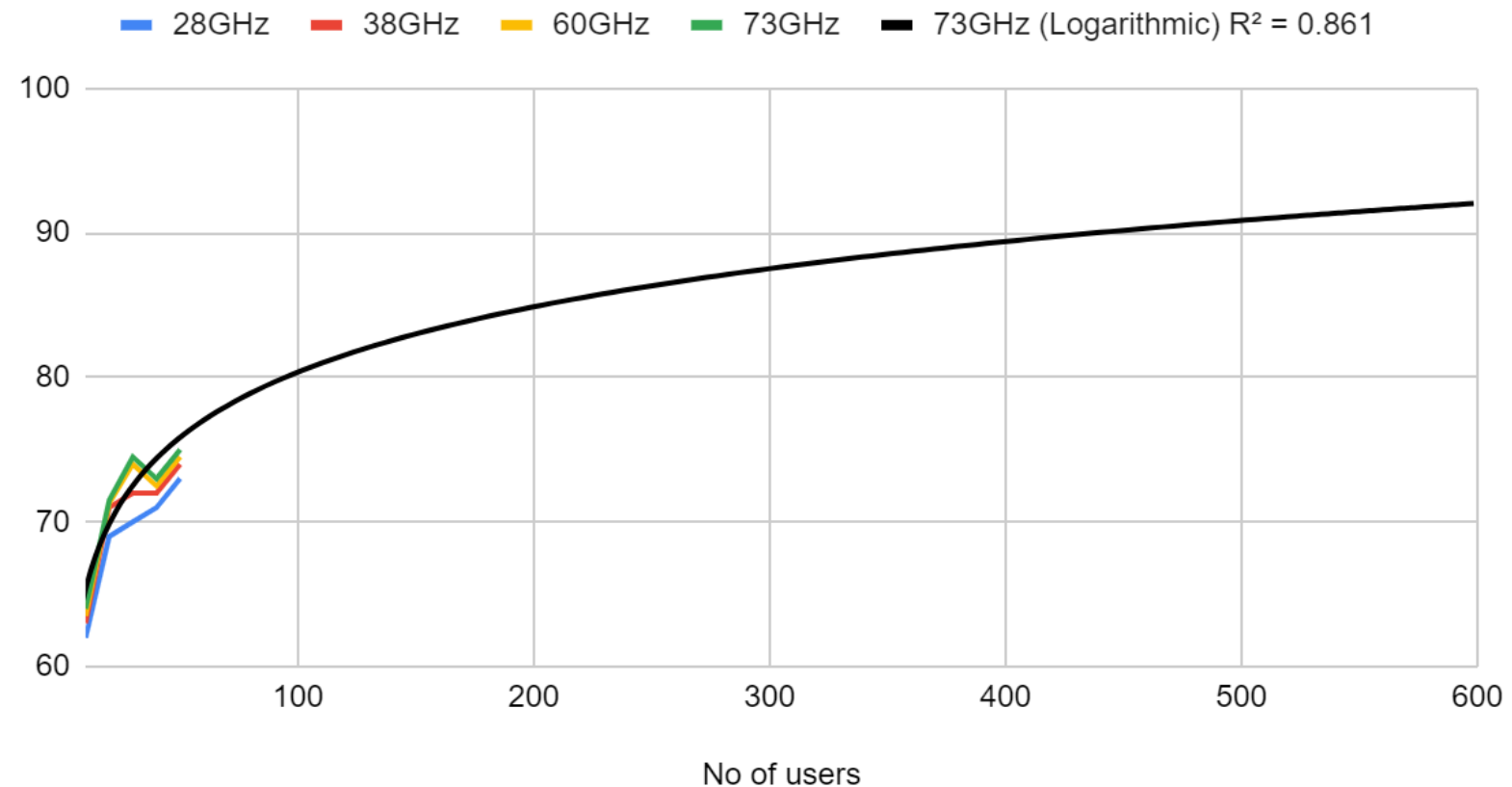
METHOD-2

IEEE, Entel Peru
2018
Method-1 + Method-2 Mix
Demand: Max. 120 – 500 Mbps/Cell
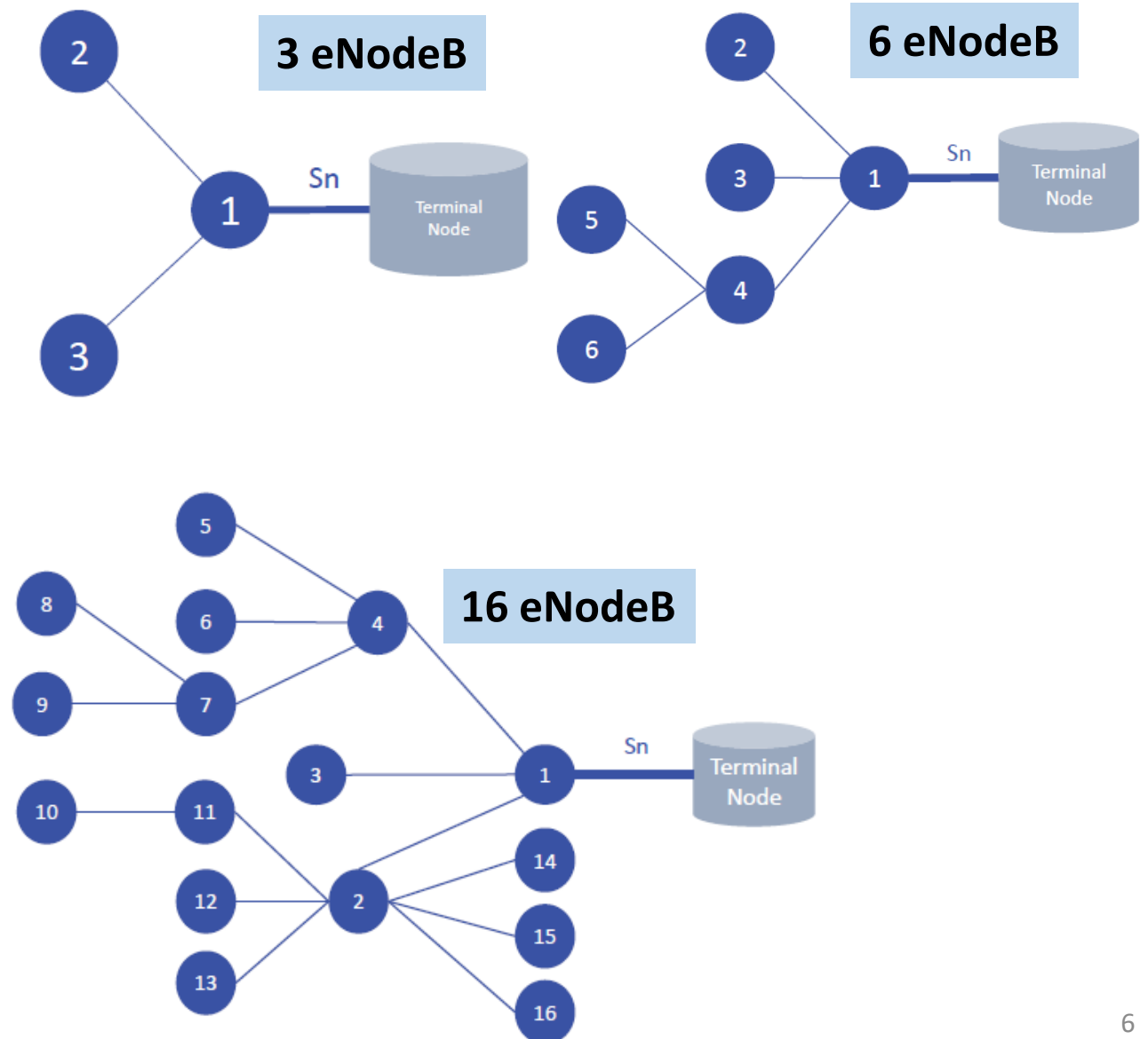
Supply side - based on eNodeB/base stations

A Normal Probability Model for Estimating Maximum Throughput of a Transport Link Based on Experimental 4G Base Station Data Analysis

IEEE 2018

This work was carried out as part of the S.E.C.R.E.T (Smart Estimation of Capacity for Right Expenses Tool) project with the support of the mobile operator Entel Peru and developed under the management of the Technological Evolution department, as part of demand analysis of the services in the Peruvian mobile market.

Ramon Cerna, Manuel Garcia, Jos´e Patino

3 eNodeB

6 eNodeB

16 eNodeB

(2) IEEE, Entel Peru, 2018, Ramon et al

Supply side - based on eNodeB/base stations

Hour	Min	3 base-stations	6 base-stations	16 base-stations
		180 users	**360 users**	**960 users**
		Max. Throughput (mbps)		
	15	140	250	490
	30	135	250	420
	45	130	250	460
1	60	125	240	450
	15	120	250	450
	30	110	230	460
	45	120	240	450
2	60	110	280	430
	15	140	230	440
	30	120	240	470
	45	140	230	430
3	60	140	250	480
	15	135	250	480
	30	110	260	470
	45	130	250	510
4	60	110	250	500
		126	**247**	**462**

		2018
	No. of Users	**Total (Mbps)**
A320	180	126
A321	250	150
A330	440	250
A350	480	280
A380	575	310

2018 Trendline for $100 - 600$ users
$126 - 310$ Mbps

Throughput (Mbps) vs. Users
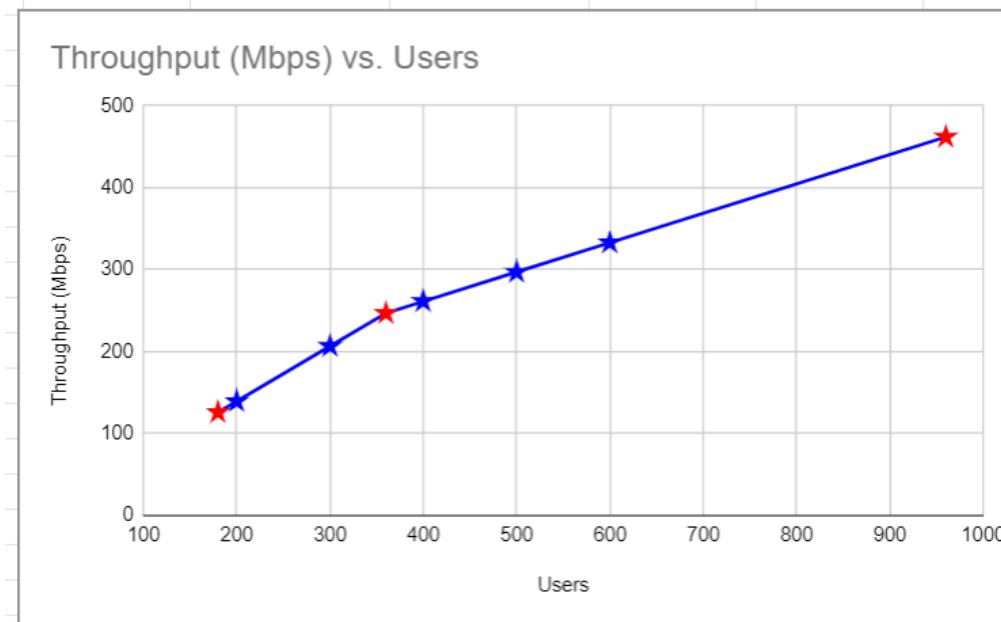
Mix of Method-1 + Method-2

- Method-1: Based on 5G throughputs - **10, 20, 30, 40, 50 users**
- Method-2: Based on 4G throughputs - **180 users & 360 users**

- Max. Speed: **120 – 500** Mbps

Better accuracy

	No. of Users	2018
		Total (Mbps)
A320	180	**120**
A321	250	170
A330	440	320
A350	480	380
A380	575	**500**

Number of Users Vs Average Cell Throughput (Mbps)

▬ 28GHz   ▬ 38GHz   ▬ 60GHz   ▬ 73GHz   ▬ 73GHz (Logarithmic) R² = 0.999

No of users

(2) IEEE, Entel Peru, 2018, Ramon et al
(1) International Journal for Electronics & Communication' 2018, Faizan et al

8
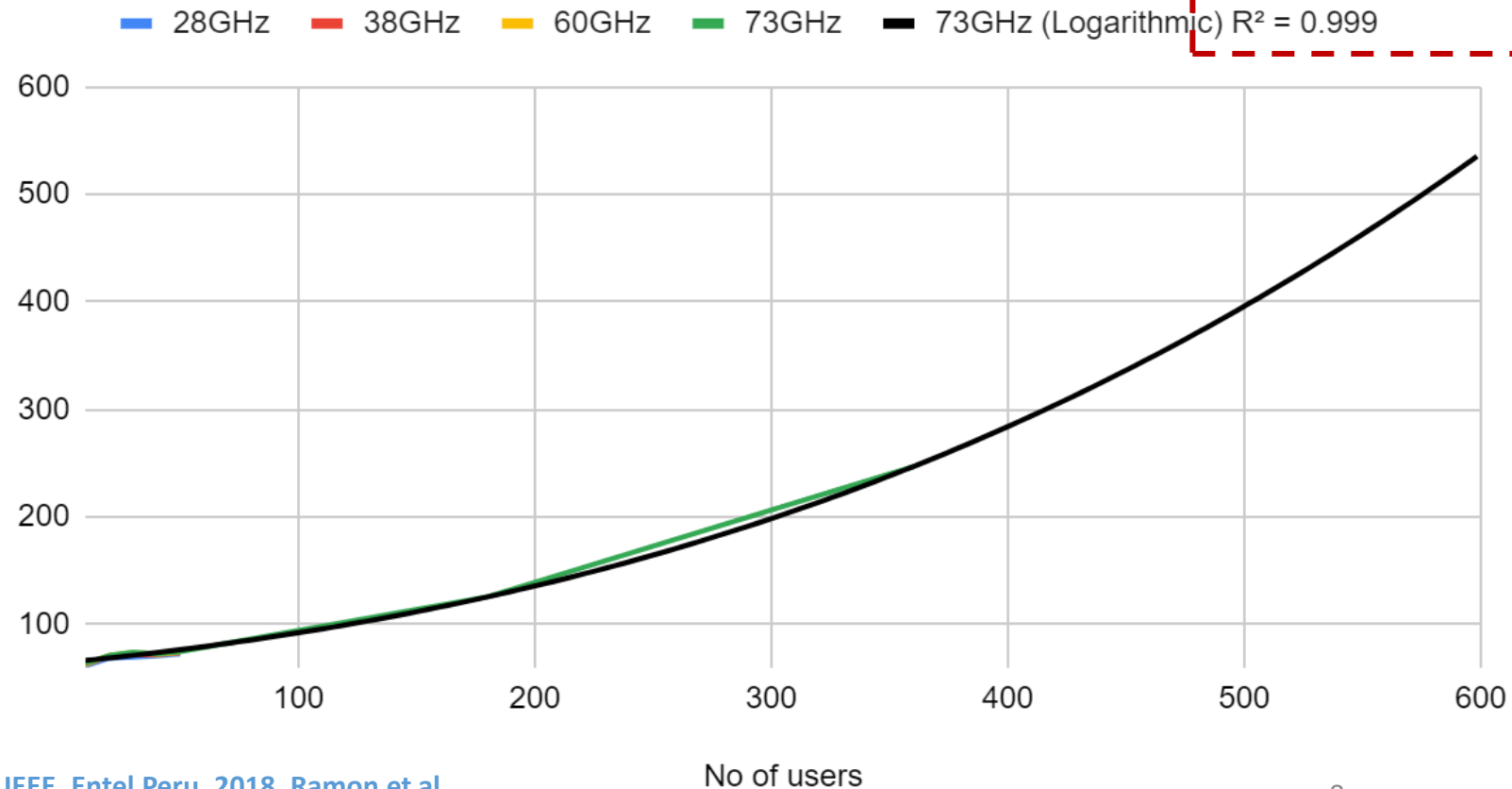
CELPLAN CONSULTING

Intelligent RAIL transport
Demand side data| 2019
Based on Busy Hour Avg usage
71 – 225 Mbps

Demand Side data
Intelligent Rail Transport Connectivity
2019 | Based on Tonnage & Busy hour Avg usage

User Applications

- Email
- Web Access
- Social Media
- Streaming
- OTT
- Messaging
- Gaming
- Downloads
- VPN

User Categories

- Business
- Tourist
- Youth

Packet Size Summary											
	Smartphone			Tablet			Laptop			Total	
	Users	DL Packet (bits)	UL Packet (bits)	Users	DL Packet (bits)	UL Packet (bits)	Users	DL Packet (bits)	UL Packet (bits)	DL	UL
Business Users/Terminal Type	22%	4728	1640	25%	4968	1584	12%	5616	1768	59%	
Tourist Users/Terminal Type	13%	5224	1384	9%	5432	1304	3%	5648	1360	25%	
Young Users/Terminal Type	10%	4904	1240	5%	4976	1240	1%	4840	1560	16%	
Totals	45%	4910	1477	39%	5076	1475	16%	5574	1679	100%	
Weighted Packet (bits)										5088	1512
Weighted Average Packet Size										3,901	
Total Tonnage / Terminal Type		73.182	13.546		171.225	23.605		96.698	13.193		
Normalized Number of Packets		0.014	0.009		0.034	0.016		0.019	0.009		
UL / DL ratio										14.76%	

Total tonnage per terminal type		Smartphone		Tablet		Laptop		All Terminals		Total
		DL	UL	DL	UL	DL	UL	DL	UL	
Total tonnage per terminal type	kbps	73	14	171	24	97	13	341	50	391

10

Demand Side needs?
Travellers connectivity needs in 2019
- based on Rail travellers Busy Hour Avg usage

As per CelPlan, for **1 user = 391 Kbps**

180 users x 391 kbps = 71 Mbps

250 users = 98 Mbps

…..

575 users = 225 Mbps

- Busy hour Avg throughput: **71 – 225** Mbps

	Smartphone	Tablet	Laptop	Total
Business	22%	31%	6%	59%
Tourist	10%	5%	1%	16%
Youth	14%	10%	1%	25%

	No. of Users	2019 Total (Mbps)
A320	180	71
A321	250	98
A330	440	174
A350	480	190
A380	575	225

SECTION-2

Demand side needs

2018/2019

InFlight Service Providers
- Supply side

Supply Side
bandwidth/speeds

2019

Extrapolation

Synthesis

2018/2019

Extrapolations

2018 - 2025

Compare & Analysis

Guesstimate

2025
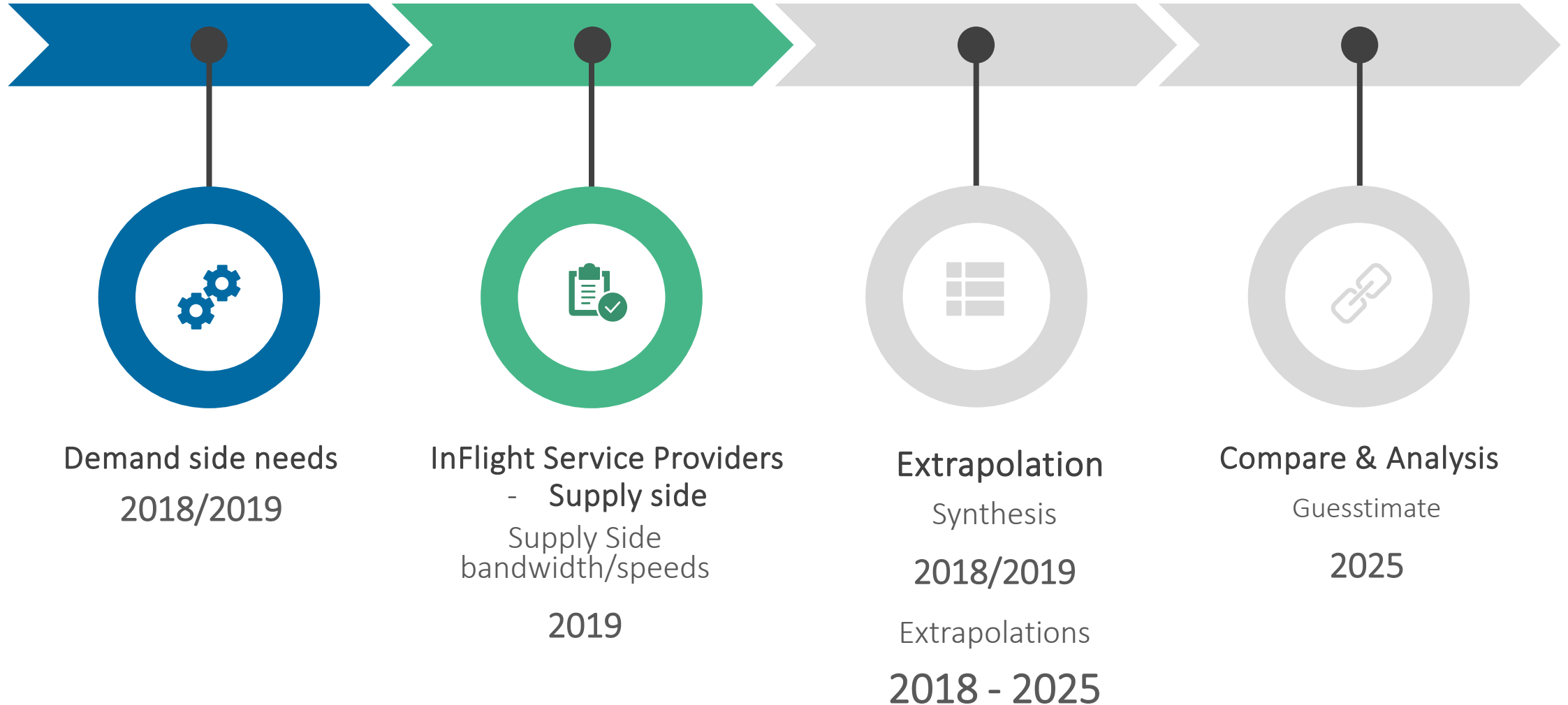
SUPPLY SIDE

A case of USA Airline Operators
Inflight Connectivity Service Providers
Airbus | Boeing
2019 – 2020
Aircraft Connectivity throughputs

Connectivity Service Providers
Bandwidth/speeds

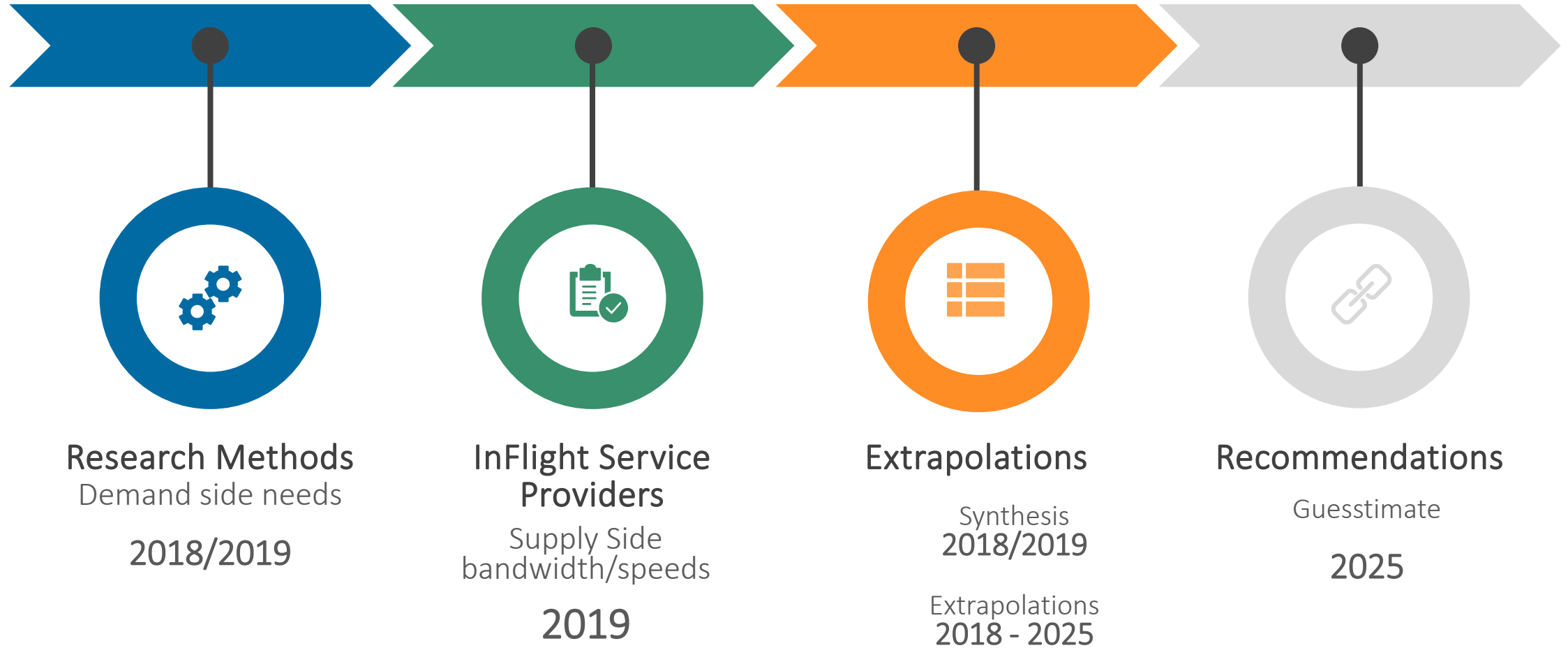| Service Provider	Service	bandwidth/ Aircraft	Bandwidth/ user	References
Viasat	Viasat-2 Inflight Connectivity	**1 Gbps**	12 Mbps avg.	https://www.viasat.com/files/assets/EXEDE_InTheAir_Datasheet_024_web.pdf https://www.aircraftinteriorsinternational.com/news/inflight-connectivity/second-generation-systems-for-viasat-2-and-viasat-3-unveiled-2.html
Panasonic	XTS	**250 Mbps max. (Theoretical)**	Not available	https://www.getconnected.aero/2019/04/aix-panasonic-roadmap-points-to-250-mbps-throughput/ https://www.aviationtoday.com/2019/09/21/panasonic-avionics-preparing-xts-asia-transitioning-airlines-new-modem/
GoGo	2Ku	**100 - 130 Mbps** 200 Mbps (Future)	Peak speed 15 Mbps	https://www.gogoair.com/commercial/inflight-systems/2ku/ https://travelupdate.com/gogo-2ku-is-super-fast-streaming-concerts-and-more-on-american-airlines/
Inmarsat/ Deutsche Telekom (DT)	EAN	**75 Mbps max.**	1 Mbps	https://www.inmarsat.com/wp-content/uploads/2018/12/InmarsatAviation_EuropeanAviationNetwork.pdf https://runwaygirlnetwork.com/2019/06/29/bas-ean-disappoints-on-bandwidth-performance-and-netflix/
SitaOnAir/ Thales Alenia/ Collins	Global Express (GX)	**50 Mbps**	2-5 Mbps	http://www.satelliteevolutiongroup.com/articles/IFC-supplement.pdf https://www.aviationtoday.com/2019/10/31/inmarsat-aviation-vp-talks-growth-business-aviation-future-roadmap-arctic-routes/
GoGo	ATG-4	**10 Mbps**	-	https://ec.europa.eu/growth/tools-databases/dem/monitor/sites/default/files/DTM_Aeronautics%20-%20Inflight%20v1.pdf

A case of US Airline Operators
Aircrafts & Connectivity as of 2019

USA Airline Operators	Service Providers	Bandwidth/Speed	Airbus Aircrafts	Min. & Max Travellers	Boeing Aircrafts	Min. & Max Travellers
American Airlines	Panasonic	20 Mbps/Aircraft 1.5 - 3.8 Mbps /user	Airbus A330-200 Airbus A330-300	250 – 440	Boeing 757-200s Boeing 767-300 Boeing 777-200ER Boeing 777-300ER Boeing 787-8 Boeing 787-9	200 - 290
American Airlines	Viasat	12 Mbps/user	Airbus A319 (legacy AA aircraft) Airbus A321 Airbus A321neo	160 – 240	Boeing 737-800 Boeing 737 MAX 8 (grounded)	160 - 200
American Airlines	GoGo 2Ku	130 Mbps/ aircraft	Airbus A319 Airbus A319 Airbus A320	160 - 180	Boeing 757	295
Delta	GoGo 2Ku	130 Mbps/ aircraft	Airbus A220, A319/A320/A321 family, Airbus A350s	100 – 480	Boeing 737-800/737-900	160 - 190
Delta	GoGo regular Ku (GTO)	60 Mbps/ aircraft	Airbus A330	440	Boeing 767/777	210 - 550
United	Viasat	12 Mbps/ user			All 737/757-300s/737 MAX 9	85 - 220
United	GoGo regular Ku (GTO)	60 Mbps/ aircraft			757-200s	200

https://thepointsguy.com/news/who-has-the-best-wi-fi-among-us-airlines/
https://thepointsguy.com/news/state-of-american-airlines-wifi/

SECTION-3

Research Methods
Demand side needs

2018/2019

InFlight Service Providers
Supply Side
bandwidth/speeds

2019

Extrapolations
Synthesis
2018/2019

Extrapolations
2018 - 2025

Recommendations
Guesstimate

2025

Synthesis - Demand & Supply in 2018-2019

- Max. Speed: **120 – 500** Mbps
- Busy hour Avg Speed: **71 – 225** Mbps

Air-Crafts		**Max. Speed**	**Busy Hour Avg. Speed**
		Method-1 + Method-2	CelPlan
		2018 DEMAND	**2019 DEMAND**
	No. of Users	**Total (Mbps)**	**Total (Mbps)**
A320	180	120	71
A380	575	500	225

Global Supply Side | 2019

High Speed		Medium Speed		Low Speed	
Viasat	Panasonic	GoGo	EAN	GX	ATG-4
1 Gbps	250 Mbps	100 Mbps	75 Mbps	50 Mbps	10 Mbps

Discrepancy

Case of USA Airline Operators Bandwidth in 2019

USA Airlines Connectivity Max. Speed			
Viasat	GoGo 2Ku	Gx	Panasonic
Very High	High	Medium	Low
1 Gbps	100 Mbps	50 Mbps	20 Mbps

Discrepancy

Discrepancy between the demand and supply

EXTRAPOLATION

High Income and Low Income Countries

GSMA/CISCO/OECD/Huawei/Ericsson: 2020 – 2023 data

Use Method-1+ Method-2: 2018 data

2025 Projections

Demand Side extrapolation?
Travellers connectivity needs in 2024
- based on CelPlan Rail travellers Busy Hour Avg usage

Total Tonnage per user (kbps)	Downlink	Uplink	Total
2019	341	50	391
2024	443	65	509

Extrapolated

Busy Hour extrapolation Factor

From 2019 to 2024 - 30%

- Method-3:

1 user = 509 Kbps
180 users = 92 Mbps
250 users = 127 Mbps
.....
575 users = 293 Mbps

	No. of Users	2024 Total (Mbps)
A320	180	92
A321	250	127
A330	440	224
A350	480	244
A380	575	293

Avg. connection speeds as per Industry reports
- 2025 Extrapolations

	2014	2018	2020	2023	2025
A HI Nations	**10 – 30 Mbps** 17/50 nations **2 - 10 Mbps** 33/50 nations Source - GSMA	**22 - 24 Mbps** 14/50 nations **10 – 30 Mbps** 36/50 nations Source - GSMA	**25 – 40 Mbps** Western EU – 40 NA – 30 APAC - 25 Source: Cisco, Huawei, Ericsson	**45 – 62 Mbps** Western EU – 62 NA – 58 APAC - 45 Source: Cisco, Huawei, Ericsson	**60 – 80 Mbps** Western EU – 80 NA – 70 APAC - 60
B MLI Nations	**2 - 10 Mbps** 83/112 nations **10 - 30 Mbps** 1/112 nations Source - GSMA	**10 - 30 Mbps** 44/112 nations **2 - 10 Mbps** 67/112 nations Source - GSMA	**13 – 21 Mbps** Central & Easterm EU – 21 Latin America, India – 15 Middle East N.Africa - 13 Source: Cisco, Huawei, Ericsson	**25 – 43 Mbps** Central & Easterm EU – 43 Latin America, India – 29 Middle East N.Africa - 25 Source: Cisco, Huawei, Ericsson	**40 – 60 Mbps** Central & Eastern EU – 60 Latin America, India – 50 Middle East N.Africa - 40

MLI – Medium & Low Income

HI – High Income

GSMA' 2019, OECD' 2014, Cisco' 2018, Huawei' 2017, Ericsson' 2019

Demand Side – Aircraft Avg. speed (Mbps)
High Income Nations – 2025 Projections

	High Income countries Avg Aircraft throughput (Mbps)				
	No. of Users	2018	2020	2023	2025
A320	180	120	140	160	180
A321	250	170	190	210	230
A330	440	310	330	350	370
A350	480	340	360	370	390
A380	575	420	440	460	480

High Income countries (Avg. Speed in Mbps)				
No of users	**2018**	**2020**	**2023**	**2025**
10	24	40	62	80
20	31	47	69	87
30	34	50	72	90
40	35	51	73	91
50	36	52	74	92
180	126	142	164	182
360	247	263	285	303
600		**Extrapolation**		

Extrapolation done by,

2018 – 2025: Industry report data in 'Yellow'

2018: Method-1 data in 'green'

2018: Method-2 data in 'blue'

High Income countries (2018, 2020, 2023 and 2025)

Legend:
- 2018
- Trendline for 2018 R² = 0.997
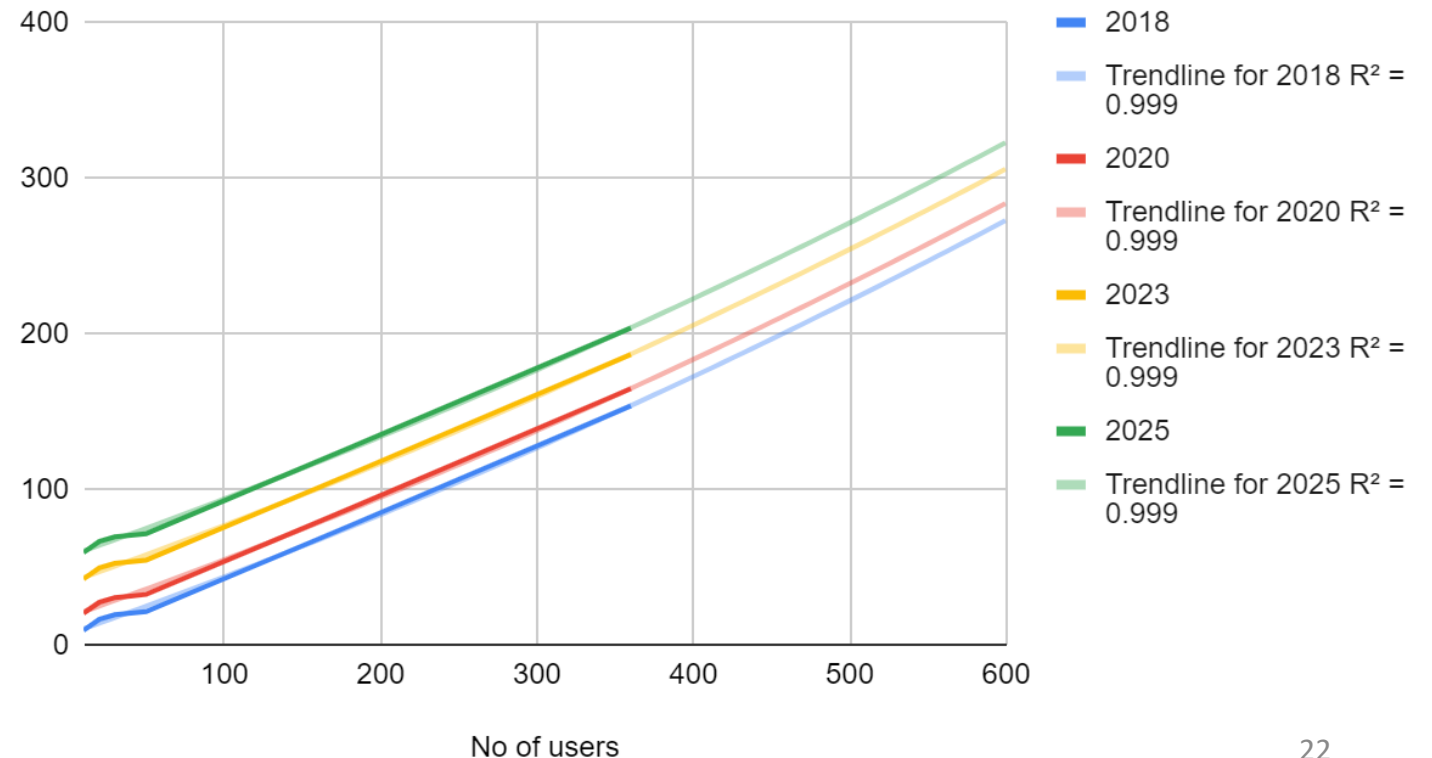- 2020
- Trendline for 2020 R² = 0.997
- 2023
- Trendline for 2023 R² = 0.997
- 2025
- Trendline for 2025 R² = 0.997

GSMA' 2019, OECD' 2014, Cisco' 2018, Huawei' 2017, Ericsson' 2019, Slide-4, 7
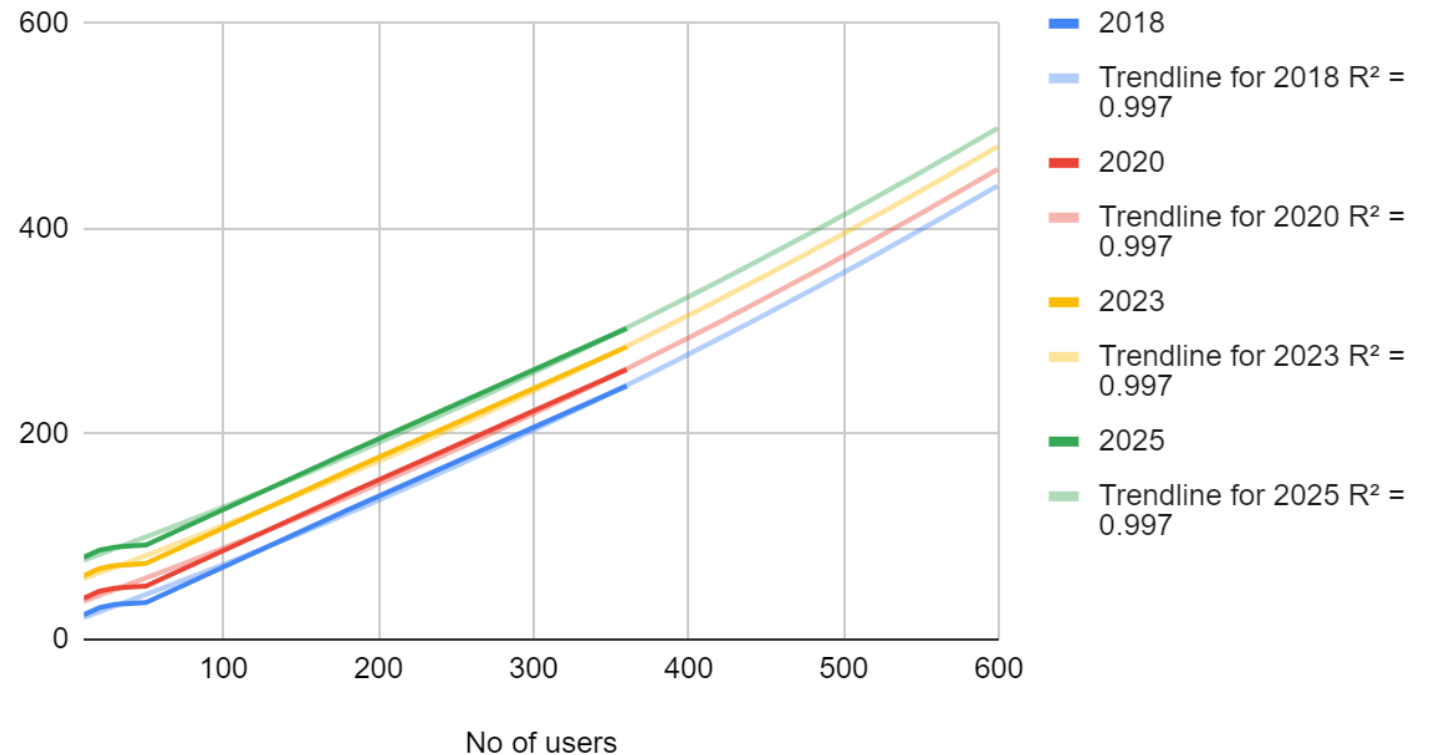
Demand Side – Aircraft Avg. speed (Mbps)
Medium & Low Income Nations – 2025 Projections

	Medium & Low income countries Avg Aircraft throughput (Mbps)				
	No. of Users	2018	2020	2023	2025
A320	180	80	90	110	120
A321	250	110	120	140	160
A330	440	190	205	225	250
A350	480	210	220	250	270
A380	575	260	270	290	310

Extrapolation done by,

2018 – 2025: Industry report data in 'Yellow'

2018: Method-1 data in 'green'

2018: Method-2 data in 'blue'

Middle Low Income countries (Avg. Speed in Mbps)				
No of users	2018	2020	2023	2025
10	10	21	43	60
20	17	28	50	67
30	20	31	53	70
40	21	32	54	71
50	22	33	55	72
180	77	88	110	127
360	154	165	187	204
600	Extrapolation			

Middle Low Income countries (2018, 2020, 2023 and 2025)

Legend: 2018; Trendline for 2018 R² = 0.999; 2020; Trendline for 2020 R² = 0.999; 2023; Trendline for 2023 R² = 0.999; 2025; Trendline for 2025 R² = 0.999

No of users

Research Methods
Demand side needs

2018/2019

InFlight Service Providers
Supply Side bandwidth/speeds

2019

Extrapolations
Synthesis

2018/2019

Extrapolations

2018 - 2025

Compare & Analysis
Guesstimate

2025

CelPlan: Demand Side increase?

From 2019 to 2024
Based on Rail travellers Busy Hour Avg usage

	No. of Users	2019 Total (Mbps)	2024 Total (Mbps)
A320	180	71	92
A321	250	99	127
A330	440	174	224
A350	480	190	244
A380	575	225	293

	Busy hour Avg. Speed (Mbps)		Increase	
	A320	A380	A320	A380
2019	71	225	**30%**	**30%**
2024	92	293		

Demand Side increase?
High Income Countries
From 2020 to 2025
Based on Avg connection speed (Mbps)

	High Income countries Avg Aircraft throughput (Mbps)				
	No. of Users	2018	2020	2023	2025
A320	180	120	140	160	180
A321	250	170	190	210	230
A330	440	310	330	350	370
A350	480	340	360	370	390
A380	575	420	440	460	480

	Avg. Speed (Mbps)		Increase	
	A320	A380	A320	A380
2020	140	440	**29%**	**9%**
2025	180	480		

Demand Side increase?
Medium & Low Income Countries
From 2020 to 2025
Based on Avg connection speed (Mbps)

	Medium & Low income countries Avg Aircraft throughput (Mbps)				
	No. of Users	2018	2020	2023	2025
A320	180	80	90	110	120
A321	250	110	120	140	160
A330	440	190	205	225	250
A350	480	210	220	250	270
A380	575	260	270	290	310

	Avg. Speed (Mbps)		Increase	
	A320	A380	A320	A380
2020	90	270	**33%**	**15%**
2025	120	310		

Final Analysis Summary

Air-Crafts		2018	2018		2019	2024	2020		2025	
		Max Speed	Avg. Speed		Busy Hour Avg. Speed	Busy Hour Avg. Speed (Extrapolated)	Avg. Speed (Extrapolated)		Avg. Speed (Extrapolated)	
		Mix of Method-1 + Method-2	High Income nations	Low Income nations	CelPlan		High Income nations	Low Income nations	High Income nations	Low Income nations
	No. of Users	Total (Mbps)	Total (Mbps)	Total (Mbps)	Total (Mbps)	Total (Mbps)	Total (Mbps)	Total (Mbps)	Total (Mbps)	Total (Mbps)
A320	180	120	120	80	71	92	140	90	180	120
A380	575	500	420	260	225	293	440	120	480	310

Thank you !

Questions are welcome!

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