Cabling Installation & Maintenance

EXECUTIVE SUMMARY

Be Ready for Modern Network Builds with Ribbon

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KEY TAKEAWAYS

- Data demand increased dramatically during the pandemic.
- The transition to fiber-deep network architecture will continue.
- Latest generation ribbon has multiple advantages.
- Other features of ribbons provide greater flexibility and time savings.
- Mass fusion splicing puts it all together.
- A look at the data confirms the advantages of collapsible ribbon and mass fusion splicing.

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OVERVIEW

The demand for digital services continues to grow at a fever pitch. Addressing this demand requires continuing the transition to a fiber-deep network architecture that has been underway for many years; the networks of the future will require far more fiber.

Modern networks that are built around ribbon save considerable time and money, and such networks are better prepared for the future. The latest generation ribbon has multiple advantages, including enabling mass fusion splicing. Ribbon provides for significantly faster fiber-to-fiber splicing, faster fiber-to-cassette splicing, and faster network testing.

CONTEXT

In a series of webinars hosted by AFL, fiber experts Doug Duke and Lucas Mays discussed the advantages of a ribbon architecture.

KEY TAKEAWAYS

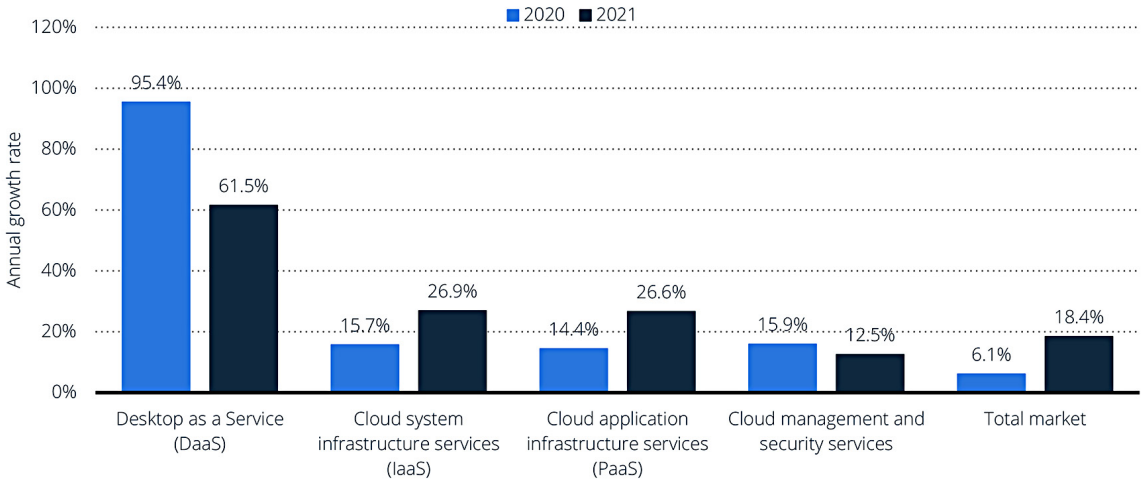
Data demand increased dramatically during the pandemic.

During the pandemic all types of digital services grew at a phenomenal rate. This includes desktop-as-a-service, cloud systems, applications, management, and security services. There was a mad rush to leverage these services to maintain productivity, and continued growth of digital services is expected.

While IT spending dropped during the height of the pandemic, it has rebounded strongly in 2021 due to government stimulus and catch-up spending. IT spending in the near term is somewhat uncertain, but there is no doubt that software and data services will continue as a mainstay.

> The fact that there is more and more demand for data, means that we need more and better networks.
>
> *Doug Duke, AFL*

Figure 1: Growth of digital services in 2020 and 2021



Source: Gartner; Statista

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The transition to fiber-deep network architecture will continue.

To support the long-term growth in the demand for digital services, a transition has been underway for several years to fiber-deep and all-fiber network architectures. AFL sees that transition continuing, driven by WiFi 6, 5G, DAS, fixed wireless access (FWA), and more.

> All of this is going to be a driver for more and more fiber . . . We've got to put more fiber in more places.
>
> *Lucas Mays, AFL*

AFL sees a trend of "converged access networks" which is a new bridge between network applications. This bridge supports different types of network traffic, high volumes of data, and high quality of data. This means that network architectures will have to change to adapt to different applications that are being served, with a consistent theme of driving fiber density throughout the network and closer to the user.

Latest generation ribbon has multiple advantages.

Previously, ribbon technologies may have been used to connect data centers, but the latest generation of ribbon cable is no longer about data centers or even large network providers, such as the phone companies. The latest generation ribbon:

- Promotes use as a ribbon or loose fiber. It enables mass fusion splicing or individual splice connectors, and it maximizes use of space in the cable core.
- Has smaller diameters, which maximizes pathway utilization, resulting in higher fiber counts. Smaller diameters mean there can be much greater length of cable onto a cable route reel. That in turn means the distance between splice points can be increased and number of splices can be decreased.

Figure 2 shows the increase in density and cable counts.

Figure 2: Latest generation ribbon cable – size advantage over traditional OSP cable designs

> That ribbon structure allows us to do what you see here . . . the density is by historical standards just astounding.
>
> *Doug Duke, AFL*

Other advantages of latest generation ribbon cable include:

- It's not just an outside plant product (OSP) anymore, it is now available in for indoor use (ISP).
- There are fanout kits, which eliminate transition splice concerns.
- There are no buffer tubes in OSP and some ISP constructions.
- It is dry and gel-free, regardless of the cable construction.

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- There are clear ribbon markings, as opposed to undecipherable text.
- There have been recent improvements to closure design, directed at ribbon enablement, which can represent a significant time savings.
- Transition tubing is not necessary.
- There are trays that allow double stacking of mass fusion splices.
- New options are available for connectivity at the panel that require less real estate and make trunk cable termination faster.

> You can double stack the ribbon splice organizers . . . which means now you can put higher fiber counts into a smaller and less expensive splice closure.
>
> *Doug Duke, AFL*

Other features of ribbons provide greater flexibility and time savings.

MPOs started primarily as a data center technology but have moved to the central office and now to hardened MPO cables in the outside plant.

There has also been advancement in test equipment, with ultrafast multi-fiber inspection tools that support MPO connectors. In addition, there are robust cleaning solutions for MPO connectors, especially One-Click® MPO Cleaner.

> Inspecting 12 fibers one at a time is pretty time consuming, but when you can do it in this MPO format, you can do all 12 fibers at once; it's about one second per fiber. It's not instantaneous but it's a lot faster than having to physically check each one.
>
> *Lucas May, AFL*

Figure 3: Multi-fiber inspection tools support MPO connectors

Mass fusion splicing puts it all together.

Mass fusion splicing literally puts it all together. Splicing 12 fibers per burn versus one per burn is obviously much faster, even with a little additional prep time. Improvements in automation, ergonomics, ribbonizing, and fiber quality enable mass fusion splicing where single fiber splicing has previously been chosen.

Many people may be concerned that mass fusion or ribbon splicing typically means a higher splice loss. This is not necessarily true. Data from an AFL internal study, which looked at the average splice loss over

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hundreds of splices, found the loss to be extremely low. While in the 1990s and 2000s, mass fusion splicing meant a loss penalty, that is no longer the case.

> Modern day fiber is friendly to low loss, even when mass fusion spliced.
>
> *Doug Duke, AFL*

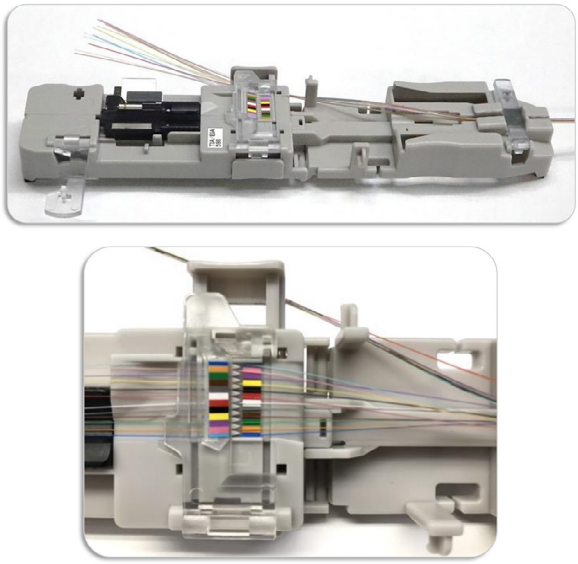
Figure 4: Average splice loss from mass fusion is now low

Fiber Combination	Average Splice Loss (dB)	Standard Deviation	Maximum Splice Loss (dB)	Minimum Splice Loss (dB)
G.657 #1 to G.657 #2	0.03	0.014	0.07	0.00
G.657 #1 to G.652.C	0.02	0.019	0.13	0.00
G.657 #1 to G.652.D	0.02	0.014	0.05	0.00
G.657 #2 to G.652.C	0.03	0.013	0.07	0.00
G.657 #2 to G.652.D	0.02	0.017	0.08	0.00

Of vital importance in mass fusion splicing is the cleanliness of the V-grooves. AFL has introduced replaceable V-groove and electrode assemblies that swap out as a module; it only takes one minute and two screws to swap out V-grooves. Being able to clean the V-grooves more quickly and efficiently is a significant enabler.

Another important aspect related to mass fusion that has gained in popularity is ribbonizing, which is the process of taking stranded cable and making a ribbon out of it. Rising fiber counts have caused ribbonizing to gain popularity in the enterprise space. AFL came up with a new field-friendly ribbonizing tool that is faster to use and requires no glue or paste, and therefore no cure time.

Figure 5: AFL's tool to improve ribbonizing



> This tool makes ribbon splicing viable for scenarios where cable isn't in a ribbon form factor.
>
> *Lucas Mays, AFL*

A look at the data confirms the advantages of collapsible ribbon and mass fusion splicing.

AFL conducted studies of the time required for fiber-to-fiber and fiber-to-cassette splicing. For each type of splicing, AFL looked at three options:

1. Traditional loose tube single-fiber splicing
2. Loose tube ribbonizing for mass fusion splicing
3. Mass fusion splicing of collapsible ribbon cable

This analysis found that for fiber-to-fiber, collapsible ribbon mass fusion splicing is about 90% faster, with time savings attributed to not having to do buffer tube entry or gel cleaning. For fiber-to cassette, collapsible ribbon mass fusion splicing was about 75% faster.

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Figure 6: Fiber-to-fiber splicing results

Times in "Min:Sec" format

	12 Fiber	24 Fiber	48 Fiber
Single Splice	27:44	45:13	87:36
Ribbonizing to MF Splice	8:10	15:01	32:12
Collapsible Ribbon MF Splice	2:51	5:45	9:20

Figure 7: Fiber-to-cassette splicing results

Times in "Min:Sec" format

	12 Fiber
Stranded Cassette	29:16
Ribbonizing to MF Splice Cassette	9:30
Collapsible Ribbon MF Splice Cassette	7:11

In terms of testing, some new generation OTDRs offer multi-pulse testing, enabling easy detection of closely spaced events for verification and fault location. And, some OTDRs offer hyper testing speeds.

Analysis shows that OTDR + MPO Switch + FleXpress achieves dramatically faster testing results.

Figure 8: Faster network testing

Test	Standard OTDR	OTDR + MPO Switch + FleXpress
Dual wavelength test	60 sec	< 5 sec
12-fiber MPO	720 sec (12 min)	40 sec
3456 fiber cable (288 MPOs)	58 hours	3.2 hours
6192 fibers (576 MPOs)	116 hours	6.4 hours

CONCLUSION

All long-term trends point to a continued increase in demand for data and digital services. Meeting this demand requires scalable network installations. This is best done through collapsible ribbon cables with higher density, lighter weight, and more fibers per square inch. Modern ribbon technology makes mass fusion the most efficient splicing method. As data demonstrates, when using ribbon architecture, installations and repairs are finished much more quickly and are far less costly.

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BIOGRAPHIES

Doug Duke

Senior Applications and Development Engineer, AFL

Doug Duke is a senior applications and development engineer in splicer engineering at AFL. After receiving his Bachelor of Science in Mechanical Engineering from the University of Texas at El Paso, Doug joined the Defense Systems and Electronics Group in Texas Instruments and worked primarily in the development of airborne radar and infrared detection systems. Since joining AFL in 1991, he has worked continuously in engineering activities related to fusion splicing of optical fibers. In his more than 30 years as a splicing engineer at AFL, Doug has guided splicer product development, authored and presented numerous technical papers, conducted seminars on fusion splicing technology and applications, and is named in several patents.

Lucas Mays

Product Manager, AFL

Lucas Mays is a product manager of fusion splicers and accessories at AFL. He earned a Bachelor of Science in Physics from the University of Louisville with a focus in optical sciences. From there, he dove into the fiber optics industry first as a splicer/installer, then as an engineer working in product R&D. Currently, he is an applications engineer helping to solve the day-to-day splicing challenges experienced in the field.