BRX-XLR

Broadband Reach Extender – Extra Long Reach

Placement Instructions for Optimum Bandwidth Performance

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Disclaimer Notice

Table of Contents

1 General Description

The Broadband Reach Extender – Extra Long Reach (BRX-XLR) is a fully integrated solution that extends the reach of deployed ADSL / ADSL2+ DSLAMs or MSANs to deliver higher bandwidth services to underserved or unserved markets. For example, it extends the reach of a 10 Mbps downstream service from 9,100 feet (2.8 km) to 12,500 feet (3.8 km) on 26 AWG / 0.40 mm gauge copper, an increase of almost 40%, and the same level of increase is achieved for larger size cables. Furthermore, this 40% increase in reach results in an estimated 100% increase in CSA (Customer Serving Area) since the area served is proportional to the square of the lineal distance.

Another way to look at the benefits of this same function is that a client that is situated at 12,500 feet (3.8 km) from the DSLAM, on a 26 AWG (0.40 mm) copper pair will see the downstream bandwidth increase from approximately 5 Mbps to over 10 Mbps. Over longer distances, the bandwidth improvement ratio is between 2 to 5 times. It is important to note that these benefits are obtained without the need to change the DSLAM/MSAN or the user CPE. By significantly increasing the effective bandwidth and reach of existing xDSL lines, operators can deliver true broadband speeds to each of their subscribers, even those located in remote areas or currently located too far from the DSLAM to receive any service.

2 BRX-XLR Main Advantages

- Extends up to 100% the ADSL/ADSL2/ADSL2+ Customer Serving Area (CSA)
- Improves effective bandwidth typically by a ratio of 2 to 5 for ADSL/ADSL2/ADSL2+ loops
- No extra power required. The BRX-XLR uses less than 2mA from the -48V sealing current from the POTS line
- Flexible Shelf design allows more subscribers to be added in the future
- Turnkey pedestal option available
- Auto calibration, no software to configure or dip switch
- Easy to install, deploy and maintain

3 Bandwidth Performance Improvement

The BRX-XLR automatically adjusts itself to optimize performance. The BRX-XLR provides noise filtering and a gain (amplification) of the signal (in the xDSL band only) in the downstream and upstream direction of up to 16 dB and always within the acceptable signal strength allowed by the xDSL standards for the Spectrum Mask of ADSL2+ and ADSL. As such, the amplification gain is higher on longer loops (i.e., loops where the attenuation of the signal is greater due to the longer loop length). A key factor in its performance is that the BRX-XLR significantly improves the signal to noise ratio seen by the CPE (in the downstream direction) and the DSLAM (in the upstream direction).

The following chart illustrates how the performance gain increases over the length of copper loops. For clarity, we are using the notion of a Bandwidth Improvement Ratio to illustrate the benefits of installing a BRX-XLR device on a copper pair. The ratio is calculated as the bandwidth using the BRX-XLR divided by the RAW bandwidth (i.e. without BRX-XLR). For instance, improving a pair from 5 Mbps to 10 Mbps would represent a Bandwidth Improvement Ratio of 2.0 (10 divided by 5).

Note: The curve is based on the use of 26 AWG (0.40 mm gauge) copper wire. To convert to larger cables sizes, simply multiply the loop length by 1.374 for 24 AWG (0.51 mm) and 1.844 for 22 AWG (0.64 mm) cables.

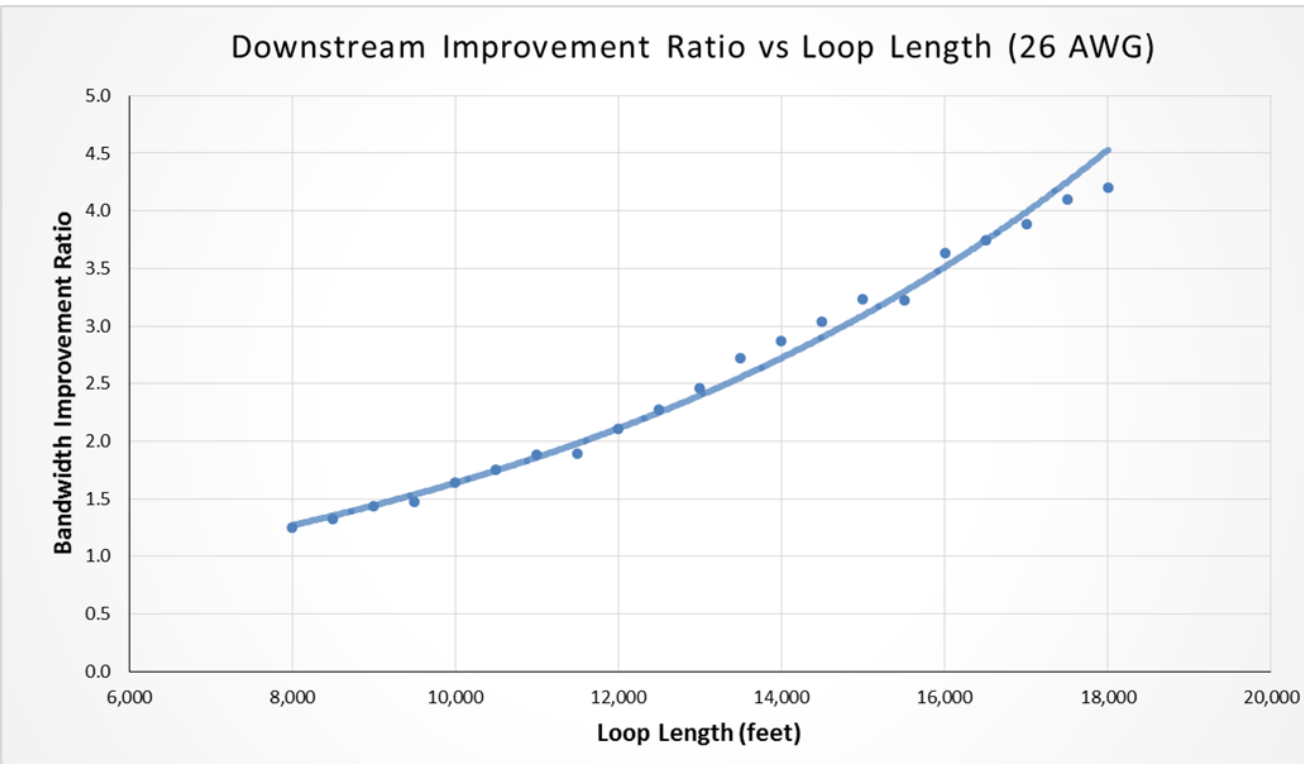

Figure 1: Downstream Improvement Ratio vs. Loop Length (feet)

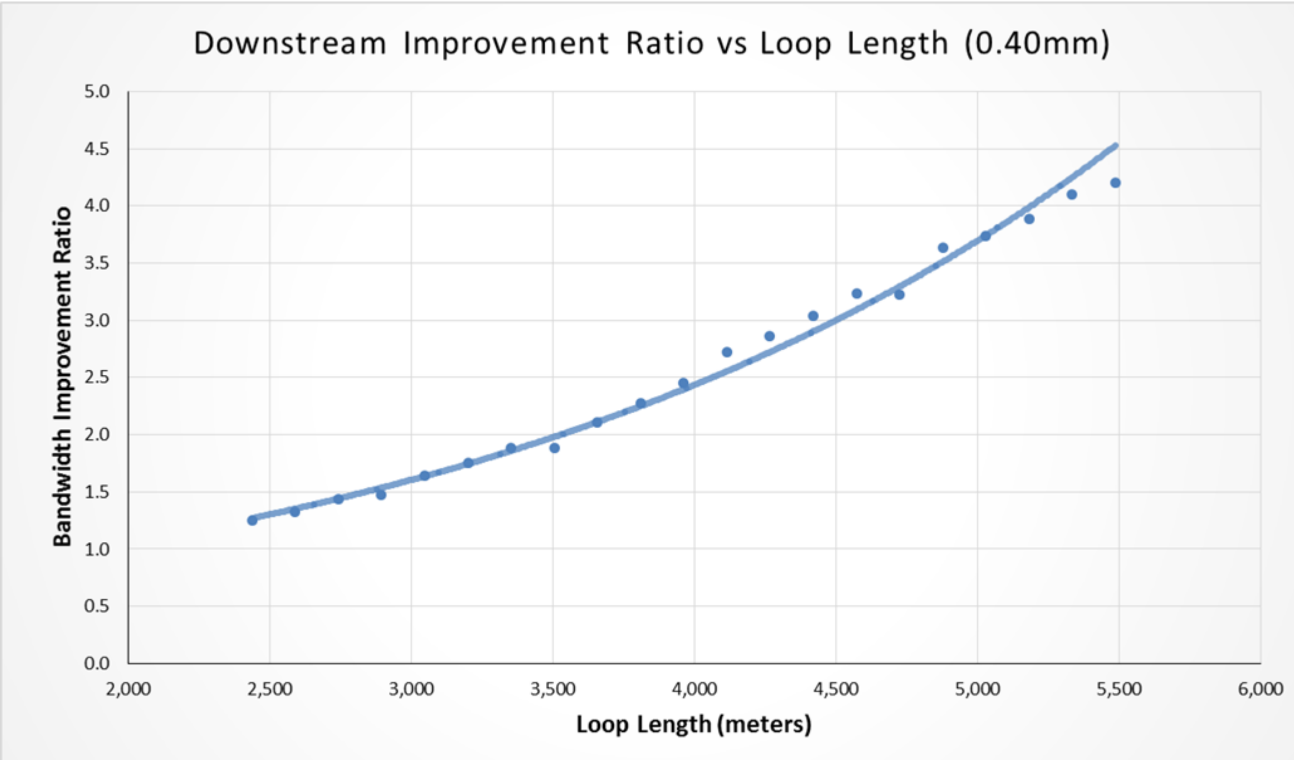

Figure 2: Downstream Improvement Ratio vs Loop Length (meters)

The table below illustrates a few examples of the bandwidth increases one can expect with the insertion of a BRX-XLR:

BRX-XLR Downstream Performance Increase (Typical Lines)					
Loop Length (feet)	Loop Length (meters)	Gauge (AWG / mm)	Without BRX-XLR (Mbps)	With BRX-XLR (Mbps)	Improvement Ratio
10,000	3,048	26 / 0.40	8.98	14.42	1.61
12,000	3,658	26 / 0.40	5.87	12.20	2.08
14,000	4,267	26 / 0.40	3.30	9.57	2.90
16,000	4,877	26 / 0.40	1.93	6.96	3.61
18,000	5,486	26 / 0.40	1.07	4.40	4.11

Table 1: Downstream Performance Increase Examples (Typical lines)

Another way to view the benefits of the BRX-XLR is to look at the graph below which demonstrates the actual bandwidth performances (with and without BRX-XLR) as it relates to loop length using 26 AWG / 0.4mm copper gauge. Again, to convert to larger cable sizes, simply multiply the loop length by 1.374 for 24 AWG (0.51 mm) and 1.844 for 22 AWG (0.64 mm) cables.

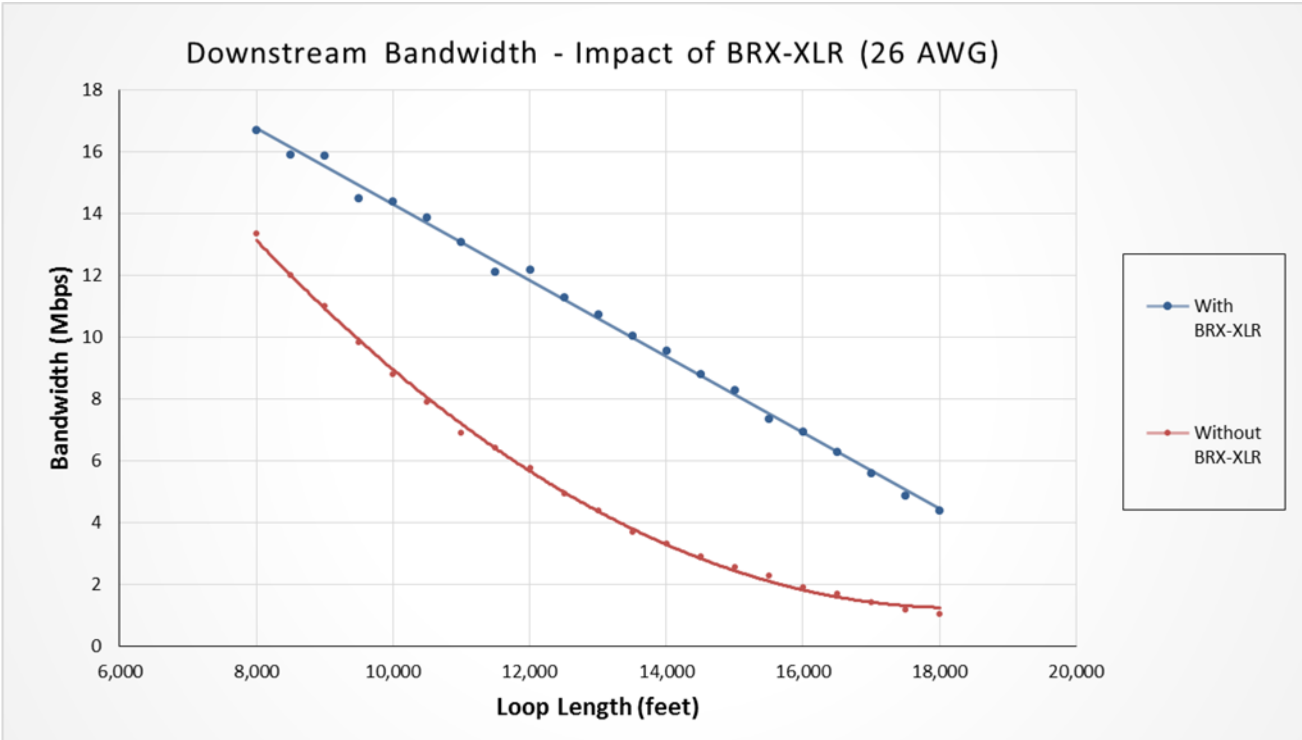

Figure 3: Bandwidth vs. Loop Length (feet) with and without BRX-XLR

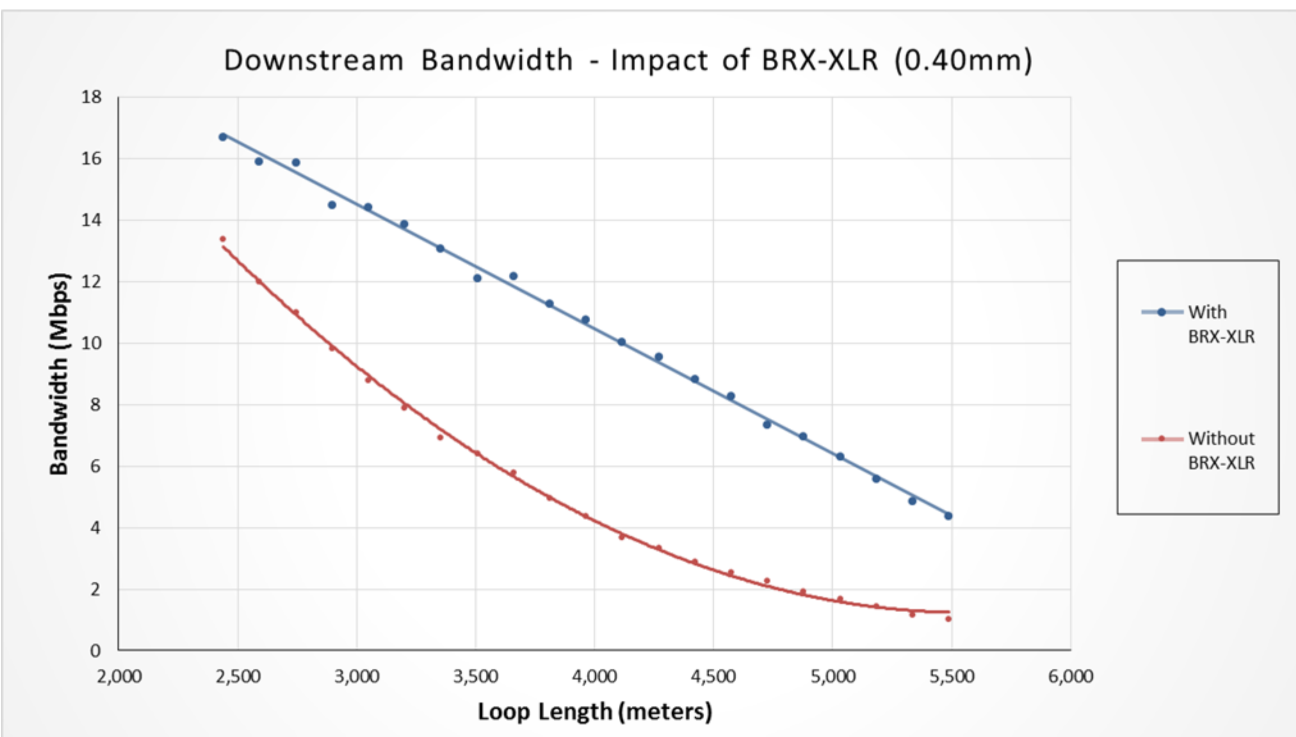

Figure 4: Bandwidth vs. Loop Length (meters) with and without BRX-XLR

It should be noted that the Bandwidth Performance Improvements above (both in the graphs and in the table) are conservative as they are based on tests performed with traffic on the other pairs of the cable binder (i.e. with crosstalk) and with otherwise typical copper line conditions. Our field experience has shown that the BRX-XLR typically provides even better Improvement Ratios (i.e. Bandwidth Enhancement) when faced with “less than ideal” line conditions where the bandwidth is negatively impacted by bridge taps, influence from power lines and/or disturbances from other pairs or the use of other protocols in the same binder such as T1/E1, HDSL, and G.SHDSL.

4 Typical Increases in Customer Serving Area

The following table provides the maximum distance extension to support a 10 Mbps downstream target bandwidth on a single copper pair for the three most popular cable sizes.

Maximum Distance for 10 Mbps Service with 1-Pair							
Cable Gauge		Without BRX-XLR		With BRX-XLR		% Increase	
AWG	mm	k feet	km	k feet	km	Distance	Serving Area
26	0.40	9.1	2.8	12.5	3.8	38%	91%
24	0.51	12.5	3.8	17.0	5.2		
22	0.64	16.8	5.1	23.0	7.0		

Table 2: Maximum Distance for 10 Mbps Service with 1-pair

Similarly, the following table provides the maximum distance extension to support a 5 Mbps downstream target bandwidth on a single copper pair for the three most popular cable sizes. The same distances can provide a 10 Mbps service over two pairs.

Maximum Distance for 5 Mbps Service with 1-Pair or 10 Mbps with 2-Pairs							
Cable Gauge		Without BRX-XLR		With BRX-XLR		% Increase	
AWG	mm	k feet	km	k feet	km	Distance	Serving Area
26	0.40	12.5	3.8	17.0	5.2	38%	91%
24	0.51	16.8	5.1	23.0	7.0		
22	0.64	22.5	6.9	31.0	9.4		

Table 3**:** Maximum Distance for 5 Mbps Service with 1-pair or 10 Mbps with 2-pairs

5 Placement Flexibility

Over and above the performance gains, one of the major advantages of the BRX-XLR over other products is that its placement along the loop is very flexible and does not impose hard constraints when choosing the location where it should be installed. For instance, on a 26 AWG (0.4mm) loop of 12,500 feet / 3.8 km, placing the BRX-XLR anywhere between 6,000 feet / 1.8 km and 9,000 feet / 2.7 km away from the DSLAM will deliver 10 Mbps to the customer.

In fact, the BRX-XLR is designed to offer very similar performance gains whenever it is deployed at a distance that ranges from 45-75% of the total loop distance (away from the DSLAM). The graph below illustrates the **minimum** performance gain that can be expected when the BRX-XLR is placed anywhere in this range.

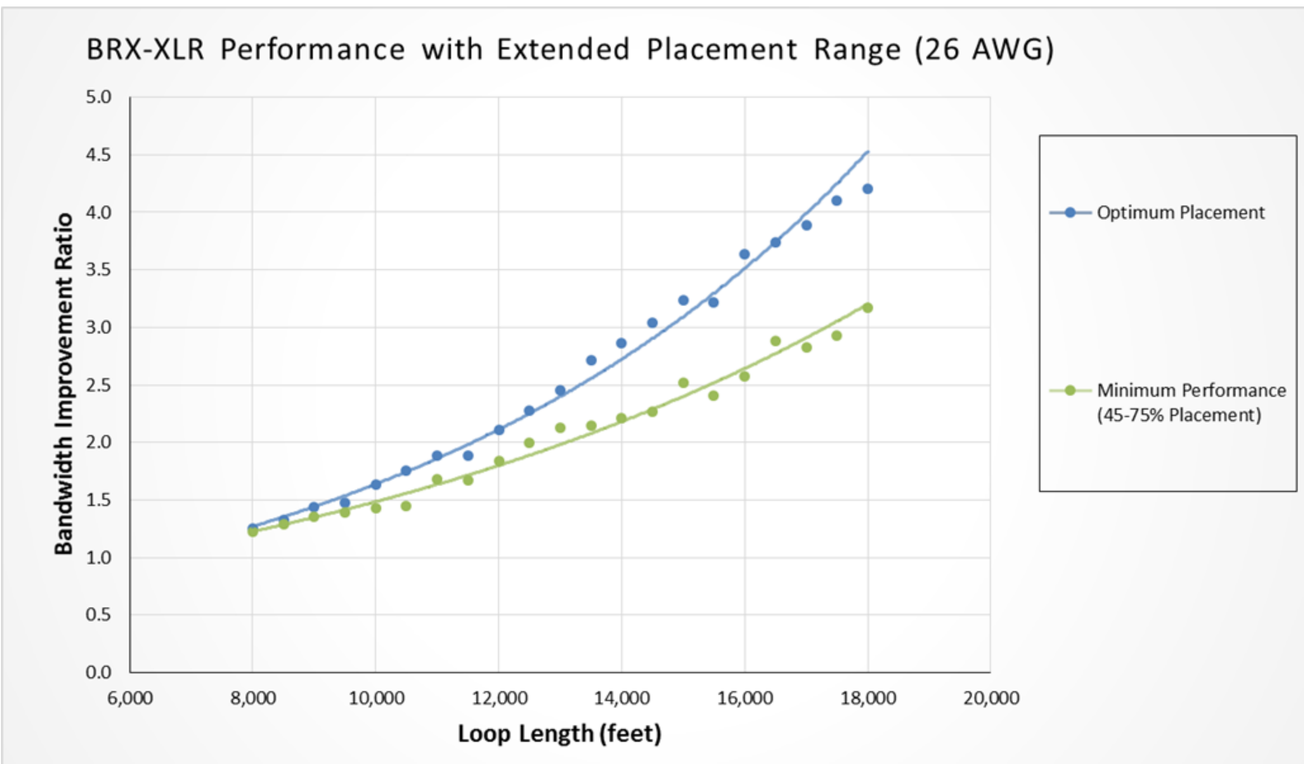

Figure 5: BRX-XLR Performance Improvement with Extended Placement Range (feet)

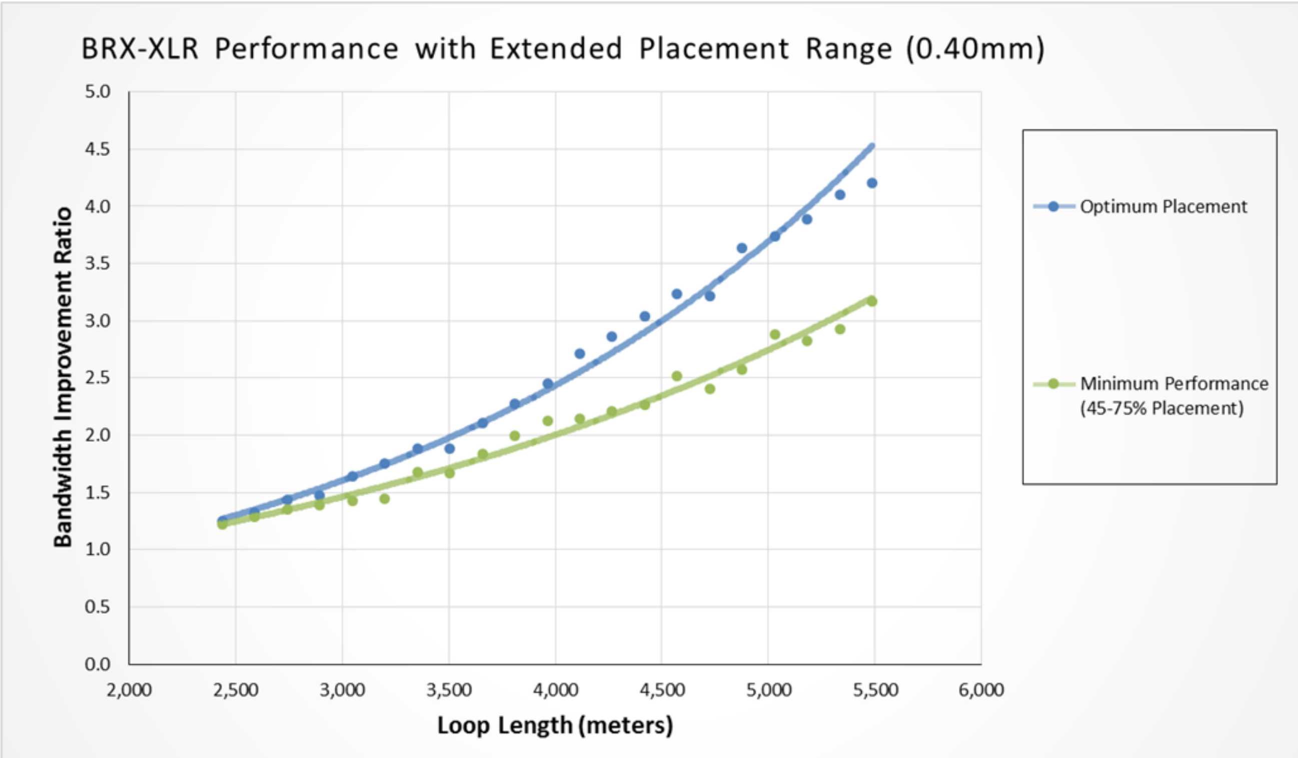

Figure 6: BRX-XLR Performance Improvement with Extended Placement Range (meters)

6 Optimum Placement

Although the placement of the BRX-XLR is very flexible, the curves in section 5 above demonstrate that there is value in properly planning the placement to optimize performance. The following curve demonstrates the optimum placement of the BRX-XLR relative to total loop length.

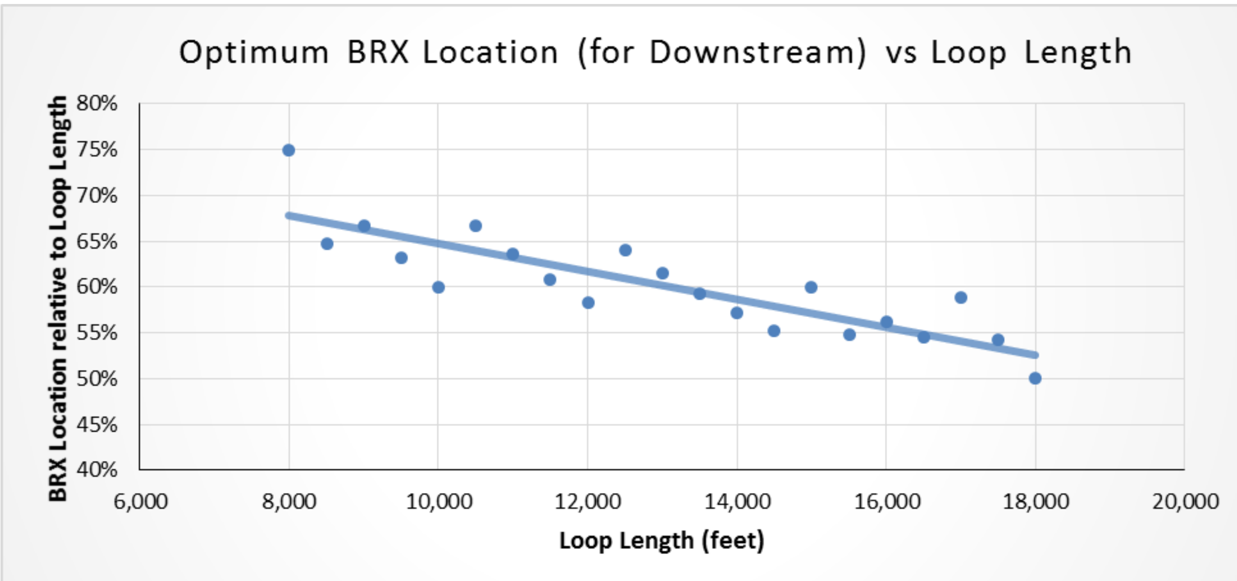

Figure 7: Optimum BRX-XLR Placement vs Loop Length (feet)

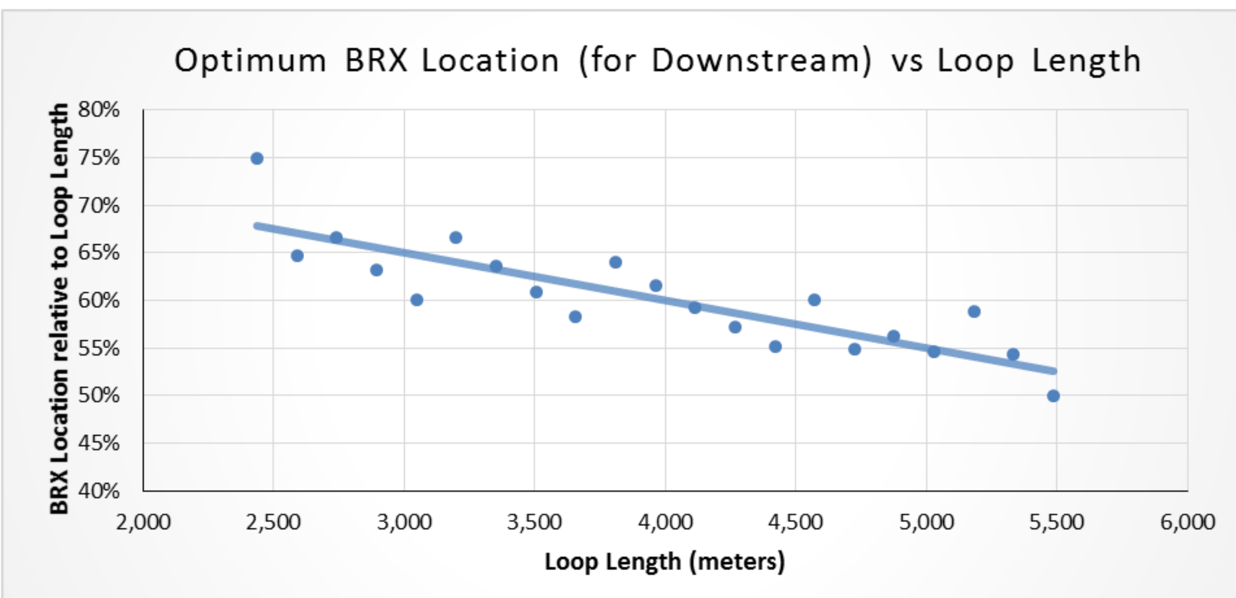

Figure 8: Optimum BRX-XLR Placement vs Loop Length (meters)

As can be seen, there is a general trend that drives towards the midpoint of the loop as the total loop length increases. Having said that, service providers have a finite amount of locations per loop where they can install the BRX-XLR which will not always be at the optimum point. Positron Access has designed the BRX-XLR Calculator tool to assist in determining the optimum location for any given loop along with many suggested alternative placements with predicted performances.

7 BRX-XLR Calculator

To view the impact related to the installation of a BRX-XLR unit on a given loop whether it is a 26 AWG (0.40 mm), 24 AWG (0.51 mm) or a 22 AWG (0.64 mm) copper pair, a PC tool is available. To download the BRX-XLR Calculator, simply sign up on the Portal at http://www.positronaccess.com/Portal.php and request access to the Portal. You will then receive a username and password.

The BRX-XLR Calculator has three tabs at the bottom that can be used for the following objectives:

- Calculate the achievable bandwidth based on the location of the BRX-XLR (from the DSLAM) and the distance to the subscriber CPE;
- Calculate the optimal bandwidth for a specific total loop length and gauge of wire and recommend the location where the BRX-XLR should be installed (usually a range of distances from the DSLAM) to achieve the target bandwidth;
- Calculate the best placement of a BRX-XLR cabinet to achieve a target bandwidth to multiple subscribers over a total loop length. This is useful to determine the Customer Serving Area (CSA) for a given access speed tier.

Please feel free to request a copy of our BRX-XLR Calculator Quick Start Guide for any assistance with using this tool.

8 Other Miscellaneous Placement Guidelines

8.1 Bonded Pairs

For convenience, the BRX-XLR Calculator does include an option (checkbox) for pair bonding. Essentially, this feature simply assumes that the two loops are essentially identical and therefore doubles the resulting bandwidth for both downstream and upstream. In reality, bonded pairs are often not the same length. It is recommended to enter the longest loop in the calculator in order to optimize placement for this loop. Since the other loop is shorter, the resulting bandwidth resulting from the bonded pairs should be slightly better than what the Calculator will predict.

8.2 Actual Raw Throughput is Different from Predicted Values

There will be times when actual raw throughput will be significantly different (>10%) from predicted values. This may be caused by a number of factors. One of the most likely reason is that the Target SNR default value in the BRX-XLR Calculator (set to 6dB), is not the same as the one provisioned in the DSLAM. If that is the case, simply change the value in the Target SNR box to match the DSLAM setting. If this does not resolve the issue, then it may be because you are faced with “less than ideal” line conditions where the bandwidth is negatively impacted by bridge taps, influence from power lines and/or disturbances from other pairs or the use of other protocols in the same binder such as T1/E1, HDSL and G.SHDSL. Our field experience has shown that the BRX-XLR provides even better Improvement Ratios (i.e. Bandwidth enhancement) when such conditions are present. As a result, it is difficult to predict what the expected bandwidth will be but we recommend that you still follow the optimal placement recommended by the BRX-XLR Calculator for the actual loop length and gauge.

Note: In order to predict the expected bandwidth as accurately as possible, it is recommended to use the “Optimized Bandwidth Analysis” button in the lower right corner of the Calculator and increase the loop length (and recalculate) until the “Raw Downstream Bandwidth” in column 4 is equal to what you are measuring. Once that is achieved, the amount indicated in column 6 entitled “With BRX-XLR Downstream Bandwidth” should be a good estimate of what you can obtain.

8.3 Minimum and Maximum Values for the BRX-XLR

To facilitate the planning process, the BRX-XLR Calculator will provide a warning in red whenever a number is entered that does not meet a minimum value that would ensure proper and useful performance. These criteria, for 26 AWG (0.40 mm) cables, are:

1) Minimum Loop Length from DSLAM to BRX-XLR (L1) should be no less than 5,000 feet (1.5 km)
2) Minimum Loop Length from CPE to BRX-XLR (L2) should be no less than 500 feet (150 m)

In addition, a red warning will pop up if the Total Loop Length is more than 18,000 feet (5.5 km). It is important to note that the product is still operational and useful beyond this point if a bandwidth below 4 Mbps is acceptable, for instance:

1) Maximum distance for a 2.5 Mbps service (or 5 Mbps with pair bonding): 19,000 feet (5.8 km)
2) Maximum distance for a 1.0 Mbps service (or 2 Mbps with pair bonding): 20,000 feet (6.1 km)