

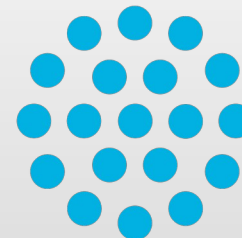
HOW WE GOT HERE

OUR NEXT GENERATION IP BACKBONE

ALANOG - SEPT 2023

Graham Wooden
Sr. Director - Engineering

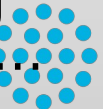
Uniti



AS 13760

A LITTLE ABOUT UNITI & ME

- Uniti a publicly traded infrastructure REIT. We are the largest independent fiber provider in the US with 8.3 million strand miles of fiber which equates to around 138k route miles. Wait, what is a REIT?!?
- Uniti began as an asset spin-off from Windstream in 2015, where most of its operating assets put into this separate company (at the time called CS&L) and then were “leased” back to Windstream. Acquisitions of other companies (Southern Light, InLine, PEG, Hunt, M2) allowed the company to become operator as well as continue with other lease-back purchases.
- I have been with Uniti since 2016. My IT career started in 1997 a small dial-up ISP in Mobile and worked for many small/large enterprise and government organizations.
- My team engineers the lifecycle of our [AS13760](#) IP Backbone along with the auxiliary services like DNS, Content Caching Servers, peering. This list seems to grow, more and more



CONSTANTLY EVOLVING

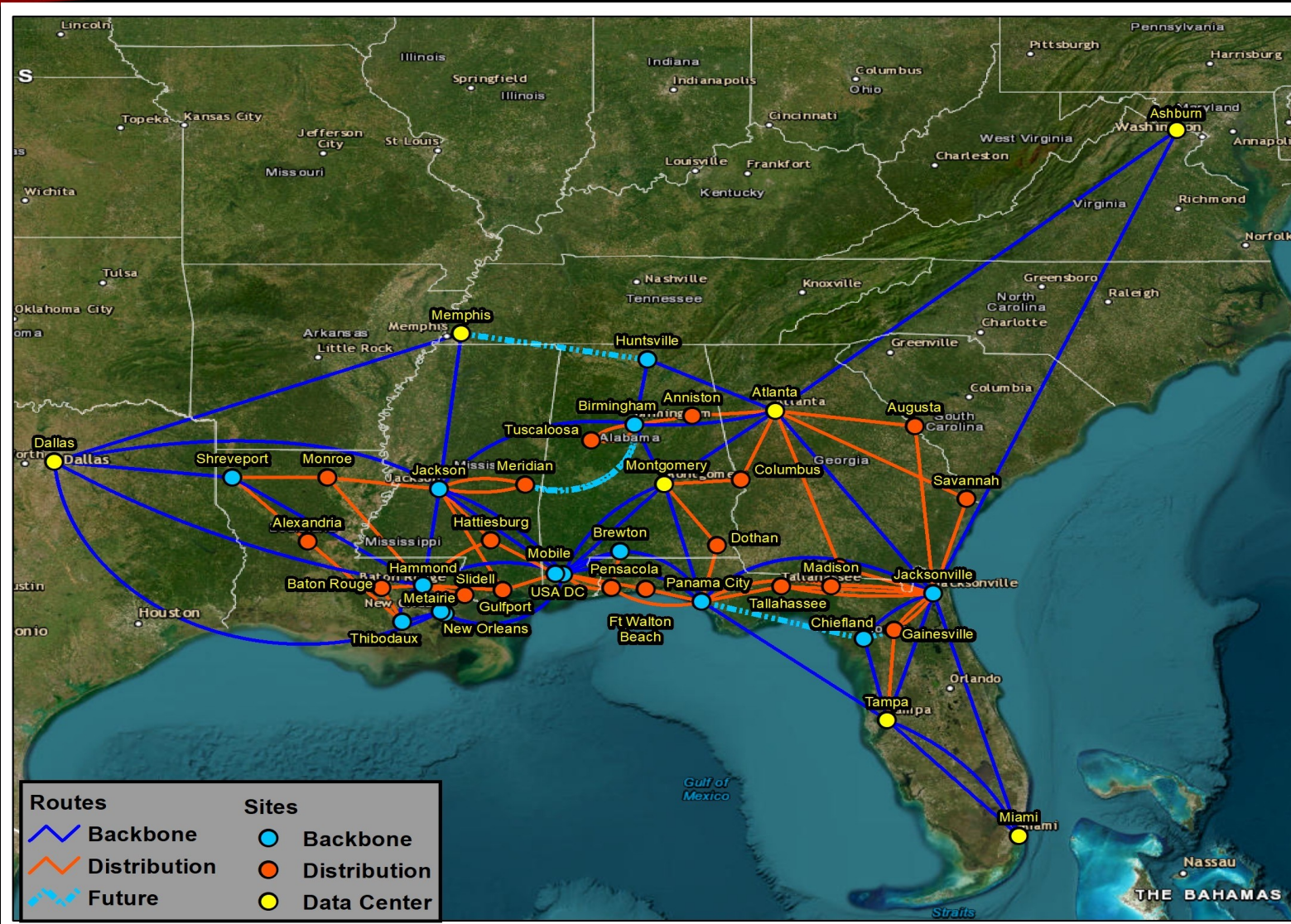
Our IP Backbone is a separate network, riding on **pure optical** – not switched or converged with any other services or networks.

Lots of dots - What is considered a Backbone location vs. another type?

2+ degrees, serving its own market and nearby smaller ones. *Ex. Jackson and Meridian, Birmingham and Tuscaloosa*

Primarily running Cisco IOS-XR on A9k/A99k Routers*

** Spoiler alert! 'Was running' ...*



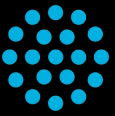
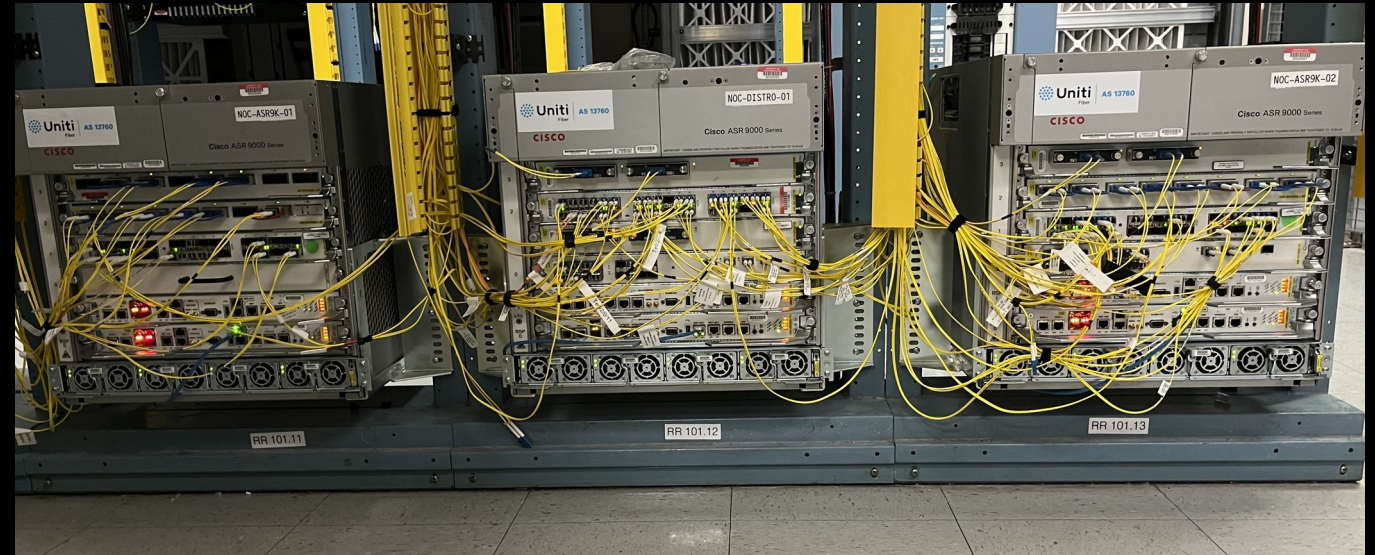
IP POSTURE

- IP Backbone Routers – 2 per location, separating out N/W & S/E degrees. No direct customer connections! (but there is always an exception – thanks Sales 😞)
- IP Market Distribution Router – direct customer layer static and BGP. Separate 100G connections to each respective north-bound BB routers – even diverse for the ones that are not local.
- IP Edge Routers – IP Transit and lateral edge peering partners eBGP sessions – all ingress/egress of the B happens there.
- **2,000+% growth of IP edge traffic utilization s**

By the numbers ...

36 BB Routers, 42 Market Routers, 9 Edge routers – all with Route Reflectors, Special Services Edge routers (i Cache Server routing) ... the list goes on and on and on ...

Truth be told - that is a lot of hardware, software, licenses and maintenance to keep up.



BEING A GOOD STEWARD

Remember that thing I said about our growth? So yeah, about that ...

Couple that with CapEX/OpEX expenditure spending constraints (*don't lie ... we all have them*), growing the ASR 9/99K platform as backbone router - was going to be challenging.

We needed ports - everywhere. Adding in a modest 8x100G LineCard - at \$55k each (used!) , into chassis' that was already pulling 45+ AMPS (-48vDC) - was simply going to be no longer feasible. In some locations, the chassis was already full of other LCs - we were literally hitting the ceiling of these monolithic chassis routers.

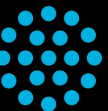


'DO MORE WITH LESS', THEY SAID

So, the question became:

"What is out there, in the market, that could ..."

- Offer the same (or improve on) experience that has defined our quality services - all the things we are doing today and provide a platform for new.
- Has more than enough 100G/400G interfaces (this is a misnomer - you will always need more!)
- Reduce our CapEx/OpEx expenditure. This is the whole package - not just the cost to procure but also to operate the router (think power & cooling costs/constraints).



SO WE DID

Enter the **Whitebox**

Err ... what?

A Network Operating System, disaggregated from the hardware – resulting in an agile solution – allowing the use of routers and switches from multiple vendors without being tied to use their OS.

Yes – all the routing you are doing today, can be done with a NOS, running on more available and flexible hardware – hence the “disaggregated” part. The software is truly independent of the hardware. ASICs, like Broadcom have SDKs that allow direct communication and programming to/from the NOS.



DISAGGREGATION

After the past several years, the use of Disaggregated based Network Operating Systems running on commodity hardware has dramatically increased – allowing it to be a real contender. Yes – folks were running Vyatta on Linux Servers before 2013 – but it was not widely accepted and often criticized for doing so.

Say what you will about AT&T – but they led the charge *publicly* in adopting an Open Network Environment, and in 2017 started deploying the model for their 5G front/mid/backhaul network rollout. At the end of 2022, their open disaggregated core was carrying more than 52% of this backbone traffic – with primarily DriveNets as the NOS running on Broadcom/Jericho2 based UfiSpace S9700 routers [1,2]

[1] https://about.att.com/story/2020/open_disaggregated_core_router.html

[2] <https://about.att.com/blogs/2023/satterlee-open-disaggregated-platforms.html>



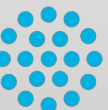
THE PATH WE CHOSE

After a review of different NOS vendors, we chose **IP Infusion**, as they have been an established leader since 2000 with their licensed NOS named ZebOS. Folks like F5, Ciena and Fujitsu – to name a few, all have licensed core routing components from IP Infusion. In 2013, they decided to offer a NOS that can complement several different router and switch hardware running Open Network Install Environments (ONIE). They are also the only development partner^[1], authorized by Broadcom for their various StradaDNX based ASIC processors – leveraging best of class QoS, High Buffer Memory, high capacity 100/400GE interfaces and Carrier features like MPLS and Segment Routing^[2]

EPS Global was chosen to be our distributor for both OcNOS and the hardware.

[1] <https://www.ipinfusion.com/products/broadcom-development-collaborator/>

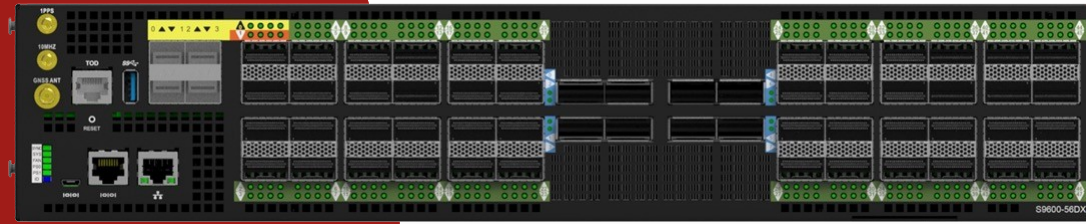
[2] <https://www.broadcom.com/products/ethernet-connectivity/switching/stratadnx>



SPEAKING OF THE HARDWARE

On the hardware front - there are many, many options. For what we needed to accomplish our initial goal - both Edgecore and UfiSpace routers were ideal for us. The models I have listed below (and in person with me today) had the right number port type availability, delivery and cost.

UfiSpace S9600-56DX 4.8T - 48x100GE, 8x400GE supported by Broadcom Qumran 2c with Intel Icelake 8-core 2.1GHz and 32GB RAM. Onboard 4x10G breakout



<https://www.ufispace.com/products/telco/aggregation/s9600-56dx-100g-400g-open-aggregation-router>

Edgecore AS7946-74XKSB 2.4T - 64x 10/25GE, 8x100GE supported by Broadcom Qumran 2c with Intel D-1548 core @ 2GHz and 32GB RAM.



<https://www.edge-core.com/productsInfo.php?cls=291&cls2=327&cls3=628&id=1113>



UfiSpace S9510-28DC 800G - 24x 10GE, 2x100GE and 2x400G DD. Qumran2a with Intel 8-core 1.7GHz and 16GB RAM.

<https://www.ufispace.com/files/1r/UfiSpace-Disaggregated-Cell-Site-Gateway-S9510-28DC-Datasheet.pdf>



AS 13760

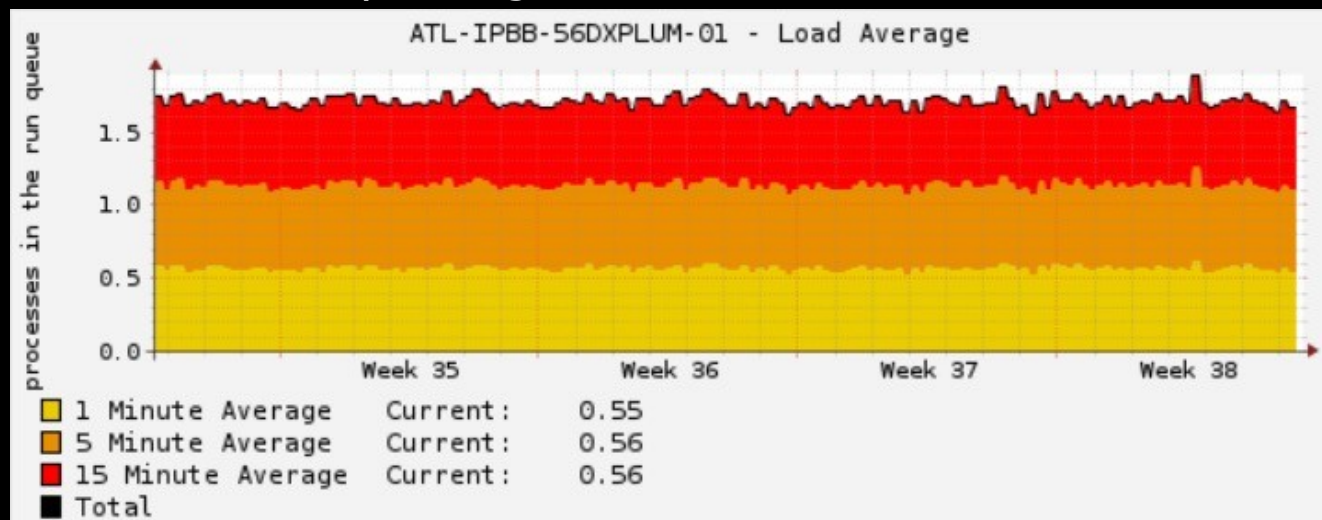
BY THE NUMBER

The ever-so-important question – has it been worth it?

For the year thus far, we have been able to reduce our power consumption by ~432A with another ~200A planned reduction by EOY.

We have been able to replace a ASR9k chassis with a 9600-56DX – for about ^{1/2} the cost of a single 8x100G LC, all the while having 5-year Maintenance and Support included.

In terms of the actual computational usage – this router below has 5 iBGP RR sessions with full INT table from each, 9x 100GE interfaces with all various utilizations with sFLOW reporting.



Over the past 4 weeks, this router has had its *15-min interval load average* at .56. This equates to just at **3.5%** CPU utilization across all cores and RAM memory was at **19%** (5.9 out of 32GB)



IN CLOSING

We are continuing to leverage the whitebox disaggregated model to complete our IP Backbone upgrades and starting to look at other networks within Uniti from which can benefit from this game-changing, forward-thinking approach.

IP Infusion has been a terrific partner to work with, allowing direct access to a very knowledgeable TAC support team – supported by SMEs and Development. We have been able to deploy rather quickly, out of our lab and into our production networks with ease

EPS Global has delivered routers quickly (under 2 weeks in most cases), where traditional purchasing with Cisco has taken 9-12 months. This has allowed to us to move quickly on these critical upgrades.

