WHITE PAPER

The ATX Maintenance Mode Taps & Passives Replacement Model

A Cost Comparison Analysis

"Cable operators that initiated a taps and passives maintenance program that replaces legacy devices with next-generation devices could save roughly 3% of the overall cost of upgrading their outside plant to 1.8GHz, as well as reduce the expense, time and complexity of a bulk upgrade."

In the first half of 2021, working with data validated by several cable operators, ATX conducted research to compare the costs of two methodologies for the routine replacement of taps and passives in an HFC network. The study's hypothesis was that cable operators planning to upgrade their HFC network to a frequency of 1.8GHz, which will require the replacement of all taps and passives in their outside plant, could save money and get a head start on reaching their endgame over a multi-year transition period by immediately beginning to replace failed devices in their network with next-generation taps and passives that support a minimum bandwidth of 1.8GHz — instead of using legacy (1GHz or 1.2GHz) devices.

The results of the research validated the hypothesis. We determined that cable operators that initiated a taps and passives maintenance program that replaces legacy devices with next-generation devices could save roughly 3% of the overall cost of upgrading their outside plant to 1.8GHz, as well as reduce the expense, time and complexity of a bulk upgrade.

Additional report findings:

- Roughly 1% of taps and passives in a cable operator network fail annually
- About 20% of tap failures are related to loose screws or bad connections – a problem that can be alleviated by using devices with a screw-less entry connector
- Labor accounts for nearly 90% of the cost of taps and passives repairs and replacements
- Repairing failing taps and passives, or replacing them with devices that are incapable of supporting 1.8GHz, may result in cable operators spending additional money to upgrade their networks
- Large cable operators that adopt a maintenance mode replacement model using next-generation taps and passives will likely need to replace tens of thousands fewer devices when they move to DOCSIS® 4.0 Extended Spectrum

Introduction

It's a given that MSOs planning to adopt the Frequency Division Duplex (FDD) version of DOCSIS 4.0 will need to eventually replace all of the hardline passives in their outside plant to support 1.8GHz RF spectrum. Due to a number of design limitations, legacy devices supporting frequencies up to 1.2GHz cannot be faceplate upgraded to reliably support a passband of greater than 1.8GHz. While the need to fully upgrade the taps and passives in the outside plant to support 1.8GHz is obvious, a replacement model that offers the easiest and most cost-efficient path to DOCSIS 4.0 Extended Spectrum compatibility has yet to be identified.

Until now.

Working with multiple North American MSOs, ATX Networks conducted research that identifies a hardline passives replacement model cable operators can begin today that promises to reduce costs and hasten the upgrade of their outside plant to support frequencies of 1.8GHz — and potentially higher.

ATX's Maintenance Mode Taps & Passives Replacement Model calls for cable operators planning to support an upper frequency of 1.8GHz in their HFC network to immediately begin replacing all hardline passives that initiate a maintenance event with devices capable of supporting frequencies of at least 1.8GHz. The comparison's findings show that MSOs that replace all malfunctioning taps and passives, including those with faulty bases, faceplates or bad connections, with next-generation devices can reduce the overall cost of their DOCSIS 4.0 upgrade, compared to MSOs that wait until they are ready to cutover to 1.8GHz technology before they begin installing DOCSIS 4.0-compatible passives.

Historically, most cable operators fix or replace roughly 1% of their hardline passives universe annually. Replacing those failing legacy taps and passives with next-generation devices with a minimum bandwidth of 1.8GHz, the ATX study projects, will reduce the overall expense of upgrading outside plants to handle frequencies of 1.8GHz by 3% over a five-year period. In addition, starting the replacement process immediately will reduce by 5% the expense of a bulk replacement of taps and passives in conjunction with the adoption of DOCSIS 4.0 by reducing the number of legacy devices in the network by potentially thousands.

The remainder of this document defines the parameters of the study and provides details about the supporting research and the underlying methodology. Most of the report's findings are based on a cable access network serving 10 million subscribers. Cable operators with larger or smaller networks are projected to achieve similar results, linearly proportional to the size of their networks.

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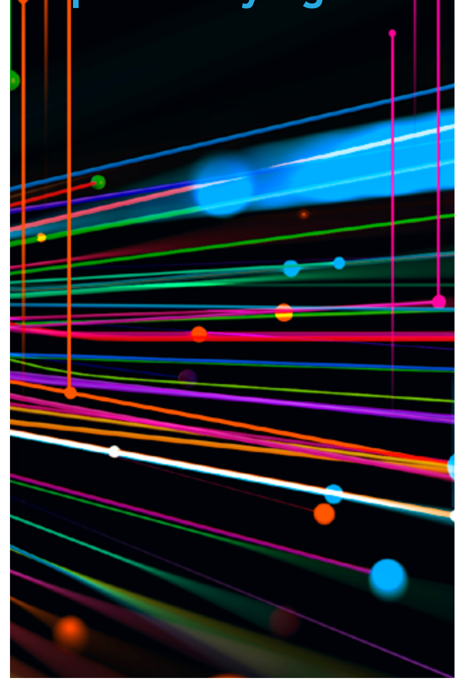

Definitions

This cost-comparison study is focused on two passive replacement methodologies, providing a detailed comparison of the two approaches over a five-year period.

Waiting Methodology – Legacy Mode of Operation

This approach calls for cable operators to address failures at taps and passives locations in a traditional manner. This means that faceplate failures are addressed with new faceplates being installed and loose screw issues are mitigated by tightening screws. If the entire device fails, a new "legacy" device (1GHz or 1.2GHz) is cut in.

Evolving Methodology – Evolutionary Mode of Operation

In this approach, technicians install a next-generation device (supporting a minimum bandwidth 1.8GHz — such as ATX's GigaXtend™ XS Series 2GHz taps and passives) anytime a truck is rolled to address a failed tap or passive.

Digging into the Data

On average, and as mentioned previously, cable operators report that roughly 1% of taps and passives in their outside plants will require a maintenance visit each year. Those incidents almost always fall into one of two categories: a device failure, which most often requires the entire device to be replaced,* or a bad connection due to a loose screw that requires tightening.

The study assigns real numbers to those percentages by identifying the number of Households Passed (HHP) for a given operator and then calculating the number of homes typically served by a single HFC tap, which is roughly 4.5 HHP per tap. That means that a cable operator network serving 10 million HHP, which is the study's theoretical profile (see Network Profile chart), would include roughly 2.2 million taps, along with close to 750,000 passives, as most HFC networks feature a tap-to-passive ratio of 3-to-1.

NETWORK PROFILE

HHP per Tap	4.5
Taps/Passives Ratio	3:1
Homes Passed	10,000,000
Total Taps	**2,222,222**
Total Passives	**740,741**
Total Devices	**2,962,963**

With a failure rate of roughly 1%, a cable operator delivering services to 10 million HHP would on average service just under 30,000 tap and passive locations annually. About eight out of 10 of all service visits are due to failed devices. The other two are to address loose connections. The Annual Location Visits chart details how those events are broken down in terms of taps and passives, as well as the type of service call, i.e., loose screw, faceplate-only or entire tap replacement.

ANNUAL LOCATION VISITS
10M HHP

Total Location Visits	**29,627**
Loose Screw Visits	**5,925**
Taps	4,444
Passives	1,481
Failed Device Visits	**23,702**
Taps - Faceplate	4,444
Taps - Full	13,333
Passives - Faceplate	1,481
Passives - Full	4,444

*Approximately 75% of device failures require a total replacement (not just the faceplate) of the tap or passive

Calculating Costs

Calculating the expense of both the Waiting and Evolving methodologies described earlier requires identifying the value of various labor and material costs connected with a tap- or passive-related maintenance event. The Labor Rates chart details typical labor costs for dispatching a truck to replace an entire device or faceplate. The cost of replacement devices, or materials, is itemized on the Device Costs chart.

Please note that all of the costs noted in the Labor Rates and Device Costs charts, as well as subsequent charts, have been normalized against a 1.2GHz average Full Tap Price (FTP) of $1.00.

LABOR RATES

Normalized to a $1.00 FTP

Targeted Truck Roll – Full Swap Out	$8.30
Targeted Truck Roll – Faceplate Only	$7.20
Bulk Rate – Full Swap Out	$2.20
Bulk Rate –Faceplate Only	$1.40

Device Costs

Average of 2,4,8 port pricing

Normalized to a $1.00 FTP

1.2GHz Full Tap Cost	$1
1.2GHz Tap Faceplace Cost	$0.75
1.2GHz Full Passive Cost	$1.50
1.2GHz Passive Faceplace Cost	$1.13
2GHz Full Tap Cost	$1.30
2GHz Full Passive Cost	$1.95

In the case of the Waiting model, allocations were made based on whether a loose screw was tightened by the technician, if only the faceplate was replaced or if the full device was replaced. For the Evolution model, a complete next-generation device was installed at every failure location, triggering the allocation of the cost of a targeted truck roll to install a "full next-generation device."

The Device Costs chart illustrates a 30% differential between the cost of a 1.2GHz tap and a 2GHz device. Though more than a trivial sum, the price differential is significantly smaller than the cost of labor to replace a device — either 1.2GHz or 2GHz. Depending on the device type, as well as whether the repair can be accomplished with a faceplate swap out or full device replacement, labor costs are 4-8X more than the cost of the device itself. In fact, in the model's aggregate accounting, labor accounts for roughly 90% of the cost of the overall maintenance event.

The disproportionate cost of labor, compared to materials, is the primary driver behind the cost comparison's conclusion that any savings related to replacing failed taps with legacy (1GHz or 1.2GHz) taps instead of higher-priced next-generation 2GHz devices will be eclipsed by the cost (both material and labor) of needing to replace the tap a second time when the network is upgraded to DOCSIS® 4.0/1.8GHz. In other words, cable operators that opt for the short-term savings of replacing failed devices with less expensive taps and passives that will not support 1.8GHz, will be financially penalized when they upgrade their outside plant to support DOCSIS 4.0.

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Findings

The major finding of the cost-analysis study is that cable operators that begin today to respond to tap and passives failures by replacing current devices with new 2GHz devices (Evolving Methodology) will be able to upgrade their networks to 1.8GHz at the end of a five-year period for 5% less than it will cost operators that repair failed hardline passives or replace them with devices incapable of supporting 1.8GHz (Waiting Methodology). Overall, when both the cost of the upgrade and the five years of maintenance costs are combined, the Evolving Methodology offers a total savings of 3% over the Waiting Methodology.

In actual dollars, the hypothetical MSO with 10 million HHP would save $543,000 (normalized to a $1.00 FTP) on the cost of the upgrade to 1.8GHz using the Evolving Methodology, and $429,000 (normalized to a $1.00 FTP) over the entire five year period. A detailed comparison between the two approaches is presented in the Waiting vs Evolving: Findings chart. The major source of savings, as the chart illustrates, is that at the end of the five-year run up to the bulk replacement of all taps and passives in the outside plant, the Evolving approach would leave cable operators with far fewer devices to replace than the Waiting approach. In our hypothetical model, followers of the Waiting Methodology would need to upgrade 2,222,222 taps and 740,741 passives to support DOCSIS 4.0 in the outside plant, compared to the 2,111,117 taps and 703,711 passives they would need to upgrade under the Evolving Methodology.

WAITING VS EVOLVING: FINDINGS

10M HHP, 5-year Time Horizon

	Waiting Methodology	Evolving Methodology
Remaining Taps to Upgrade	2,222,222	2,111,117
Device Costs	$2,888,889	$2,744,452
Labor Costs	$4,888,888	$4,644,457
Remaining Passives to Upgrade	740,741	703,711
Device Costs	$1,444,445	$1,372,236
Labor Costs	$1,629,630	$1,548,164
Upgrade Costs	$10,851,852	$10,309,310
Aggregate Maintenance Spend (5 years)	$1,289,966	$1,402,840
Total Upgrade Costs	**$12,141,818**	**$11,712,150**
Normalized to a $1.00 FTP		

Bottom-line Analysis

The comparison's findings demonstrate that cable operators with definitive plans to expand their HFC networks to support frequencies of 1.8GHz or higher can reduce both labor and material expenses by adopting a maintenance mode program that calls for failed 1.2GHz or slower hardline taps and passives to be swapped out with 2GHz-capable taps and passives.

While 3% is not going to instigate any champagne-popping from the CFO, the dollar amount could be substantial for a cable operator with millions of subscribers. Further, the study's results clearly show that cable operators that opt to continue to install lower-cost passives incapable of supporting 1.8GHz spectrum ranges are costing — not saving — their organizations money in the longer term. In addition to financial penalties, not adopting an Evolving Methodology to routine maintenance practice will negatively impact spectrum expansion transition efforts. Supporting a Waiting Methodology for routine tap and passive replacement will add both time and complexity to the eventual upgrade of the entire outside plant to support 1.8GHz frequencies.

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Additonal Benefits of Evolving Methodology

One of the advantages of incrementally preparing the network for eventual upgrade to 1.8GHz is the familiarity technicians will acquire with the new technology in advance of the bulk replacement exercise, where they may be replacing hundreds of thousands of devices. Replacement procedures are similar for most taps and passives. But some nuances do exist, like cutting center conductors to a certain length, and the sooner technicians gain experience with new procedures, the sooner they acquire proficiency.

A screw-less connector feature of the ATX GigaXtend XS family of 2GHz taps and passives will not only help to reduce installation time, it is likely to eliminate maintenance events resulting from screws that have worked their way loose. See the sidebar *Up-Close: The GigaXtend XS Screw-less Entry Connector* for more information.

The major benefit of adopting the Evolving Methodology for hardline passive maintenance, as cited earlier, is that it enables cable operators to essentially get a head start on upgrading their networks to support 1.8GHz. With taps and passives failing at a rate of roughly 1% annually, an MSO with 10 million subscribers would have already upgraded some 110,000 taps and passives prior to the switch over to DOCSIS 4.0. That’s 110,000 devices cable operators will not have to buy and 110,000 truck rolls they will not need to make as part of their bulk outside plant upgrade.

UP-CLOSE: The GigaXtend XS Screw-less Entry Connector

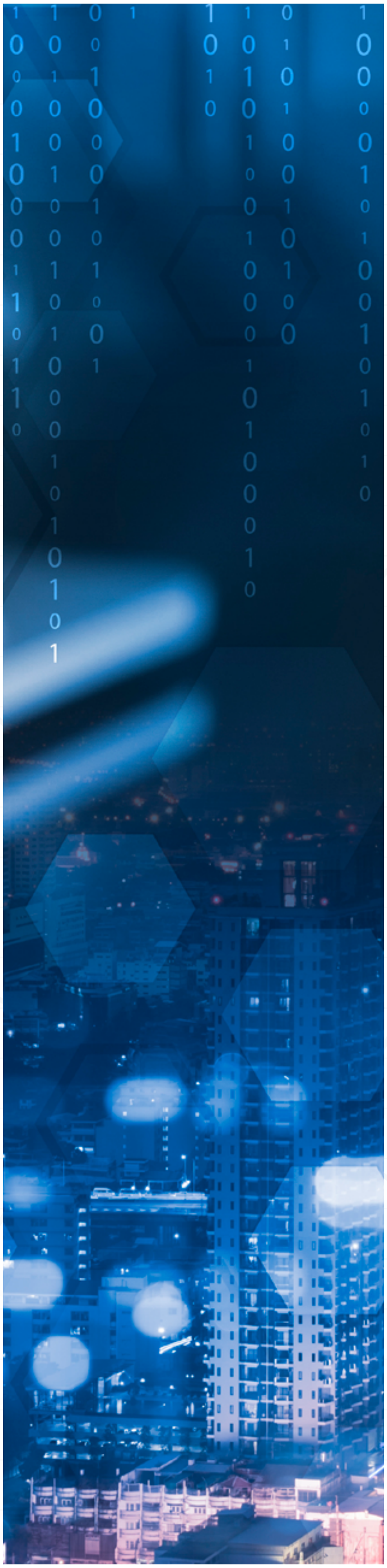
GigaXtend XS taps and passives feature a screw-less hardline 90-degree entry connector that has emerged as a significant timesaver for technicians. By eliminating screws, which can be dropped, loosen over time or left untightened by a hurried technician, GigaXtend’s spring-loaded contact design also means a potential reduction in repeat maintenance to replace or retighten a wayward fastener. While a few minutes of technician time here and there might not add up to a lot on a per-tap basis, the overall savings in a network with hundreds or thousands of passives could be significant.

An Alternative Approach

A major condition of the cost comparison is that it's only applicable to cable operators committed to upping the frequency of their network to 1.8GHz or beyond. Operators with no plans to support frequencies beyond 1.2GHz would be financially ill-advised to pursue an Evolving Methodology, as it is less expensive annually to fix failed devices or use 1.2GHz devices to replace those that cannot be repaired than to respond to every maintenance event by replacing the tap with a more expensive device with higher (but unneeded) performance levels. It is the reduced cost of the upgrade exercise, or cutover to 1.8GHz, at the end of the maintenance period that justifies adoption of the Evolving Methodology. Without an eventual bulk upgrade, the study's hypothetical cable operator would save nearly $31,500 (normalized to a $1.00 FTP) annually in labor and materials by adopting the Waiting approach, rather than the Evolving, as detailed in the *Annual Costs* chart.

ANNUAL COSTS

	Waiting Mode	Evolution Mode	Delta
Total Maintenance Cost/year	**$257,875**	**$ 289,233**	**31,358**
$ for Taps	**$191,324**	**$213,322**	
Materials	$16,666	$ 28,887	
Labor	$174,658	$184,434	
$ For Passives	**$66,551**	**$75,912**	
Materials	$8,340	$14,442	
Labor	$58,212	$61,470	
All Values Normalized to a $1.00 FTP			



But what if cable operators that were planning to upgrade their HFC plants invested the money they would save annually from pursuing a Waiting Methodology approach? In other words, what if they took the $31,358 they could save annually by fixing legacy taps and passives or replacing them with 1.2GHz devices, instead of following the Evolution Methodology approach, and dedicate that money to an investment venture? Could they potentially earn enough on that investment to nullify the long-term advantages of an Evolving Methodology approach?

It's possible, of course, but unlikely. Cable operators would have to realize a better-than-65% annual gain on that investment to essentially break even with the financial advantages of adopting an Evolving upgrade methodology. An annual gain of more than 60%, even under the most favorable market conditions, is highly improbable. In addition, even if the two methodologies were similar in terms of overall costs, cable operators opting for the Waiting approach would not reap the time and familiarity benefits of upgrading the outside plant using the Evolving approach.

The bottom line is that unless your CFO's surname is Midas, your best financial bet for upgrading your outside plant is to pursue an Evolving Methodology from day one.

Next Steps

The evidence is in: cable operators moving to DOCSIS 4.0 can reduce the cost and complexity of upgrading their outside plants by immediately adopting a next-generation taps and passives routine maintenance replacement model.

We've crunched the numbers and, on average, cable operators that jump start their transition to the 1.8GHz version of DOCSIS by adopting an Evolving Mode taps and passives replacement strategy can save 3% on the cost of their multi-year upgrade.

Need more evidence about the benefits of an aggressive passives adoption strategy? Reach out to your ATX representative about a complementary and customized version of this report. We're happy to help you figure out how best to evolve your HFC network and start building out your future outside plant today.

About ATX Networks

ATX Networks is a global leader in broadband access and media distribution solutions. ATX's market-leading and award-winning solutions are based on Agile Innovation design principles, enabling communications service providers to futureproof and evolve their networks in lockstep with market demand. ATX partners with the world's most innovative cable, satellite, fixed telecom, wireless and media broadcast service providers to usher in a new era of ubiquitous gigabit broadband that will meet the communications needs of this generation and the next. For further information, visit ATX at www.atx.com, and follow us on Twitter @ATXNetworksCorp.

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