RVA *LLC*
Market Research & Consulting

2019 Broadband Experience Index
By Broadband Type

Using Multiple, Measurable, Performance Criteria
To Compare The Real-World Consumer Experience
By Type Of Broadband

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October 1, 2019

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BACKGROUND NEED

One of the most significant needs that retail consumers, network operators, consultants, and government policy officials have when considering and evaluating Internet or "broadband" is a simple and reliable way to compare quality and performance across the various delivery options. The current Internet delivery options include DSL, Cable modem, Wireless, Satellite, and Fiber-to-the-Home service.

Many have observed that a measure of comparative performance should not be based only on one single specification, noting that a single attribute could not possibly capture the full picture of performance difference. Unfortunately, using a single measure is quite common today - broadband comparisons, especially for consumers, are often based only on advertised download speeds.

Realizing this deficiency, the Fiber Broadband Association (FBA) and RVA LLC have both had the goal of determining a method to more fairly and completely compare broadband types. (The Federal Communication Commission or FCC has also been pursuing a similar goal.)

DETERMINING MEASUREMENT ATTRIBUTES

Criteria for broadband measurement was developed based on the experience of past RVA consumer Internet studies.

While much of the industry only focuses on download speeds, consumers have indicated several factors that are important to measuring broadband:

Reliability

Reliability refers to the stability of the system – broadband being available when needed, with a minimum number of user interventions (rebooting modems or calling customer service) required.

Reliability has been shown in several past RVA studies to be the single most important predictor of overall broadband satisfaction. The importance of reliability was determined both by directly asking consumers how important individual broadband attributes were to their broadband overall, and by utilizing multiple regression analysis to independently model which attributes had the most influence on their satisfaction.

Bandwidth

Bandwidth, which is the amount of data that can be transmitted in a fixed amount of time, influences the speed at which applications can load as well as the quality of communications. Bandwidth can be thought of as the size of a pipe.

Based on consumer rankings, bandwidth is the second most important broadband attribute. Multiple regression analysis shows that upload speeds currently influence satisfaction more than download speeds - perhaps because upload speeds are, on average, most constrained at present.

Latency

Latency defines the time it takes an individual packet of information to travel from one point to another. Latency can be thought of as the speed of flow within a pipe.

Latency can affect quality communication. An obvious example of latency is the delay seen in real-time TV satellite feeds from across the world. Latency becomes especially important in some Internet consumer applications – such as gaming competitions or stock market day-trading. It is certainly important in background security and transportation monitoring applications.

METHODOLOGY INNOVATION

To help accomplish the goal of a more comprehensive and reliable broadband comparison methodology, RVA LLC has, over the past several years, honed online surveying methods to better measure broadband in its real-world application. This effort utilized multiple performance and attitudinal criteria. (It should be noted that determining attitudes about various broadband aspects in a survey is relatively standard and straight-forward, but determining performance measures via a survey instrument is more complex.)

To conduct meaningful performance measurement, RVA first developed ways to indirectly measure broadband reliability – primarily by asking consumers to recall the number of times they needed to reboot their modems monthly and call customer service annually.

RVA also implemented direct measurement of broadband speeds within the survey process by asking respondents to take and record a speed test (via a provided industry recognized speed test link).

More recently, RVA developed a process to automatically conduct and record speed test results during a survey without respondent interaction, thus saving time, increasing completion rates for the question, and, most importantly, increasing accuracy (eliminating transcription errors, etc.). This year, RVA has added automatic latency tests to the surveying methodology.

RVA CONSUMER STUDY METHODOLOGY

Raw data for determining the Broadband Experience Index was pulled from a May 2019 national RVA Consumer Broadband Study of online panelists. The random study gathered 2,053 U.S. responses. (There were over 2,500 responses when including Canada.)

One of the ways the consumer study differentiated users was by the method of final Internet delivery to the home: Fiber-to-the-home (FTTH) via fiber optic cable; Cable via coaxial cable; DSL or Fiber-to-the-node (FTTN) via copper wire; Wireless via radio waves; and Satellite via signals from geostationary satellites. (The wireless segment included those who utilized either fixed or mobile wireless for Internet service at home.)

Following the RVA random study of home broadband users, satellite Internet users were oversampled in order to obtain an additional 145 responses, thus bringing the total satellite sample to 158 and the total overall U.S. consumer sample to 2,198.

Where possible in the survey, actual measurements were taken of data relative to the broadband attributes. In addition, respondents were asked about their satisfaction with these attributes from their provider.

RVA survey data measures end-to-end performance, which can include the influence of backbone Internet and in-home Wi-Fi performance. These factors could penalize higher performing broadband methods, such as FTTH and cable, more than lower performing methods. (An example would be older Wi-Fi systems limiting the download bandwidth measured from high bandwidth "gigabit" users.)

One additional note: many providers of a given broadband method generally offer several speed tiers with different price points. The 2019 RVA Consumer Study did not test individual tiers, such as what experience the highest speed tier for each method provided. The study measured the average of what random consumers subscribed to for each method (which is related to what each method can provide at a reasonable price point).

BROADBAND EXPERIENCE INDEX METHODOLOGY

The Broadband Experience Index uses four components: 1) Performance measurements from the 2019 RVA Consumer Broadband Study; 2) The latest FCC Operator performance measurements (from the 2017 FCC "Measuring Broadband America" report); 3) Attitudinal measurements from the 2019 RVA Consumer Study; and 4) a Net Promoter Score Index calculated from the 2019 RVA Consumer Study raw data.

The "Net Promoter Score" is a fairly common indicator of overall relative satisfaction and the likelihood of recommending a product or service to a friend. The score is determined by asking customers to rate on a 10-point scale how likely they would be to recommend their product or service. "Promoters" are designated as those who indicate "very likely to recommend" (a "9" or "10" rating). "Detractors" are designated as those who only give a "1"-"6" rating to this question. The score is then determined by subtracting detractors from promoters. (Generally, net promoter scores for the telecom and communication industry are fairly low overall and are often negative.)

All raw data used in the Index is listed on the next chart, followed by a chart showing the normalized data, i.e. data converted to a common range for comparison (method to be described later).

Finally, the data from the four Index components was averaged to determine an overall Broadband Experience Index for each broadband delivery method. (It should be noted that no <u>weighting</u> was given to the various broadband attributes when calculating the Index.)

Results follow:

2019 RAW FINDINGS

Raw data from the study was cross tabulated by broadband delivery method to review relative performance data. Differences in all the performance and attitudinal measures (speed, latency and reliability) are evident in the data.

2019 Broadband Experience Index: RAW DATA					
By Type Of Broadband					
Best =				Worst=	
	FTTH	Cable	Wireless	DSL/FTTN	Satellite
RVA PERFORMANCE MEASUREMENTS 2019					
Average Download Speed (Mbps)	119	108	24	22	9
Average Upload Speed (Mbps)	40	14	7	6	1
Average Latency (Milliseconds)	34	66	241	387	2281
Average Reliability (# monthly reboots and annual calls)	1.4	1.9	2.0	2.4	2.3
FCC PERFORMANCE MEASUREMENTS 2017					
Average Download Speed (Mbps)	73	97	na	17	16
Average Upload Speed (Mbps)	82	10	na	2	3
Average Latency (Milliseconds)	17	27	na	44	585
Reliability (No measurement)	na	na	na	na	na
RVA ATTITUDINAL MEASUREMENTS 2019					
Very Satisfied Download Speed	49%	40%	31%	36%	16%
Very Satisfied Upload Speed	49%	37%	32%	35%	16%
Very Satisfied Latency (No measurement)	na	na	na	na	na
Very Satisfied Reliability	51%	42%	40%	40%	23%
RVA NET PROMOTER SCORE 2019					
Net Promoter Score (NPS)	5%	-5%	-11%	-9%	-16%
SAMPLE SIZE FOR MOST MEASURES	363	879	261	378	158

Notes Regarding Differences in RVA Data to FCC Data:
- 2017 FCC data primarily measured Tier 1 providers serving urban and suburban areas. 2019 RVA data was a random sample of consumers using providers of all sizes, including those serving rural areas.
- 2017 FCC data may have used more optimized satellite receiver setups. 2019 RVA data is based on a random sample of actual satellite users, some likely with line-of-sight tree obstructions, slightly misaligned antennas, etc.

Note Regarding Latency
- Latency for wireless and DSL is particularly influenced by outliers – some cases where latency is extremely high. High latency for satellite is somewhat more consistent – primarily because signals must travel back and forth to a geostationary satellite located over 22,000 miles above the earth.

2019 NORMALIZED FINDINGS

In order to review multiple data points with different value ranges, all data was converted to percentiles, with the highest rating for any given attribute set at 100% and the lowest rating for any given attribute set at 0%. Thus, 100% represents "best in class" for a particular attribute, while 0% represents the "lowest in class". In addition, all data was converted directionally, so that a high score would always be better (i.e. low latency and low reboots and service calls are better, of course in raw terms, but these measures were inverted when converted for comparability.)

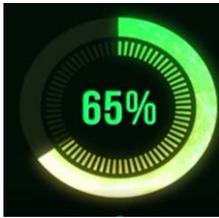| 2019 Broadband Experience Index: NORMALIZED SCORES					
By Type Of Broadband					
Best =			Worst=		
	FTTH	Cable	Wireless	DSL/FTTN	Satellite
RVA PERFORMANCE MEASUREMENTS 2019					
Average Download Speed (Mbps)	100%	90%	14%	12%	0%
Average Upload Speed (Mbps)	100%	33%	15%	13%	0%
Average Latency (Milliseconds)	100%	99%	91%	85%	0%
Average Reliability (# monthly reboots and annual calls)	100%	55%	40%	0%	10%
SUBTOTAL	100%	69%	40%	27%	3%
FCC PERFORMANCE MEASUREMENTS 2017					
Average Download Speed (Mbps)	70%	100%	na	1%	0%
Average Upload Speed (Mbps)	100%	10%	na	0%	1%
Average Latency (Milliseconds)	100%	98%	na	95%	0%
Reliability (No measurement)	na	na	na	na	na
SUBTOTAL	90%	69%	na	32%	0%
RVA ATTITUDINAL MEASUREMENTS 2019					
Very Satisfied Download Speed	100%	73%	45%	61%	0%
Very Satisfied Upload Speed	100%	64%	48%	58%	0%
Very Satisfied Latency (No measurement)	na	na	na	na	na
Very Satisfied Reliability	100%	68%	61%	61%	0%
SUBTOTAL	100%	68%	52%	60%	0%
Net Promoter Score (NPS)	100%	52%	24%	33%	0%
SUBTOTAL:	100%	52%	24%	33%	0%
2019 BROADBAND EXPERIENCE RATING	98%	65%	38%	38%	1%

2019 BROADBAND EXPERIENCE INDEX

Averaging all the four measurement subtotals from the normalized percentile scores, without weighting – RVA 2019 Internet performance measurements, FCC 2017 Internet performance measurements, RVA 2019 Internet attitudinal measurements, and RVA 2019 Internet net promoter score - provides an overall 2019 Broadband Experience Index.

At present, Fiber is clearly providing the "best in class" consumer broadband experience, while Satellite is providing the lowest consumer broadband experience.
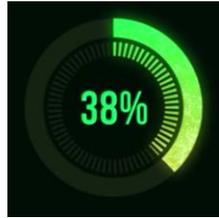

98%   Fiber

65%   Cable

38%   Wireless

38%   DSL

1%   Satellite

ALTERNATIVE CALCULATIONS

The 2019 Broadband Experience Index normalizes the data using a range based on the current best data measurement for any attribute versus the current lowest data measurement for any attribute.

Another possible approach would be to use a range based on the current best data measurement for any attribute versus a zero score for any attribute. Using this calculation approach, the Alternative 2019 Broadband Experience Index would be as follows:

	FTTH	Cable	Wireless	DSL/FTTN	Satellite
2019 ALTERNATIVE BEI RATING	99%	69%	47%	45%	14%

NOTES FOR FUTURE STUDIES

The Broadband Experience Index could be expanded in the future as new methods of delivering broadband come into play. As an example, wireless may be divided into fixed and mobile wireless, especially as new wireless methods using millimeter wave frequencies become more commonly used.

The satellite category could be separated into two types: geosynchronous and non-geosynchronous lower orbit satellite delivery.

It is important to note that this is the first iteration of the Broadband Experience Index. Some evolution of methodology will likely occur over time. RVA and the Fiber Broadband Association certainly welcome any comments and suggestions regarding the Broadband Experience Index.