ESTIMATING DEMAND FOR TRAFFIC CAPACITY BASED ON END USER BEHAVIOR

A Latin American case study

Telecom Advisory Services, LLC

Capacity Central America and Andean 2014
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FORECASTING NETWORK UTILIZATION AS A FUNCTION OF DEMAND REMAINS A CRITICAL CAPABILITY

- Drives network planning

- Is a critical factor in determining capital expenditures, and consequently, free cashflows

- It represents a lever to offer quality of service

- However, traffic demand forecasting is rendered complex by three factors

  - While capital planning and infrastructure deployment is a multi-year process, traffic (as driven by end user utilization) is volatile and fickle with a much shorter time horizon and cycle times

  - Traffic surges can be extremely localized (for example a city, a province, even a neighborhood) while infrastructure capacity is often planned at the aggregate level (how can one deal with short-range high local capacity surges?)

  - From a business process standpoint, an operator marketing function has some visibility of future demand (sales, activations, churn, etc.) but often fails to communicate this to enginerring for network planning purposes (cross functional process in an service provider are not always that streamlined)
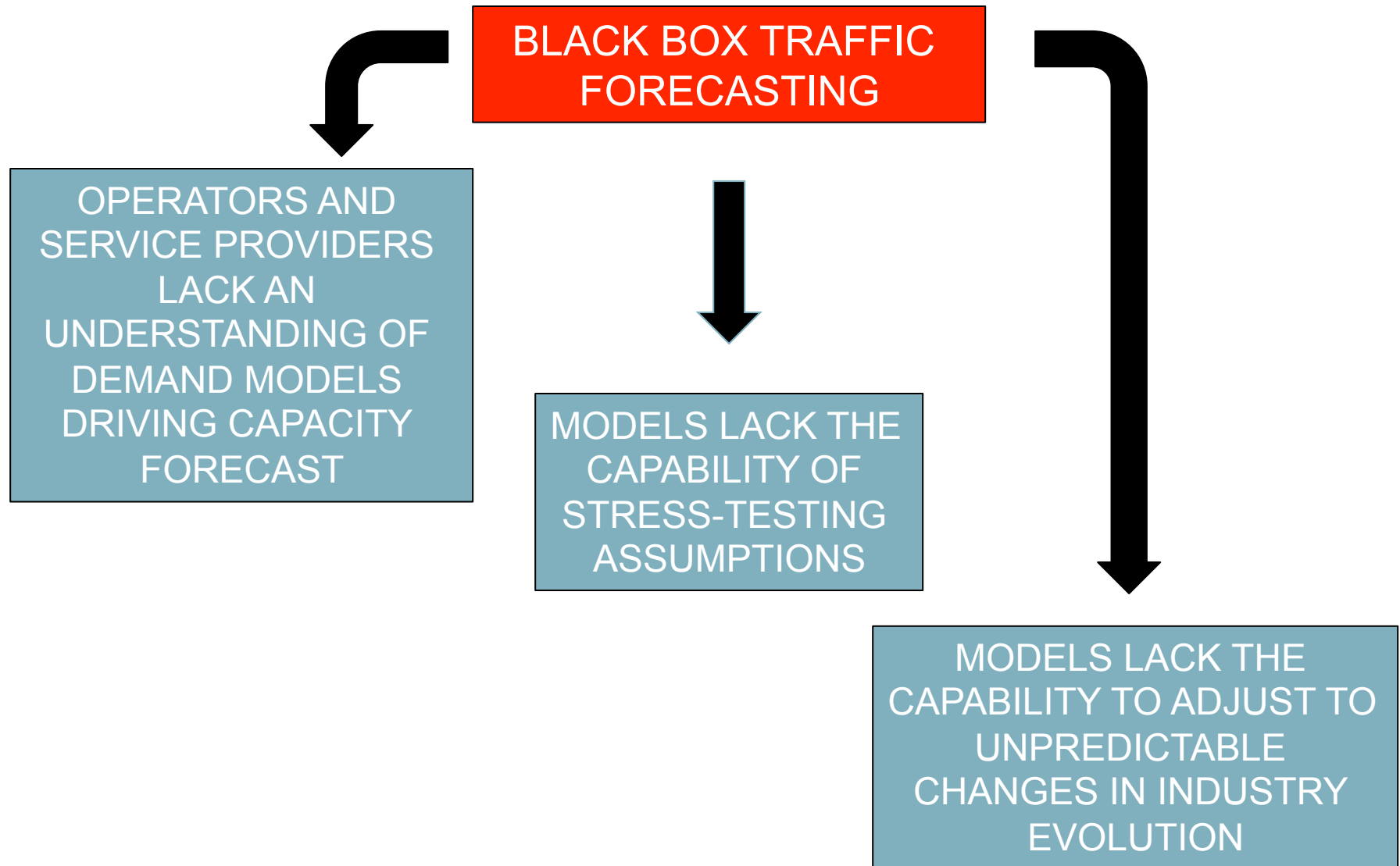
THE TELECOMMUNICATIONS INDUSTRY IS FRAUGHT WITH MISTAKES IN FORECASTING TRAFFIC DEMAND, WHICH RESULT IN SIGNIFICANT BUSINESS IMPACT

- Over-optimistc demand for satellite traffic

  - Optimistic cross-Atlantic satellite traffic forecasting resulted in a capacity glut in the early 80s, resulting in a collpase of pricing

  - Excess capacity in local telecommunications transport in the US due to the CLECs deployment in the 90s resulted in significant stranded last mile infrastructure

- Pessimistic demand for wireless traffic

  - Limited visibility on smartphone device utilization at the time of the iPhone launch in 2007 resulted in network capacity shortfalls in the New York and San Francisco markets

  - Limited understanding in the growth of Internet mobile device traffic growth pushed some wireless providers in Latin America to limit smartphone sales to avoid significant degradation of service quality (this was obvioulsy aggravated by spectrum shortages)

THERE ARE SEVERAL APPROACHES TO FORECASTING TRAFFIC DEMAND

APPROACH	DETAILS	ADVANTAGES	DISADVANTAGES
Lead indicator forecasting	• Develop an econometric model that links the variable to be forecast (traffic) to others with reliable projections (GDP, trade volumes)	• Some quantitative reliability • Easy to built	• Strength of causal link • Reliability of past causal links to forecast future developments
Trend extrapolation	• Smooth out traffic trends over the past years • Extend trend in the future	• Reliable in the short term	• Less reliable over the long run • Cannot adjust for volatility
User primary research	• Survey end users inquiring for future device utilization and adoption	• Grounded on market data of future utilization	• Users are good to forecast the short term only • Differences between self-reported vs. actuals
End-user driven	• Compile bottom-up actual data on devices and usage per device • Forecast future evolution of both variables	• Reliability of actual data on utilization • Forecast based on adoption and replacement rate of devices	• Cannot adjust for volatility (which requires expert and operator validation)

BLACK BOX TRAFFIC FORECASTING

OPERATORS AND SERVICE PROVIDERS LACK AN UNDERSTANDING OF DEMAND MODELS DRIVING CAPACITY FORECAST

MODELS LACK THE CAPABILITY OF STRESS-TESTING ASSUMPTIONS

MODELS LACK THE CAPABILITY TO ADJUST TO UNPREDICTABLE CHANGES IN INDUSTRY EVOLUTION

- Traffic model structure

- Results for Latin America

- Implications for capacity management

END –USER TRAFFIC FORECASTING

1

| Number of Devices | **+** | Traffic per Device |

Total traffic per country

2

Split traffic by type

- International traffic

- Content traffic
- Local traffic

3

Develop traffic matrices

Split traffic by region
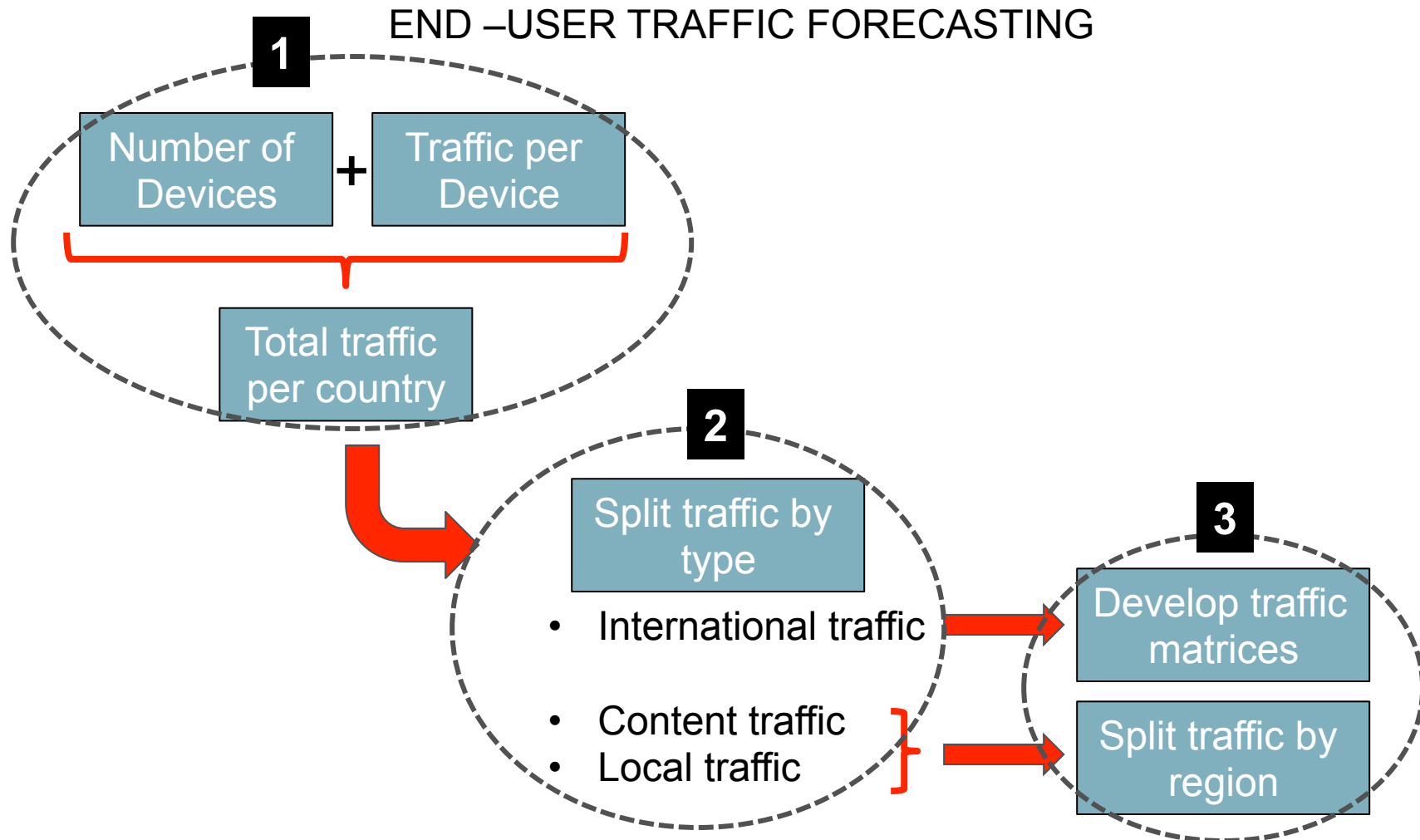
(*) This model was developed under commission to the CAF-Latin American Development Bank

THE FIRST STEP CONSISTS IN CALCULATING THE TOTAL INTERNET TRAFFIC FOR EACH COUNTRY

TOTAL WIRELESS INTERNET TRAFFIC

Number of devices	→	Traffic by device	→	Total wireless traffic

- Smartphones
- Internet enabled feature phones
- Tablets
- Laptops

- Megabytes per month

Total megabytes per month

TOTAL FIXED INTERNET TRAFFIC

Installed Base of household data devices	→	Average traffic per household device	→	Pecentage of Internet traffic by household PC	→	Total Internet household traffic

- PCs
- Game consoles
- M2M

- Megabytes per month per device

Total magabytes per month

Fixed enterprise broadband	→	Average enteprise Internet traffic	→	Total Internet Enterprise traffic

- Broadband Penetration

- Megabytes per month

Total magabytes per month

Total Internet traffic

IN THE CASE OF MOBILE INTERNET, THE INSTALLED BASE OF DEVICES AND THE TRAFFIC PER DEVICE WAS COMPILED

MOBILE INTERNET DEVICES (Smartphones, Tablets, Internet enabled feature phones, PCs) (in million units)

COUNTRY	2011	2012	2013	2014	2015	2016	2017	CAGR 2012-17
Argentina	56	59	62	65	67	69	70	66%
Brasil	246	282	310	331	348	361	361	60%
Chile	25	27	29	32	33	35	35	52%
Colombia	45	49	52	55	58	60	60	61%
Mexico	95	103	111	118	125	131	131	65%
Panama	5	5	6	6	6	6	6	61%
Peru	27	30	33	35	38	40	40	61%
Venezuela	31	32	33	34	35	35	35	61%
Total	530	588	636	676	710	737	738	69%

Source: GSMA Intelligence

TRAFFIC PER TERMINAL (in MB)

COUNTRY	2011	2012	2013	2014	2015	2016	2017	CAGR 2012-17
Argentina	53	61	116	186	297	473	778	66%
Brasil	59	74	130	202	315	490	778	60%
Chile	116	124	214	313	456	665	998	52%
Colombia	61	84	143	226	357	565	904	61%
Mexico	55	74	132	213	344	555	899	65%
Panama	61	84	143	226	357	565	904	61%
Peru	61	84	143	226	357	565	904	61%
Venezuela	61	84	143	226	357	565	904	61%

Source: Cisco

AT THIS POINT, THE INTERIM PROJECTIONS WERE VALIDATED WITH RELIABLE SECOND PARTY SOURCES, SUCH AS CISCO'S VISUAL NETWORKING INDEX

COMPARISON OF MOBILE INTERNET TRAFFIC (in Petabytes)

COUNTRY	2011	2012	2013	2014	2015	2016	2017	CAGR 2012-2017
Argentina	3	4	7	12	20	33	54	72%
Brazil	15	21	40	67	109	177	281	68%
Chile	3	3	6	10	15	23	34	59%
Colombia	3	4	7	12	21	34	54	68%
Mexico	5	8	15	25	43	73	118	73%
Panama	0	0	1	1	2	4	6	68%
Peru	2	3	5	8	13	22	36	70%
Venezuela	2	3	5	8	12	20	32	64%
Total	32	45	86	144	236	385	615	69%

Source: TAS analysis

COUNTRY	2011	2012	2017	CAGR 2012-2017
Argentina	3	4	54	71%
Brasil	14	21	252	65%
Chile	3	3	30	56%
Mexico	6	8	131	77%
Resto de LA	14	20	257	67%
Total	40	55	724	67%

Source: CISCO

SIMILARLY, AS IN THE CASE OF MOBILE TRAFFIC, FOR FIXED RESIDENTIAL INTERNET THE KEY DRIVER IS THE INSTALLED BASE OF HOUSEHOLD PCs AS WELL THE TRAFFIC PER UNIT

INSTALLED BASE OF HOUSEHOLD PERSONAL COMPUTERS (in million units)

COUNTRY	2011	2012	2013	2014	2015	2016	2017	CAGR 2012-17
Argentina	7.1	7.7	7.8	8.3	8.8	10.0	11.5	9%
Brazil	40.9	48.1	54.7	60.9	71.8	84.8	100.0	16%
Chile	5.1	6.0	6.6	7.2	8.5	10.1	11.9	15%
Colombia	4.2	5.2	6.1	6.8	8.5	10.7	13.4	21%
Mexico	20.4	23.1	25.7	28.2	31.9	36.2	41.0	12%
Panama	0.2	0.3	0.3	0.3	0.4	0.5	0.6	17%
Peru	1.8	2.3	2.8	3.4	4.2	5.1	6.1	22%
Venezuela	3.0	3.3	3.4	3.4	3.6	3.9	4.1	5%

Source: IDC

TRAFFIC PER UNIT(en GB)

COUNTRY	2011	2012	2013	2014	2015	2016	2017	CAGR 2012-17
Argentina	10.4	11.6	14.2	17.8	22.8	30.0	30.0	21%
Brazil	7.4	10.0	12.4	16.5	23.0	32.6	32.6	27%
Chile	11.0	12.5	15.8	20.3	27.0	36.7	36.7	24%
Colombia	6.5	7.5	9.1	11.4	14.7	19.9	19.9	22%
Mexico	5.9	7.6	10.5	14.2	18.5	24.3	24.3	26%
Panama	6.5	7.5	9.1	11.4	14.7	19.9	19.9	22%
Peru	6.5	7.5	9.1	11.4	14.7	19.9	19.9	22%
Venezuela	6.5	7.5	9.1	11.4	14.7	19.9	19.9	22%

Source: Cisco

WHEN COMPARED WITH CISCO'S, OUR PROJECTIONS ARE BETWEEN 5% AND 15% MORE CONSERVATIVE

COMPARISON OF FIXED RESIDENTIAL INTERNET TRAFFIC (in Petabytes)

COUNTRY	2011	2012	2013	2014	2015	2016	2017	CAGR 2012-17
Argentina	76	94	120	164	228	354	406	34%
Brazil	316	516	750	1,139	1,934	3,328	3,927	50%
Chile	59	79	114	163	259	424	500	45%
Colombia	28	42	61	89	150	264	331	51%
Mexico	124	184	293	445	677	1,036	1,174	45%
Panama	2	2	3	5	7	12	14	46%
Peru	12	18	28	45	73	124	149	52%
Venezuela	20	26	34	45	64	96	102	31%
Total	638	961	1,403	2,094	3,392	5,638	6,602	47%

Source: TAS analysis

COUNTRY	2011	2016	CAGR 2012-16
Argentina	77	484	44%
Brazil	320	3,064	58%
Chile	68	485	47%
Mexico	141	1,051	47%
Rest of LA	183	1,261	46%
Total	789	6,344	51%

Source: Cisco

IN THE CASE OF ENTERPRISE INTERNET TRAFFIC, THE KEY DRIVER IS THE NUMBER OF FIRMS WITH BROADBAND ACCESS, AS WELL AS THE AVERAGE TRAFFIC GENERATION

NUMBER OF ENTERPRISES WITH BROADBAND ACCESS (thousand)

COUNTRY	2011	2012	2013	2014	2015	2016	2017
Argentina	515	542	566	596	630	667	706
Brazil	1,895	2,053	2,225	2,417	2,629	2,855	3,101
Chile	495	538	583	630	680	732	788
Colombia	483	491	500	511	520	530	541
Mexico	816	884	960	1,046	1,141	1,242	1,353
Panama	379	380	381	382	383	384	386
Peru	436	442	449	456	463	471	479
Venezuela	453	459	464	468	473	478	483

Sources: Cisco and TAS analysis

TRAFFIC PER ENTERPRISE (in GB)

COUNTRY	2011	2012	2013	2014	2015	2016	2017
Argentina	43	54	60	65	69	72	76
Brasil	46	56	67	77	81	78	74
Chile	40	50	56	60	64	66	69
Colombia	47	59	65	70	74	78	81
Mexico	42	49	50	52	53	53	53
Panama	47	59	65	70	74	78	81
Peru	47	59	65	70	74	78	81
Venezuela	47	59	65	70	74	78	81

Source: Cisco

SIMILARLY TO THE PRIOR COMPARISON, OUR FORECAST OF FIXED ENTERPRISE INTERNET TRAFFIC IS BETWEEN 5% AND 15% MORE CONSERVATIVE THAN CISCO'S

COMPARISON OF ENTERPRISE FIXED INTERNET TRAFFIC (in Petabytes)

COUNTRY	2011	2012	2013	2014	2015	2016	2017	CAGR 2012-17
Argentina	22	30	34	39	44	48	54	13%
Brazil	87	116	150	187	213	221	230	15%
Chile	20	27	32	38	43	49	55	15%
Colombia	23	29	32	36	39	41	44	9%
Mexico	34	43	49	54	60	66	72	11%
Panama	18	22	25	27	29	30	31	7%
Peru	20	26	29	32	34	37	39	9%
Venezuela	21	27	30	33	35	37	39	8%

Source: TAS analysis

COUNTRY	2011	2016	CAGR 2012-16
Argentina	24	60	16%
Brazil	91	265	19%
Chile	21	58	18%
Mexico	36	96	18%
Rest of LA	59	173	20%

Source: CISCO

HAVING ESTIMATED THE DEMAND FROM MOBILE, RESIDENTIAL FIXED AND ENTERPRISE FIXED, THE THREE CATEGORIES ARE ADDED TO PROJECT TOTAL INTERNET TRAFFIC BY COUNTRY

TOTAL INTERNET TRAFFIC (IN PETABYTES)

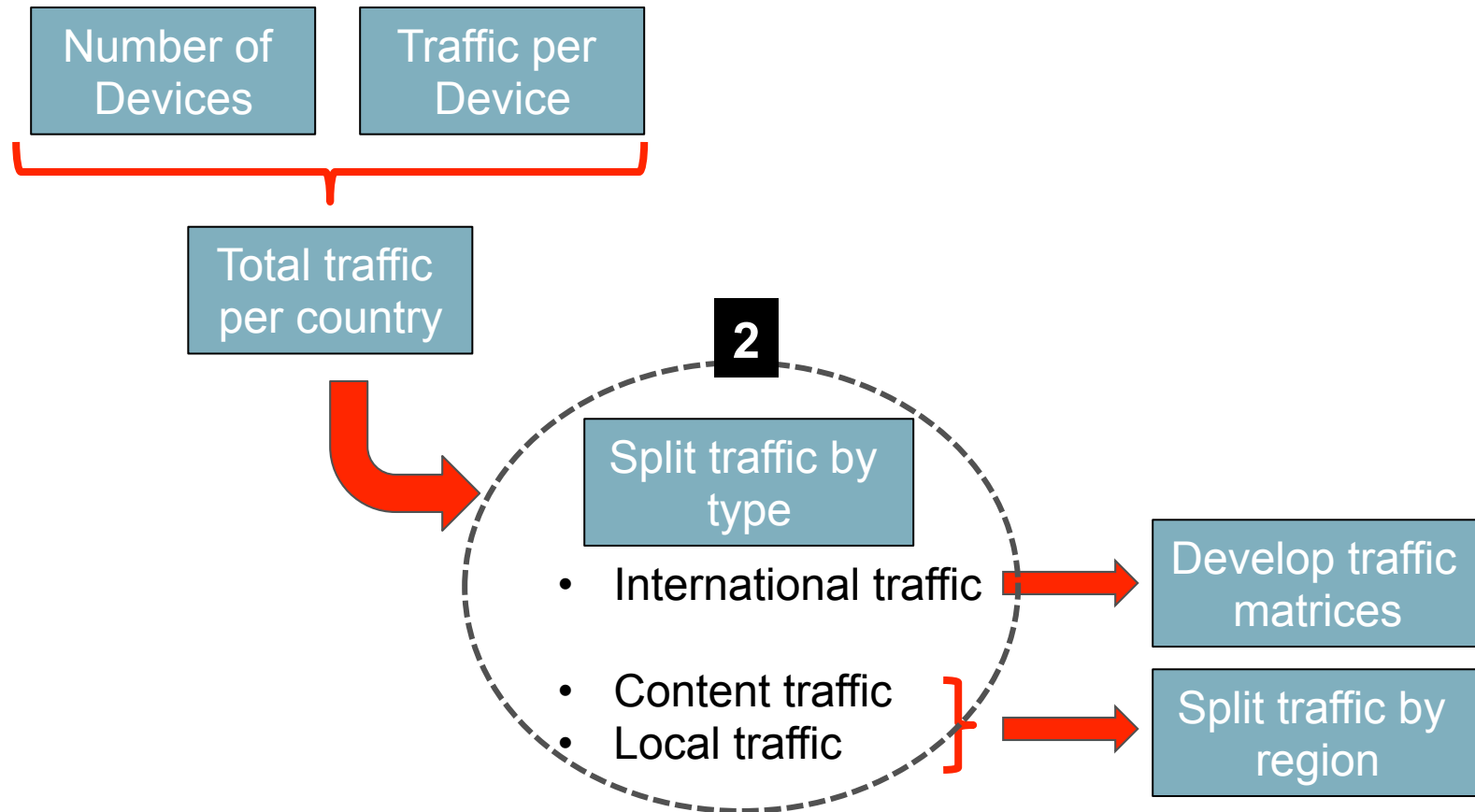| COUNTRY	2011	2012	2013	2014	2015	2016	2017	CAGR 2012-2017
Argentina	102	127	162	215	292	435	514	32%
Brazil	418z	652	939	1,393	2,257	3,727	4,437	47%
Chile	82	109	152	210	318	496	589	40%
Colombia	53	75	101	138	209	339	430	42%
Mexico	163	235	357	524	780	1,174	1,363	42%
Panama	20	25	29	33	38	45	51	16%
Peru	34	47	62	85	121	183	224	37%
Venezuela	43	56	69	85	111	153	173	25%
Total	915	1,325	1,871	2,683	4,125	6,553	7,781	42%

Note: 1 PB= 1 Petabyte= 10^15 = 1 million Gigabytes

Source: TAS analysis

THIS REPRESENTS 85 OF TOTAL LATIN AMERICAN INTERNET TRAFFIC

END –USER TRAFFIC FORECASTING

Number of Devices

Traffic per Device

Total traffic per country

2

Split traffic by type

- International traffic

- Content traffic
- Local traffic

Develop traffic matrices

Split traffic by region

THE SPLIT BETWEEN TRAFFIC TYPE (LOCAL, INTERNATIONAL OUTGOING AND INTERNATIONAL CONTENT IN LOCAL CACHE) IS COMPILED FROM OPERATOR INTERVIEWS

Total Traffic

85%	5%	10%
International Traffic	International Content in Cache	Local Traffic

- **Mexico**

Total Traffic

65%	30%	5%
International Traffic	International Content in Cache	Local Traffic

- **Argentina**
- **Colombia**
- **Peru**

Total Traffic

60%	30%	10%
International Traffic	International Content in Cache	Local Traffic

- **Chile**

Total Traffic

55%	20%	25%
International Traffic	International Content in Cache	Local Traffic

- **Brazil**

Sources: Internexa in Colombia, NAP Colombia, CUDI in Mexico, PTTMetro in Brazil,

PERCENTAGE OF LOCAL CONTENT TRAFFIC BY COUNTRY

COUNTRY	2011	2012	2013	2014	2015	2016	2017
Argentina	5%	5%	5%	6%	6%	6%	6%
Brazil	25%	25%	25%	25%	25%	25%	25%
Chile	10%	10%	10%	10%	10%	10%	10%
Colombia	5%	5%	5%	6%	6%	6%	6%
México	10%	10%	10%	10%	10%	10%	10%
Panamá	5%	5%	5%	6%	6%	6%	6%
Perú	5%	5%	5%	6%	6%	6%	6%
Venezuela	5%	5%	5%	6%	6%	6%	6%

Sources: Internexa, TAS analysis

ASSUMPTIONS

- The percentage of local traffic remains constant in Brazil, Chile and Mexico

- In the other countries, local traffic will grow at 5% annually

THE FORECAST OF SPLIT BETWEEN LOCAL DOMESTIC AND INTERNATIONAL TRAFFIC IS DRIVEN BY THE GROWTH IN LOCAL CONTENT VOLUME

PERCENTAGE OF INTERNATIONAL TRAFFIC BY COUNTRY

COUNTRY	2011	2012	2013	2014	2015	2016	2017
Argentina	65%	62%	59%	56%	53%	50%	48%
Brazil	40%	40%	40%	40%	40%	40%	40%
Chile	65%	62%	59%	56%	53%	50%	48%
Colombia	65%	62%	59%	56%	53%	50%	48%
Mexico	85%	82%	79%	76%	74%	71%	68%
Panama	85%	85%	85%	85%	85%	85%	85%
Peru	65%	62%	59%	56%	53%	50%	48%
Venezuela	85%	82%	79%	76%	74%	71%	68%

Sources: Internexa, TAS analysis

ASSUMPTIONS

- Brazilian international traffic remains constant
- Local traffic in Argentina, Chile, Colombia and Peru is estimated to grow at 5% annually
- The traffic in Mexico and Venezuela decreases with same trend as the prior countries
- In Panama, traffic is primarily international and remains constant over the forecast period

ON THE OTHER HAND, THE VOLUME OF INTERNATIONAL CONTENT IN CACHE IN LATIN AMERICAN DATA CENTERS WILL CONTINUE GROWING

PERCENTAGE OF INTERNATIONAL CONTENT IN LOCAL CACHE

	2011	2012	2013	2014	2015	2016	2017
Argentina	30%	30%	32%	33%	35%	36%	38%
Brazil	20%	20%	21%	22%	23%	24%	26%
Chile	30%	30%	32%	33%	35%	36%	38%
Colombia	30%	30%	32%	33%	35%	36%	38%
México	5%	5%	5%	6%	6%	6%	6%
Panamá	5%	5%	5%	6%	6%	6%	6%
Perú	30%	30%	32%	33%	35%	36%	38%
Venezuela	5%	5%	9%	5%	9%	16%	29%

Sources: Internexa, TAS analysis

ASSUMPTIONS

- International content in local cache in Agentina, Brazil, Chile, Colombia and Peru is growing at 5% annually
- In Mexico the international content hosted in cache will remain hosted in the United States due to geographic closeness and low transit and hosting prices
- The Panama situation is similar to Mexico due to the number of submarine cables reaching the country
- International content in cache in Latin America will gradually reach the level of countries with extensive IXP infrastructure

AT THIS POINT, WE ARE ABLE TO FORECAST TOTAL TRAFFIC BY TYPE, STARTING BY INTERNATIONAL OUTGOING

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                        TOTAL TRAFFIC

   INTERNATIONAL      INTERNATIONAL        LOCAL TRAFFIC
     TRAFFIC        CONTENT IN CACHE
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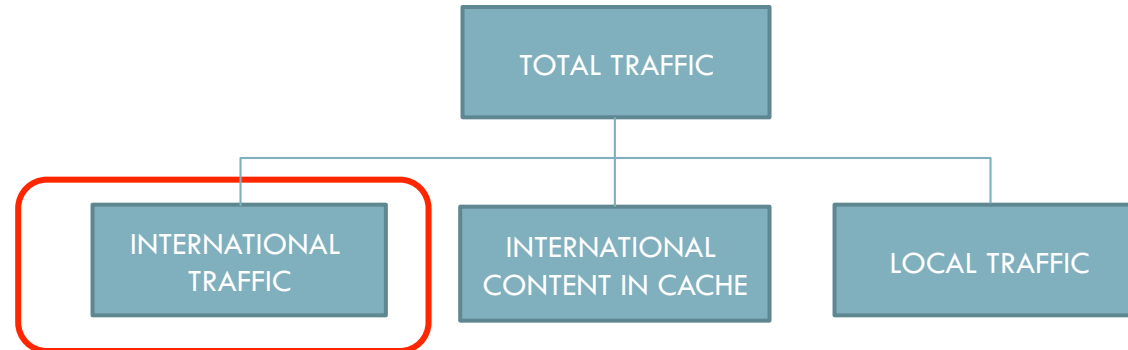
INTERNATIONAL OUTGOING TRAFFIC BY MONTHT (In Petabytes)

COUNTRY	2011	2012	2013	2014	2015	2016	2017	TACC 2012-17
Argentina	66	83	102	132	174	250	284	34%
Brazil	230	359	507	738	1,170	1,889	2,195	57%
Chile	49	65	89	120	175	266	305	44%
Colombia	35	48	64	84	124	195	238	47%
México	139	199	302	443	657	986	1,140	52%
Panamá	18	22	26	29	33	40	44	20%
Perú	22	30	39	52	72	105	124	41%
Venezuela	39	50	59	76	95	119	112	23%
TOTAL	597	858	1,189	1,675	2,500	3,849	4,442	49%

Source: TAS analysis

LIKEWISE, WE PROJECT TOTAL TRAFFIC RESULTING FROM INTERNATIONAL CONTENT RESIDENT IN LATIN AMERICAN CACHES
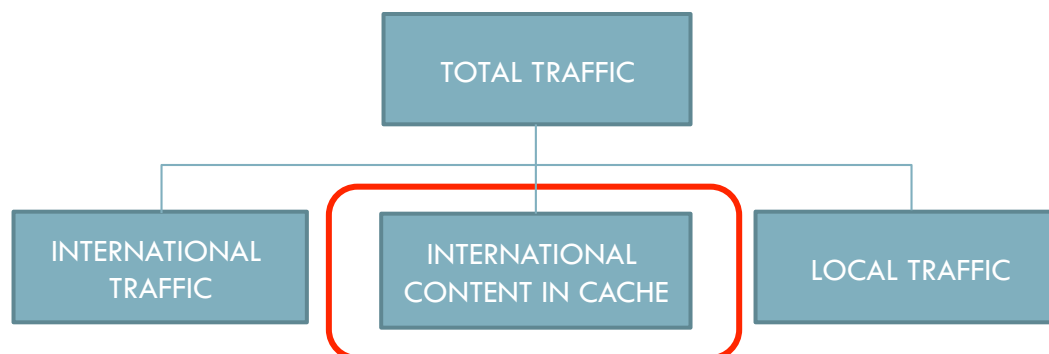
TRAFFIC DRIVEN BY INTERNATIONAL CONTENT IN CACHE (In Petabytes)

COUNTRY	2011	2012	2013	2014	2015	2016	2017	TACC 2012-17
Argentina	30	38	51	71	101	159	197	45%
Brasil	84	130	197	307	523	906	1,133	68%
Chile	24	33	48	70	110	181	226	56%
Colombia	16	22	32	46	73	124	164	59%
México	8	12	19	29	45	71	87	61%
Panamá	1	1	1	2	2	3	3	22%
Perú	10	14	20	28	42	67	86	53%
Venezuela	2	3	6	4	10	25	51	128%
TOTAL	176	253	374	556	906	1,535	1,946	62%

Source: TAS analysis

FINALLY, WE PROJECT LOCAL INTERNET TRAFFIC
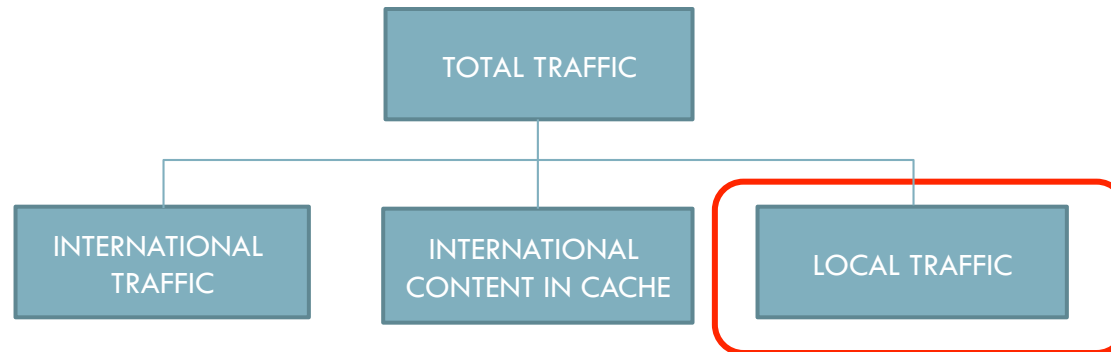
MONTHLY LOCAL INTERNET TRAFFIC (In Petabytes)

COUNTRY	2011	2012	2013	2014	2015	2016	2017	TACC 2012-17
Argentina	5	6	8	12	17	26	33	45%
Brazil	104	163	235	348	564	932	1,109	60%
Chile	8	11	15	21	32	50	59	48%
Colombia	3	4	5	8	12	21	27	59%
México	16	23	36	52	78	117	136	53%
Panamá	1	1	1	2	2	3	3	27%
Perú	2	2	3	5	7	11	14	53%
Venezuela	2	3	4	5	6	9	11	39%
TOTAL	141	214	308	452	719	1,169	1,393	58%

Source: TAS analysis

END –USER TRAFFIC FORECASTING

Number of Devices

Traffic per Device

Total traffic per country

Split traffic by type

- International traffic
- Content traffic
- Local traffic

3

Develop traffic matrices

Split traffic by region
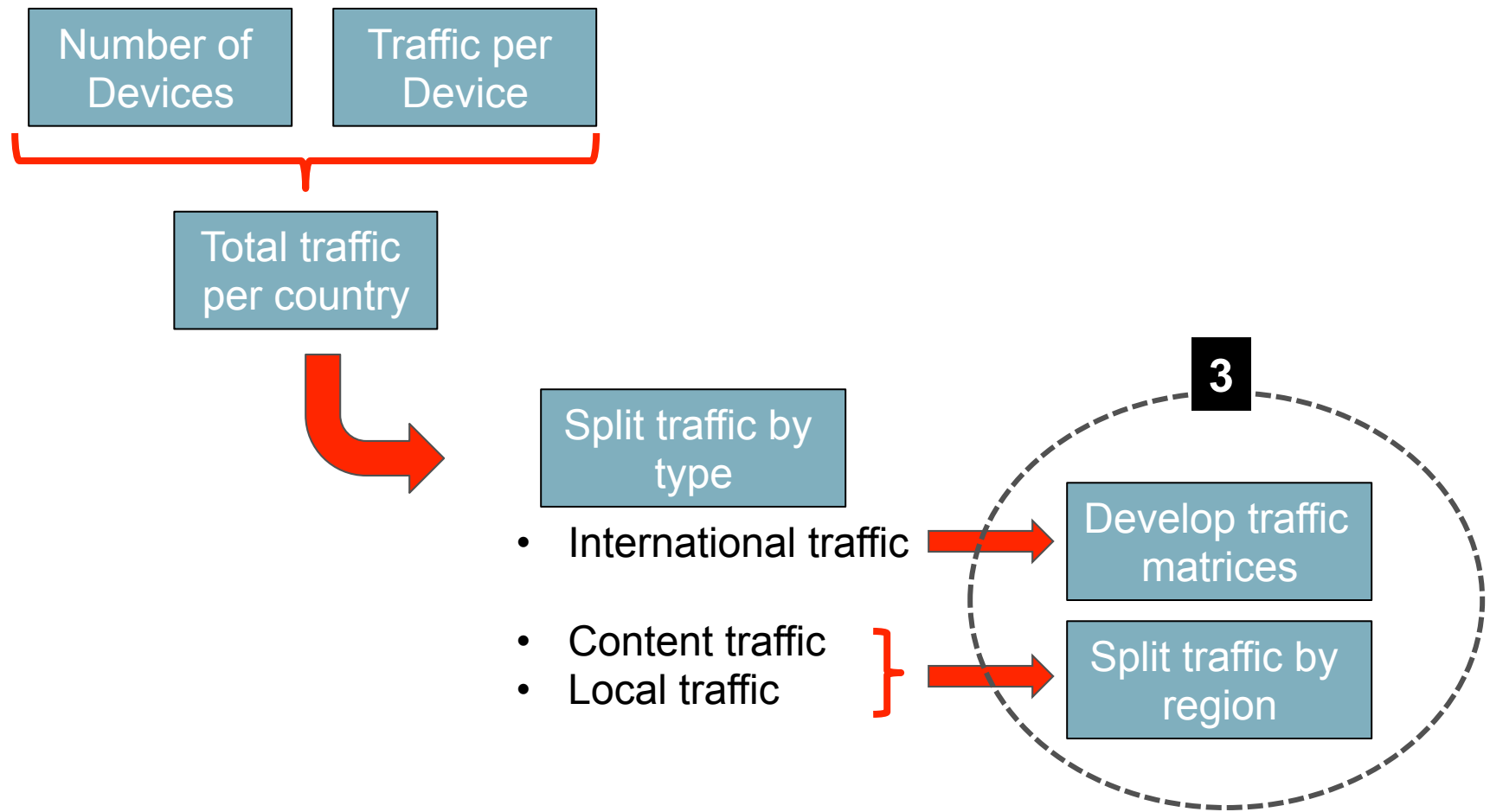
IN ORDER TO BUILD THE INTER COUNTRY REGIONAL MATRICES, WE RELIED ON LONG DISTANCE TRAFFIC AND INTERNATIONAL TRADE MATRICES AS PROXIES: BOTH ARE HIGHLY CORRELATED

International Trade Matrix

OUTGOING

INCOMING	Argentina	Brasil	Chile	Colombia	Mexico	Panama	Peru	Venezuela
Argentina		8.9%	1.6%	0.5%	0.6%	0.0%	0.4%	0.0%
Brasil	21%		5.5%	2.1%	1.2%	0.1%	2.8%	1.1%
Chile	5.8%	2.1%		2.5%	0.6%	0.8%	4.3%	0.1%
Colombia	2.2%	1.0%	1.2%		1.6%	1.3%	2.3%	0.7%
Mexico	1.1%	1.5%	2.4%	1.4%		0.7%	1.0%	0.5%
Panama	0.0%	0.0%	0.1%	3.1%	0.3%		0.7%	
Peru	2.2%	0.9%	2.2%	2.6%	0.4%	0.2%		0.3%
Venezuela	2.2%	1.8%	0.9%	4.4%	0.5%	0.1%	2.0%	
Otros paises	65.9%	83.8%	86.0%	83.3%	94.9%	96.8%	86.5%	97.3%

International Outgoing LDI Matrix

OUTGOING

INCOMING	Argentina	Brasil	Chile	Colombia	Mexico	Panama	Peru	Venezuela
Argentina		6.4%	8.1%	3.3%	0.4%		8.9%	
Brasil	4.8%		2.6%	2.3%			3.2%	1.5%
Chile	7.9%	2.4%		2.4%			8.9%	
Colombia	1.9%	1.2%	2.1%		0.7%	20.9%	3.2%	21.3%
Mexico	1.4%	1.9%	1.5%	5.4%		2.5%	2.0%	1.2%
Panama				3.7%			0.3%	1.6%
Peru	9.9%	1.2%	4.9%	3.1%				1.7%
Venezuela	1.0%	0.5%	0.7%	9.6%		6.2%	2.2%	
Otros paises	73.2%	92.9%	88.2%	73.5%	99.3%	70.4%	80.1%	72.8%

Fuente: Telegeography
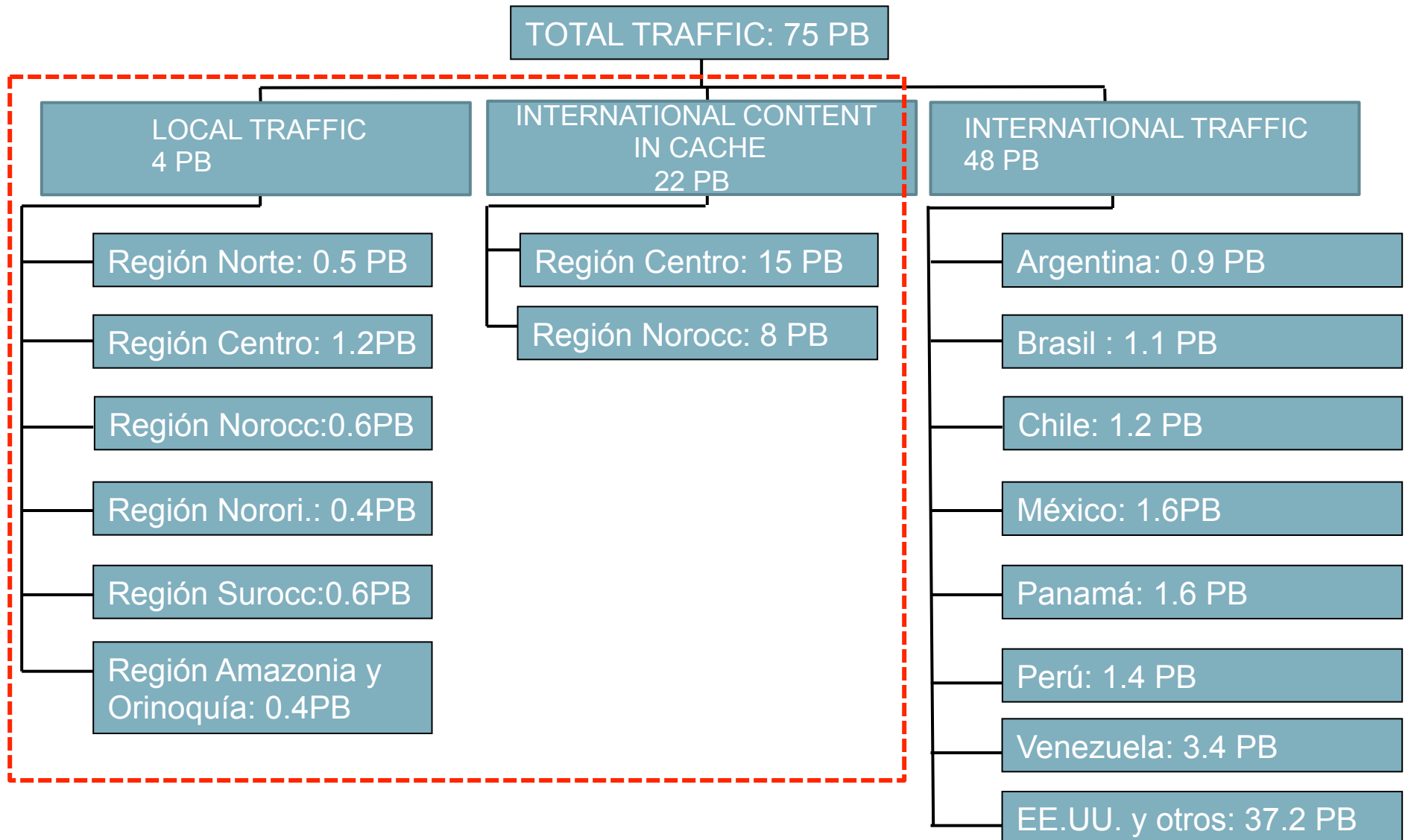
The correlation coefficient of both matrices is 0.97

THIS ALLOWS CREATING THE INTER COUNTRY INTERNET MONTHLY TRAFFIC MATRIX

INTERCOUNTRY MONTHLY INTERNET TRAFFIC MATRIX 2012 (in Petabytes)

INCOMING TRAFFIC		Argentina PB	Argentina %	Brasil PB	Brasil %	Chile PB	Chile %	Colombia PB	Colombia %	Mexico PB	Mexico %	Panama PB	Panama %	Peru PB	Peru %	Venezuela PB	Venezuela %	TOTAL PB	TOTAL %
Argentina	PB	-	-	27	8	3	5	1	2	1	1	-	-	1	5	0	0	34	4
	%	-	-	81		9		3		3		-		4		0		100	
Brasil	PB	11	13	-	-	3	4	1	2	1	1	0	0	1	3	1	1	17	2
	%	62		-	-	16		6		7		0		5		4		100	
Chile	PB	6	7	8	2	-	-	1	2	1	0	0	0	2	7	0	0	18	2
	%	32		46		-	-	7		3		1		11		0		100	
Colombia	PB	2	2	4	1	1	2	-	-	2	1	2	11	1	3	6	11	18	2
	%	9		22		6		-	-	13		14		5		31		100	
Mexico	PB	1	1	6	2	1	2	2	3	-	-	0	2	0	1	0	1	11	1
	%	9		54		11		15		-	-	3		4		4		100	
Panama	PB	-	-	-	-	0	0	2	3	0	0	-	-	0	1	0	1	3	0
	%	-		-		2		65		11		-	-	6		16		100	
Peru	PB	5	6	4	1	2	4	1	3	0	0	0	0	-	-	0	1	13	2
	%	37		28		18		10		3		0		-	-	4		100	
Venezuela	PB	1	2	4	1	0	1	3	7	0	0	1	3	1	2	-	-	11	1
	%	12		36		4		31		4		6		6		-	-	100	
EE.UU. Y otros paises	PB	58	70	305	85	54	83	37	77	193	97	19	84	24	79	43	85	733	85
	%	8		42		7		5		26		3		3		6		100	
TOTAL	PB	83	100	359	100	65	100	48	100	199	100	22	100	30	100	50	100	858	100
	%	10		42		8		6		23		3		4		6		100	

Fuente: Análisis TAS

COLOMBIA: MONTHLY INTERNET TRAFFIC FLOWS (2012)

TOTAL TRAFFIC: 75 PB

LOCAL TRAFFIC 4 PB	INTERNATIONAL CONTENT IN CACHE 22 PB	INTERNATIONAL TRAFFIC 48 PB
Región Norte: 0.5 PB	Región Centro: 15 PB	Argentina: 0.9 PB
Región Centro: 1.2PB	Región Norocc: 8 PB	Brasil : 1.1 PB
Región Norocc:0.6PB		Chile: 1.2 PB
Región Norori.: 0.4PB		México: 1.6PB
Región Surocc:0.6PB		Panamá: 1.6 PB
Región Amazonia y Orinoquía: 0.4PB		Perú: 1.4 PB
		Venezuela: 3.4 PB
		EE.UU. y otros: 37.2 PB

- Traffic model structure

- Results for Latin America

- Implications for capacity management

LATIN AMERICA: TOTAL MONTHLY INTERNET TRAFFIC (*)
(In petabytes)
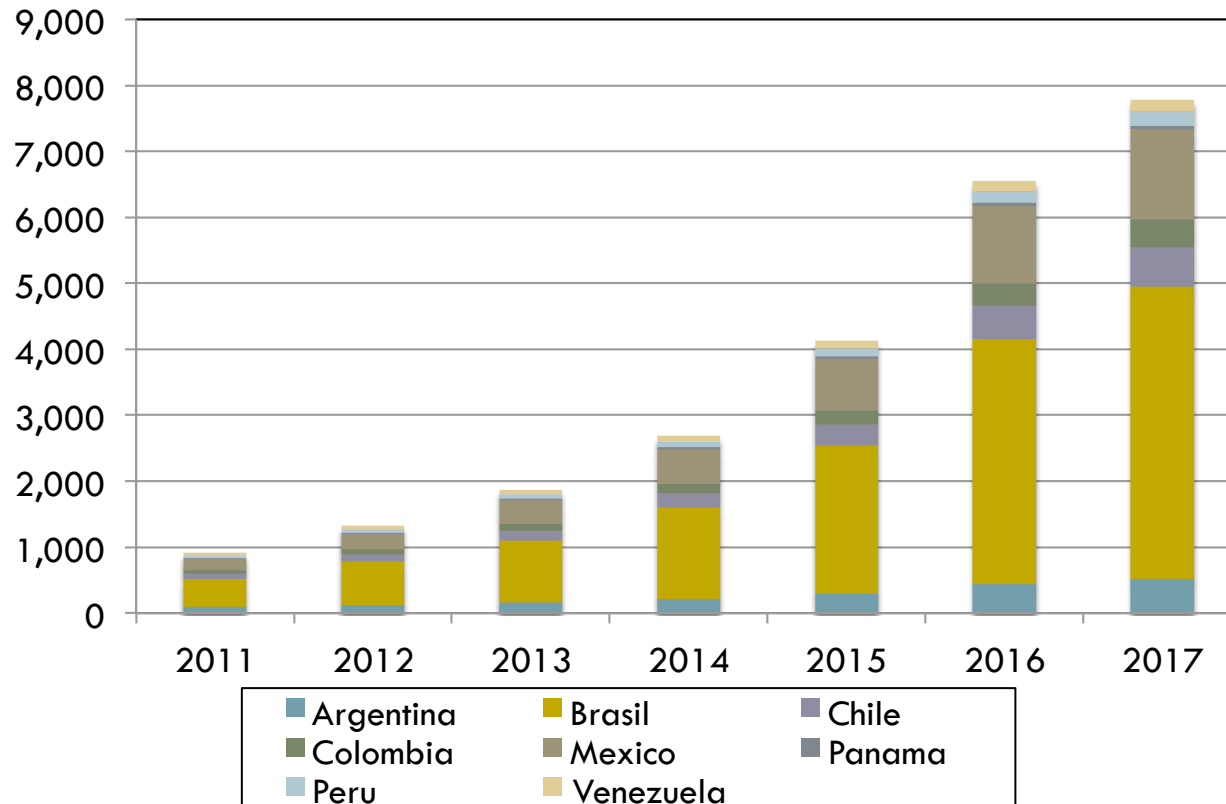
COUNTRY	CAGR
Argentina	32 %
Brazil	47 %
Chile	40 %
Colombia	42 %
Mexico	42 %
Panamá	16 %
Peru	37 %
Venezuela	25 %
TOTAL	42 %

Legend: Argentina, Brasil, Chile, Colombia, Mexico, Panama, Peru, Venezuela

Note: 1 PB= 1 Petabyte= 10^15 = 1 million Gigabytes
(*) Los países incluidos representan 85% del trafico total latinoamericano
Source: TAS analysis

LATIN AMERICA: INTERNET TRAFFIC FLOWS (2012)

Fuente: Análisis TAS

APPROXIMATELY 14% OF INTERNET TRAFFIC FLOWING TO THE UNITED STATES COMPRISES COMMUNICATION FLOWS BETWEEN LATIN AMERICAN COUNTRIES

LATIN AMERICA: INTERNATIONAL TRAFFIC MONTLY FLOWS (in Petabytes)

		OUTGOING TRAFFIC								
		Argentina	Brazil	Chile	Colombia	Mexico	Panamá	Peru	Venezuela	TOTAL
INCOMING TRAFFIC	Argentina		27	3	0.9	1	0	1.4	0	33.3
	Brazil	11		3	1.1	1.2	0.01	0.9	0.6	17.8
	Chile	6	8		1.2	0.6	0.09	2	0.03	17.9
	Colombia	2	4	1		2.3	2.48	0.8	0.6	13.2
	Mexico	1	6	1	1.6		0.35	0.5	0.4	10.8
	Panamá	0	0	0	1.6	0.3		0.2	0.4	2.5
	Peru	5	4	2	1.4	0.4	0.02		0.5	13.3
	Venezuela	1	4	0.5	3.4	1.5	0.7	0.6		11.7
	Otros	43	305	54	37.2	193.3	18	24	43	717.5
	TOTAL	83	359	65	48	199	22.3	30	50	856.3
	Porcentaje Latam	31 %	15 %	16 %	23 %	4 %	16 %	21 %	15 %	14 %

Source: TAS analysis

LATIN AMERICA: MONTHLY FLOWS ON INTERNATIONAL CONTENT
(in Petabytes)

COUNTRY	Total Traffic	International Content Traffic	Percentage
Argentina	127	38	30 %
Brazil	652	130	20 %
Chile	109	33	30 %
Colombia	75	22	29 %
México	235	12	5 %
Panama	25	7	28 %
Peru	47	14	30 %
Venezuela	56	3	5 %
TOTAL	1,326	253.3	20 %

Source: TAS analysis

LATIN AMERICA: INTERNET TRAFFIC FLOWS (2017)

- Traffic model structure

- Results for Latin America

- Implications for capacity management

THE INFRASTRUCTURE FOR LONG HAUL TRANSPORT IS COMPRISED BY MOSTLY SUBMARINE CABLES
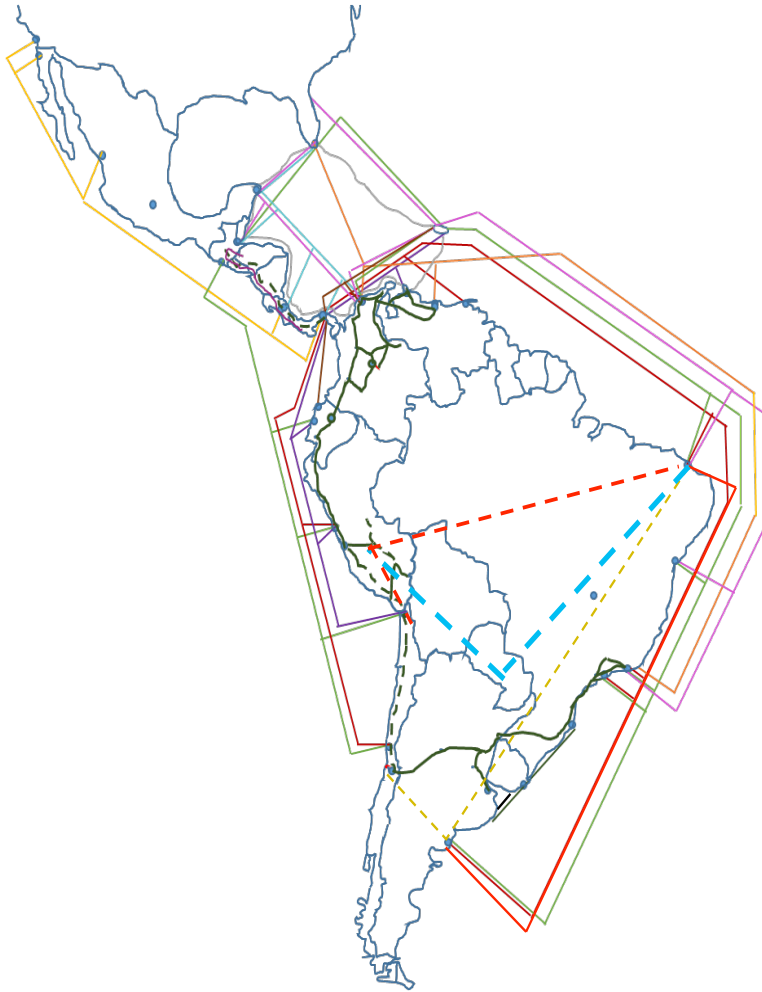
Fuente: Telegeography, Análisis TAS
Nota: Solo se incluyen los cables que conectan más de un país de la región.

		ARG	BRA	CHI	COL	ECU	MEX	PAN	PER	VEN	CA
AMX-1	—		X		X		X				
PAN-AM	—			X	X	X		X	X	X	
Sam-1	—	X	X	X	X	X			X		X
SAC/LAN	—	X	X	X				X	X	X	
PAC	—						X	X			X
ARCOS	—				X		X	X		X	X
MAYA-1	—				X		X	X			X
PCCS	—				X	X	X				
Globe Net	—		X		X					X	
Americas II	—		X							X	
UNASUR	—	X	X								
Bicentenario	—	X									
Atlantis II	—	X	X								
ARSAT	- -	X	X	X							
COPACO	- -		X						X		
RED DORSAL	- -		X	X					X		
Internexa	—	X	X	X	X	X		X	X	X	X
Redca	—							X			X

IN THE PAST YEARS, INTERNATIONAL TRANSPORT CAPACITY IN LATIN AMERICA HAS BEEN GROWING AT AN ANNUAL RATE OF 50%

LATIN AMERICA: INTERNATIONAL BANDWIDTH CAPACITY (in Gbps)

País	2008	2009	2010	2011	2012	CAGR 2008-12
Argentina	249	312	680	859	1.349	53%
Brasil	385	743	1.125	1.640	2.584	61%
Chile	199	249	602	691	1.059	52%
Colombia	95	167	269	429	580	57%
México	205	324	557	887	1.478	64%
Panamá	150	138	217	247	293	18%
Perú	181	451	456	385	493	28%
Venezuela	39	71	113	198	270	62%
TOTAL	1.502	2.454	4.,019	5.337	8.104	52%

Source: Telegeography

LATIN AMERICA: MAIN INTERNATIONAL ROUTES
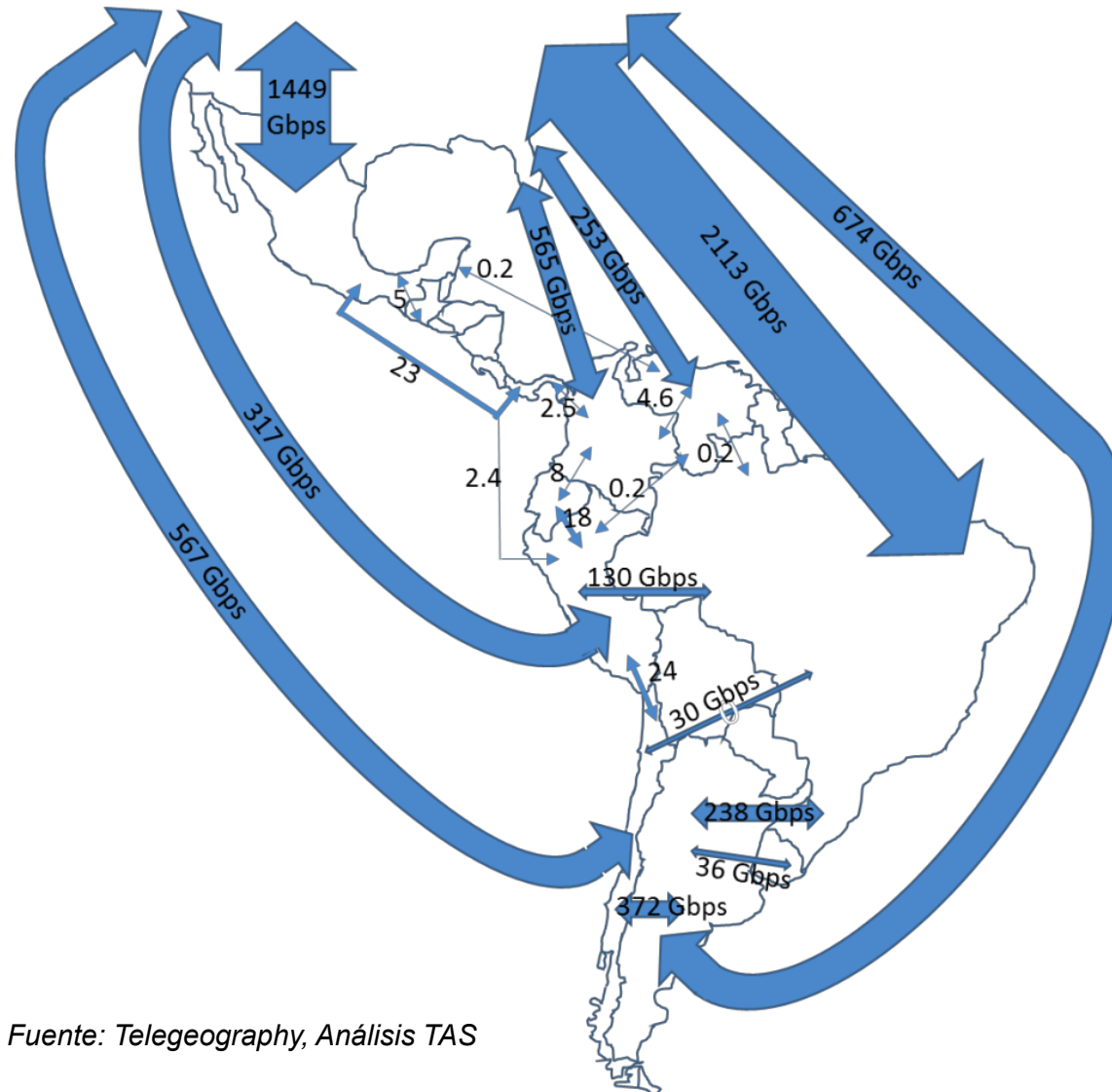
Fuente: Telegeography, Análisis TAS

LATIN AMERICA: UTILIZATION IN INTERNATIONAL CAPACITY BY ROUTE (Gbps)

	Capacity	Average Traffic	Peak Average Traffic	Average Utilization	Peak Utilization
Sao Paulo-Miami	1.144	265	519	23%	45%
Buenos Aires-Miami	624	163	305	26%	49%
Santiago-Miami	457	104	197	23%	43%
Rio de Janeiro-Miami	403	104	201	26%	50%
Buenos Aires-Santiago	371	41	171	11%	46%
Bogotá-Miami	347	83	163	24%	47%
México-Dallas	320	77	151	24%	47%
Lima-Miami	317	74	145	23%	46%
México-Los Angeles	254	56	109	22%	43%
Caracas-Miami	243	58	114	24%	47%
Buenos Aires-Sao Paulo	213	33	57	16%	27%
Total	**4.695**	**1.058**	**2.131**	**23%**	**45%**

Source: Telegeography

- **Utilization:**
  - 23% of capacity (source: TAS, with wide variance by route and range between average to peak)
  - 14% of deployed lit and unlit capacity (source: Telegeography)

- **Demand:**
  - The international cache content will grow at an annual rate of 62% (10.2 times current traffic)
  - Local traffic Internet traffic will grow at an annual 58.8 rate (8.8 times current traffic)
  - International traffic will grow at 49% (6.3 times the current traffic)

- **However, planned total capacity is expected to double by 2016**
  - Current capacity: 100 Tbps
  - Planned capacity (AMX1, PCS, SAPL): 100 Tbps

- **Are we experiencing a capacity glut?**
  - Prices are falling at a range between 29% (Mexico-Dallas) and 17% (Bogota-Miami)
  - 70% decline in some routes
  - However, at USD18 per Mbps per month, the median 10 GigE price in Sao Paulo is eleven times higher than in New York and 13 times above London
  - So far, however, prices are not falling faster than the increase in demand
  - And prices in secondary markets are very high still
  - But a doubling in capacity could trigger an acceleration in price erosion

ECONOMIC PERSPECTIVES

- The wholesale transit market is experiencing a cobweb model (which describes cyclical supply and demand in a market where the amount of product is determined before prices are observed)
- The supply side cannot adjust itself to the velocity and volatility of change on the demand side
- The decline in price realization is resulting not only from oversupply but also from non-market factors (pricing affordability barriers in the retail broadband market is pushing governments to impose policies to reduce transit prices; see Argentina, Brazil and Chile proposal for the ITU Plenipotentiary to lower high transit costs)

STRATEGIC PERSPECTIVES

- Current market structure reveals the failure of carrier vertical integration moves (limits industry capability to reach a supply/demand equilibrium)
- Is consolidation an option? We doubt it unless someone undergoes a significant premium erosion (potentially too much stranded capital with very limited return to scale)
- Wholesale carriers need to forward integrate in the value chain but not too far from the core business (interconnection services, co-location)
- Maybe there is a need for a secondary market for capacity acting as a pricing clearinghouse

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