

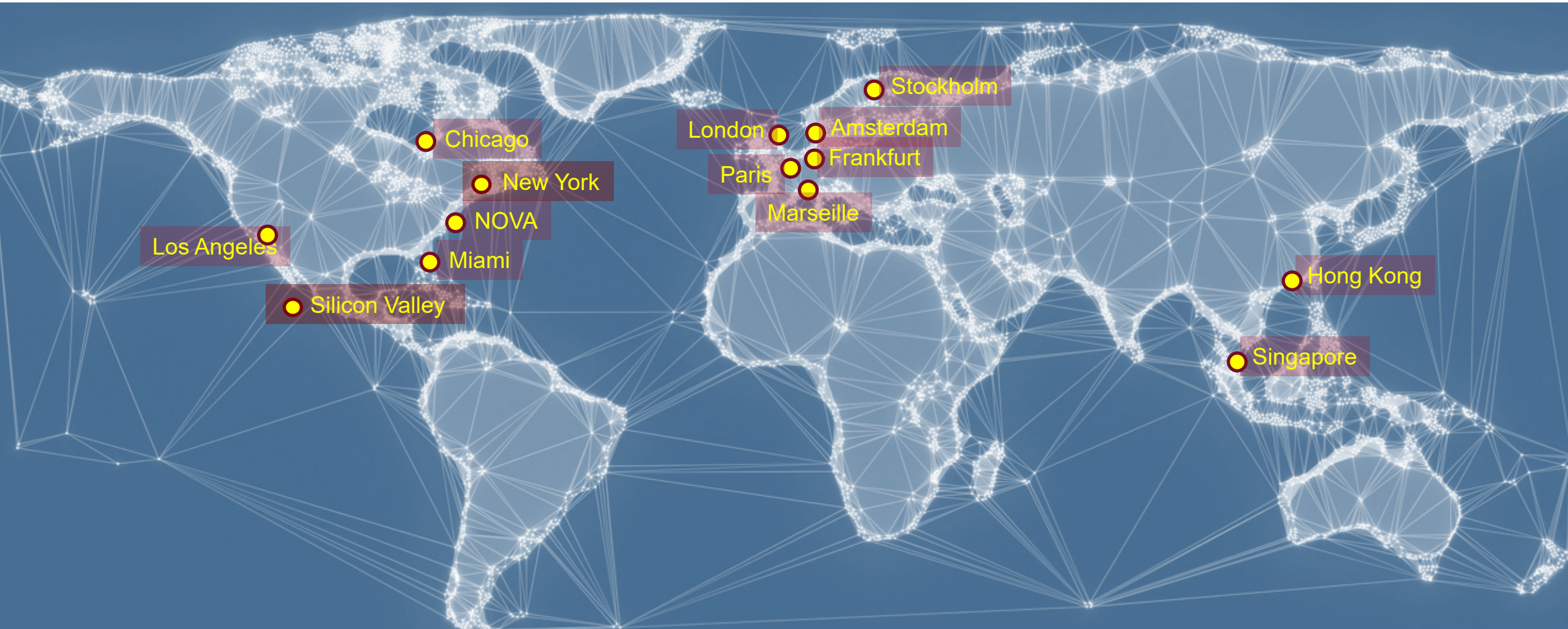


Components of a Robust Global Internet Hub (GIH)



Global Internet Hubs

 TeleGeography International research firm that tracks the development of global interconnection hubs



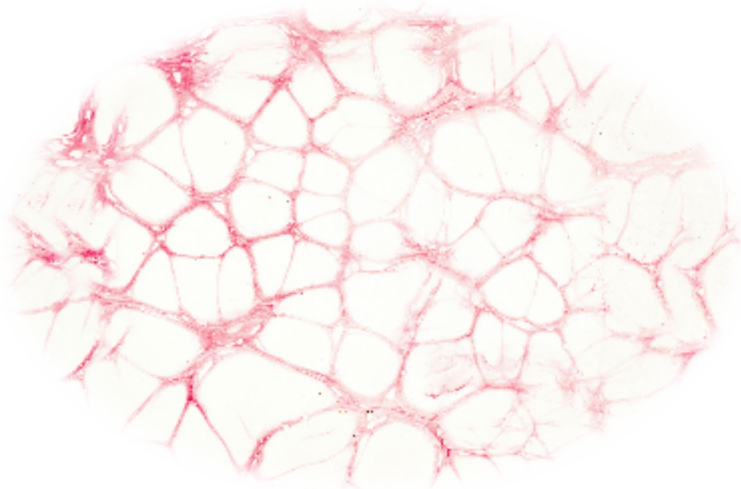
Visualizing Components of a Robust Digital Infrastructure Hub

A circular, semi-transparent image of plant cells, showing a network of interconnected cell walls that resemble a honeycomb or mesh structure. The cells are roughly hexagonal and arranged in a somewhat regular pattern, with some larger and some smaller cells. The image is centered on the slide and serves as a background for the main text.

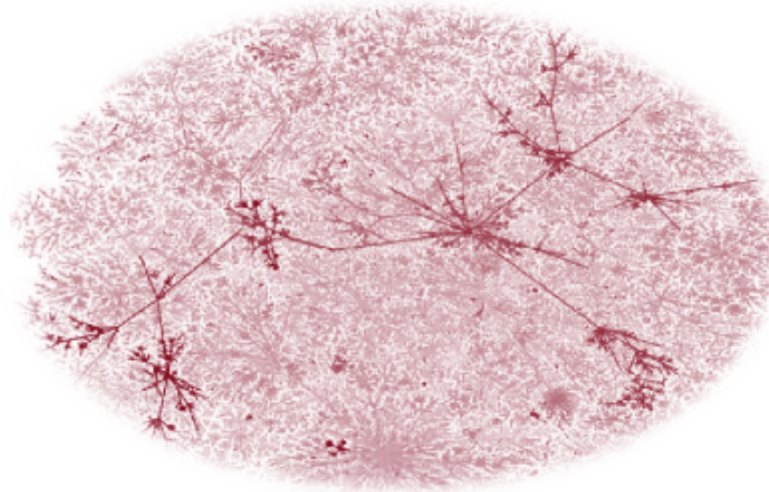
**Let's Look at a Hypothetical
City or Region that's a
Global Interconnection Hub.**

Visualizing an Interconnection Hub

The Internet is a
Collection of
Independent Networks



Networks Overlap
and Connect in
Interdependent Hubs*



Over a Dozen Large
U.S. Cities Are
Interconnection Hubs



Companies choose to co-locate and interconnect in robust and growing digital infrastructure hub markets.

Carrier networks Content delivery networks Social networks Cloud services Hosting Gaming ISPs

* <https://www.semanticscholar.org/paper/Mapping-and-Visualizing-the-Internet-Cheswick-Burch/53939501df05912431ded6502993bee40cf6e6c7/figure/1>

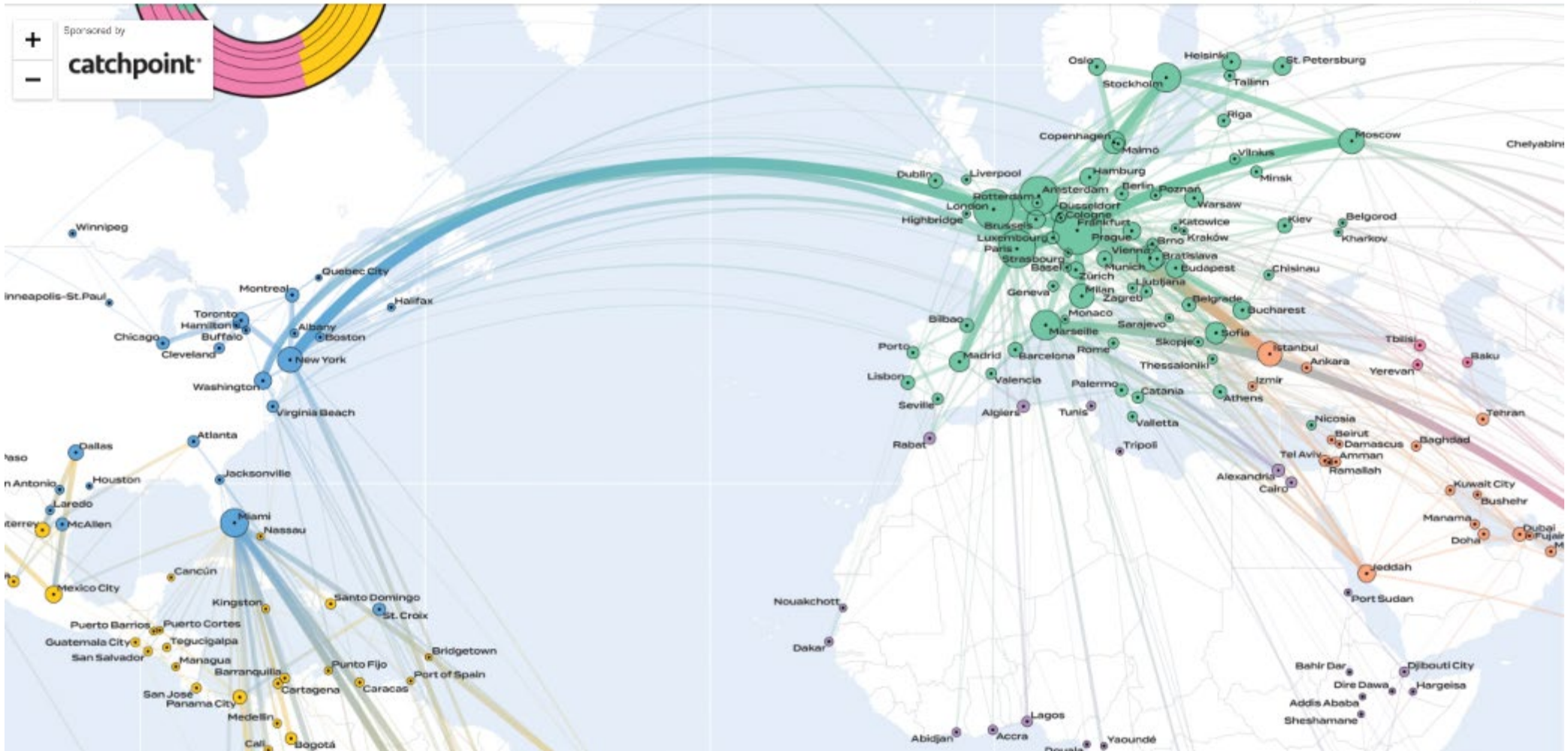
Visualizing an Interconnection Hub

Interdependent Hubs and Spokes

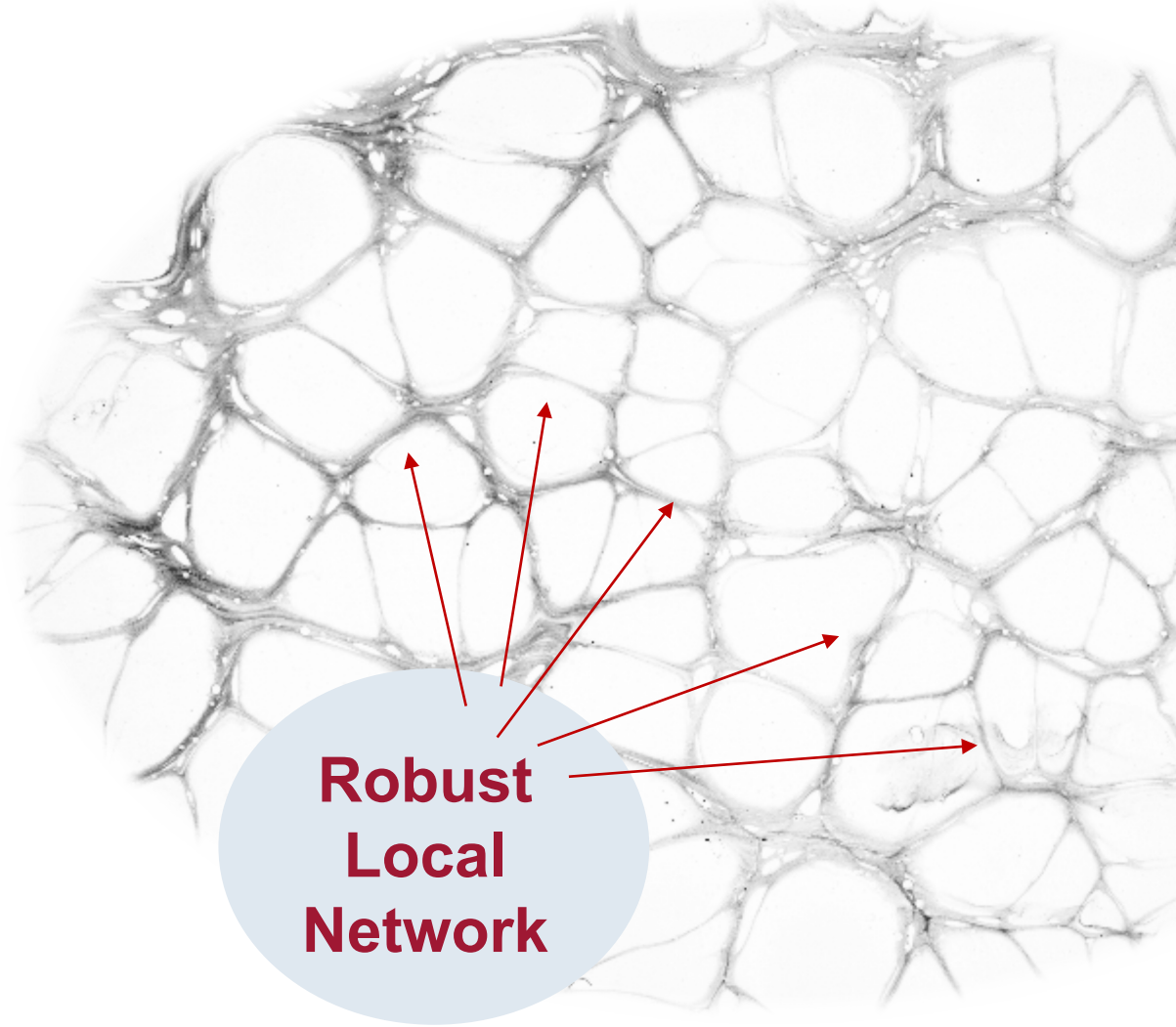
Global Internet Map 2022

Capacity Traffic Prices Exchanges Cloud Infrastructure

Buy the Wall M



Visualizing an Interconnection Hub



Data runs on robust, diverse, and redundant networks that provide the connectivity that defines the worldwide internet.

Digital interconnection hubs require widespread access to physical fiber networks along with a competitive mix of enterprise and internet backbone service providers.

Visualizing an Interconnection Hub

Interconnected,
Geographically Dispersed
Data Centers

I-64 Innovation
Corridor
Megaregion
currently has 14
data centers.

Northern Virginia
has 151 data
centers.

Data Centers

Data centers are the fundamental infrastructure on which interconnection hubs depend. These are the network-centric buildings that house, protect, and provide interconnection for network equipment. Data center hubs usually grow hand in hand with network hubs. Where networks go, data centers must be built to house them. There are different types of data centers. Some data centers house multiple networks that connect with each other and with peering platforms and cloud providers in these buildings. Other categories include enterprise-focused data centers, which focus primarily on corporate networks, and hyperscale facilities, which house dedicated cloud platforms. SOURCE: TeleGeography

Visualizing an Interconnection Hub

Diverse Fiber Routes

Robust local networks can't exist in isolation.

Diverse fiber routes connect to other hub markets. It is important to have strong infrastructure connecting the region to other large markets. This interdependent ease of access ultimately serves to make it easier to grow the local market.

Market A

Interconnection
Hub Market

Diverse Fiber Routes Connecting to Other Hub Markets

(This can be subsea and/or terrestrial)

Market B

Market C

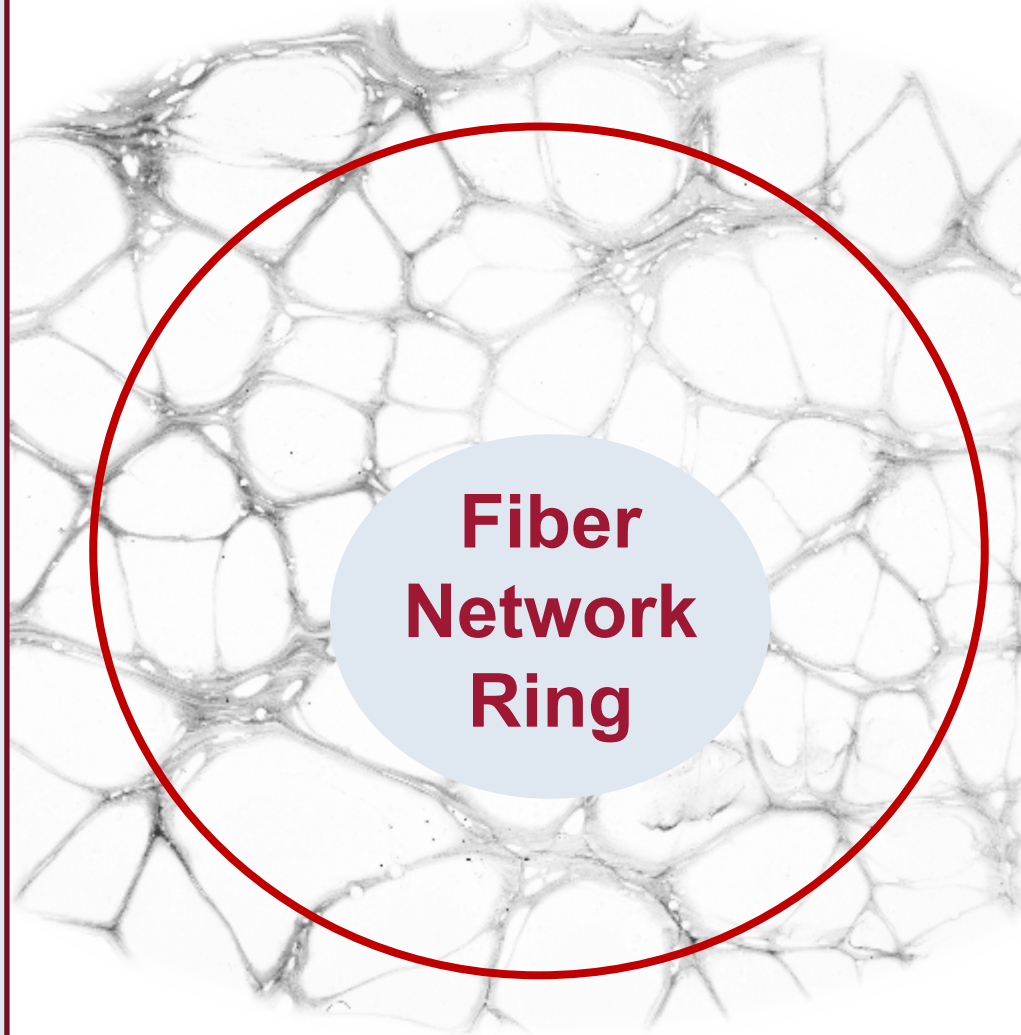
Visualizing an Interconnection Hub

Fiber Network Ring

Fiber Network Rings are robust network backbones that connect a region's governments, universities, large business parks, etc.

A fiber network ring serves as an additional interconnection access resource that is deployed when and where incumbent networks are not adequate to serve the current market demand or expected future growth. Additional reasons for a ring include the need for redundancy or a special municipal need for safety, smart cities, or security.

The need for a fiber network ring is determined on a case-by-case basis by the jurisdictions in each market.



When Is a Ring Needed?

A competitive mix of carriers provisioning deep fiber access along with backbone services effectively connect a region.

A growing number of regions are investing in municipal fiber network rings.

After a few years of study, localities across the Hampton Roads region determined their market would benefit from a ring. The Southside Broadband Authority was established. Five cities on the Southside invested \$25M to build a 119-mile network ring. Future phases include eventually connecting 17 cities and counties of the 757 region.

GTS has been hired through a public-private partnership to install and manage the ring. The ring is projected to cut in half participating cities' annual internet connection fees and provide broadband service to underserved neighborhoods.

Visualizing an Interconnection Hub

Data centers are one of the most energy intensive structures. For every one input of data, five other inputs are produced, relaying the information to other data centers. This requires substantial electricity to keep the systems running.

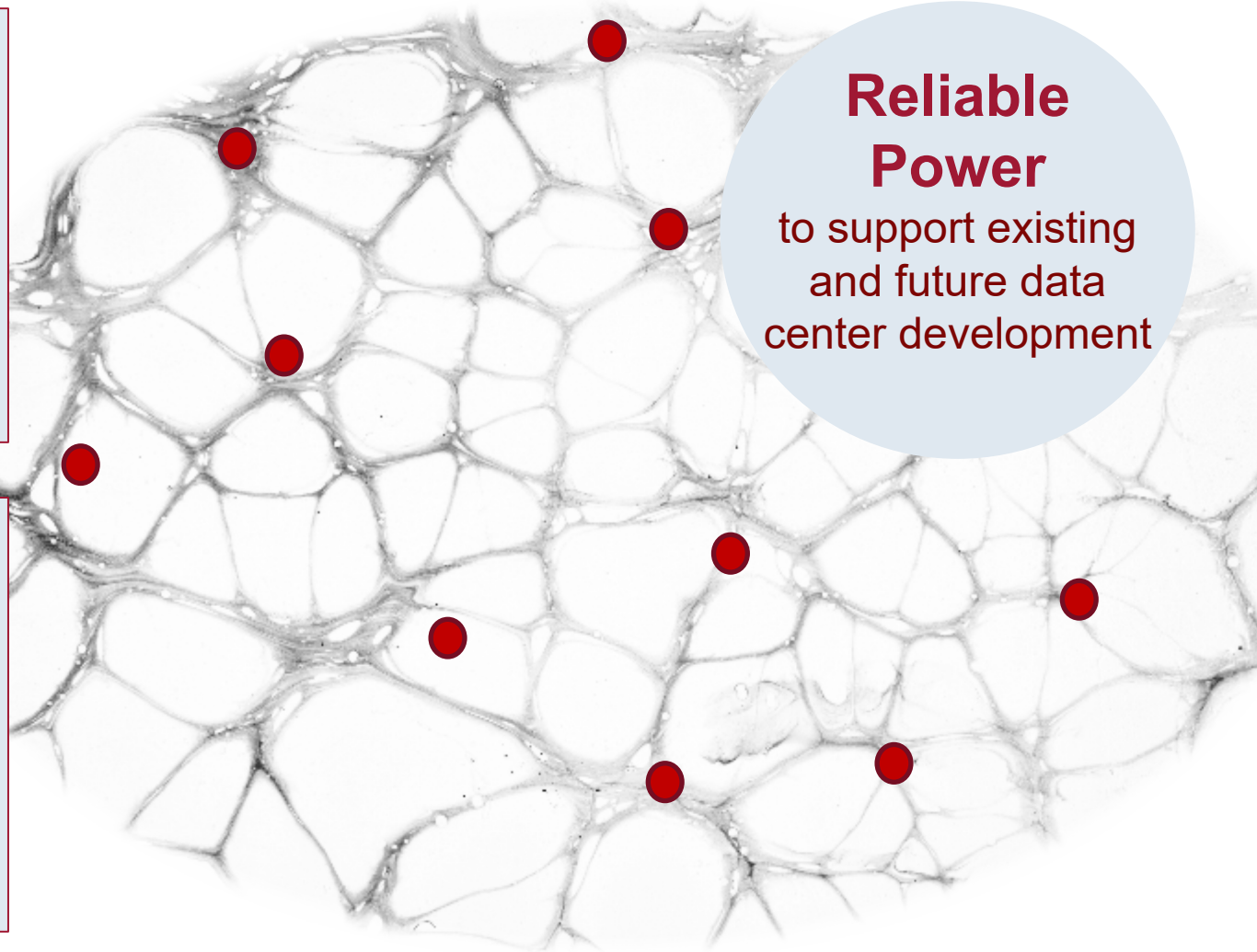
Leaders in the data center industry are moving towards net-zero carbon emissions.

Meta (Facebook's parent company), Microsoft, Google, and Amazon plan to power 100% of their future data center operations with some form of carbon-free energy.

**Reliable
Power**
to support existing
and future data
center development

Supporting data centers is a priority for Dominion Energy. This segment accounts for 20% of the electricity sold by the utility. Dominion Energy has connected 69 data centers with 2,637 MW of capacity since 2019 (which is equivalent to 659,000 residential homes).

Dominion has enough generation to meet Northern Virginia's expanding data center demand. But new data centers require new transmission infrastructure. This requires local permitting which takes time with many variables out of Dominion's control.

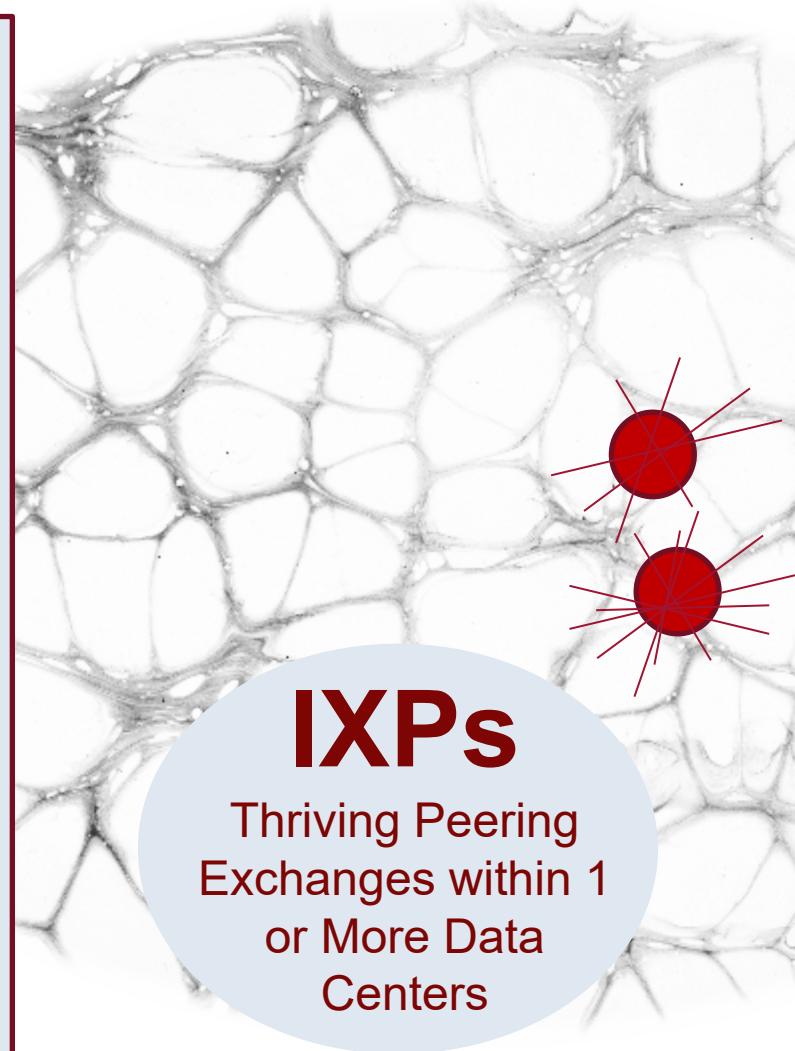


Visualizing an Interconnection Hub

IXPs

IXPs (Internet Exchange Points) are a "fabric" of Ethernet switches within one or more data centers. They provide a platform for interconnections between networks.

A few IXs (Internet Exchanges) offer services for free, but most charge a monthly port fee. Some larger exchanges charge a one-time membership or registration fee as well. Traffic exchanged on the peering platform is free. Along with transit from larger carriers, free peering between networks is an essential means of growing the internet itself. Optimal IX connectivity is physically provisioned on a local level, where networks can peer with virtually non-existent latency.



IXPs

Thriving Peering Exchanges within 1 or More Data Centers

Continued . . .

Local networks rely on bigger networks to get to the internet. IXs allow them to supplement some of this dependence by exchanging free traffic directly with each other. And IXs make the process of setting up peering connections much faster. As more networks join the exchange, connect to each other, and exchange traffic, momentum builds. More networks join as they see their peering possibilities grow. As members and traffic build, major carriers, CDNs, cloud, and content providers start to join as well, and a thriving local ecosystem develops.

Example: Richmond region has a distributed IX called DE-CIX Richmond in three separate data centers – three separate IXPs.

The more interconnected a market is, the more likely a content provider (Microsoft, Facebook-Meta, Netflix) will store their content on local cache servers that local carriers connect with. This benefits local businesses and consumers as access to Google, Microsoft, Facebook accounts are local, not long distance to Ashburn or Atlanta.

Visualizing an Interconnection Hub

Cloud Infrastructure

The world increasingly runs on the cloud: applications and computing platforms that are run by third parties and accessed on-demand. These platforms are so critical that the market for network and data center investment is increasingly driven by Amazon, Microsoft, and Google.

These companies [deploy cloud resources where they perceive localized internetworking growth to demand such investment](#). When they deploy cloud on-ramps in areas it's a sign that this is an increasingly important interconnection node and a place where they need to provide optimal localized access to the cloud.

Cloud deployments generally take two basic forms:

On-ramps: These are [locations offering dedicated access to the biggest cloud service providers](#). These access points allow customers and partners to quickly interconnect to nearby cloud regions.

Regions: These are full localized deployment by cloud providers. For the largest cloud providers, a region consists of [at least one localized zone with multiple dedicated data centers](#). This is a heavy investment in the local market and solidifies that market as a high-priority interconnection node for cloud services.



Cloud Infrastructure

How Does a Local Market Attract Cloud Infrastructure?

Simply put – by prioritizing and fueling the growth of the local interconnection market.

Encourage local network storage: large enterprises, government agencies, universities, networks, co-locating with each other in local data centers.

Encourage local network interconnection: growth of local network membership (such as at DE-CIX Richmond) and *growth of traffic* at the exchange (and ideally at other exchanges in the region too). *(DE-CIX is singled out for now because it's basically all that is available today).*

As we get a critical mass of large enterprise/other network infrastructure in the megaregion, they will need dedicated on-ramps to their cloud services and will leverage demand to get those deployments.

Encourage the network ecosystem as it grows to get onramps. No single entity or advocacy group can do it on their own. **Cloud will come when the local market demands it.**

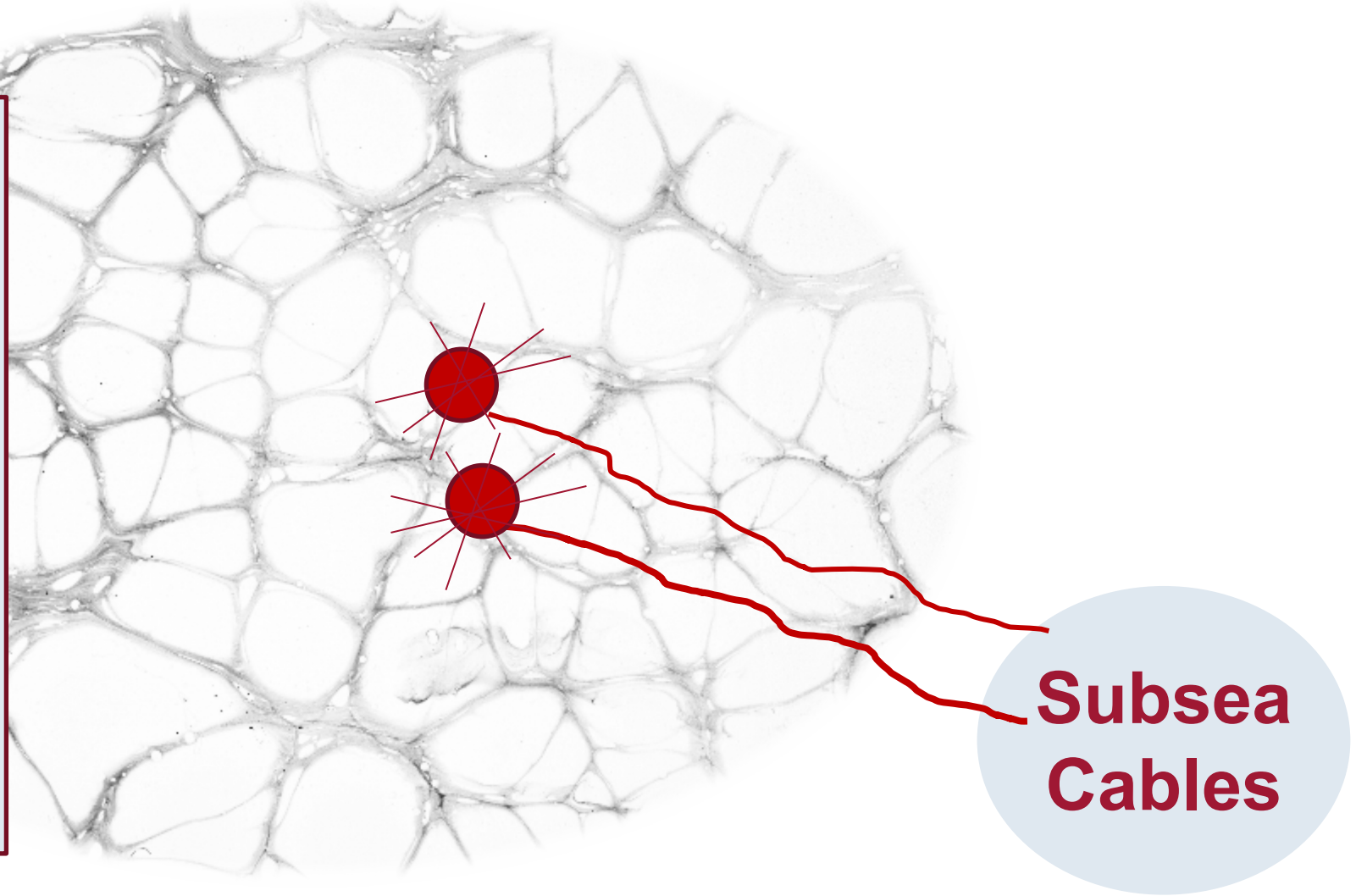
Visualizing a **Global** Interconnection Hub

Subsea Cables

99.7% of all intercontinental internet traffic is carried on subsea cables. Hyperscalers (the largest content producers such as Google, Meta, Microsoft and Amazon) are major investors in some of the newest, fastest subsea cables.

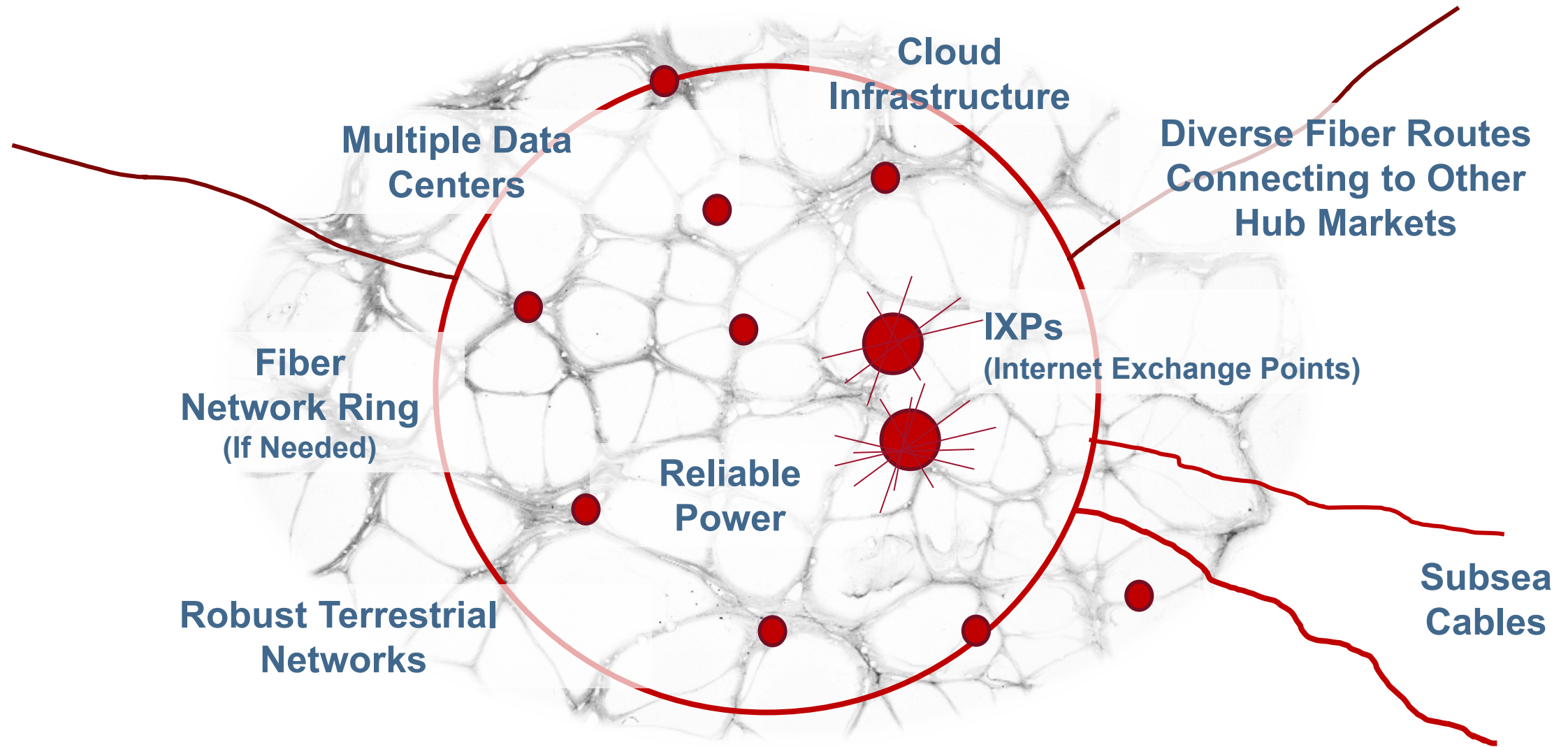
Three subsea cables come into Virginia Beach today, connecting the I-64 Innovation Corridor to Europe and South America.

It is estimated that 10-plus new cables will be added to the East Coast over the next 10 years.



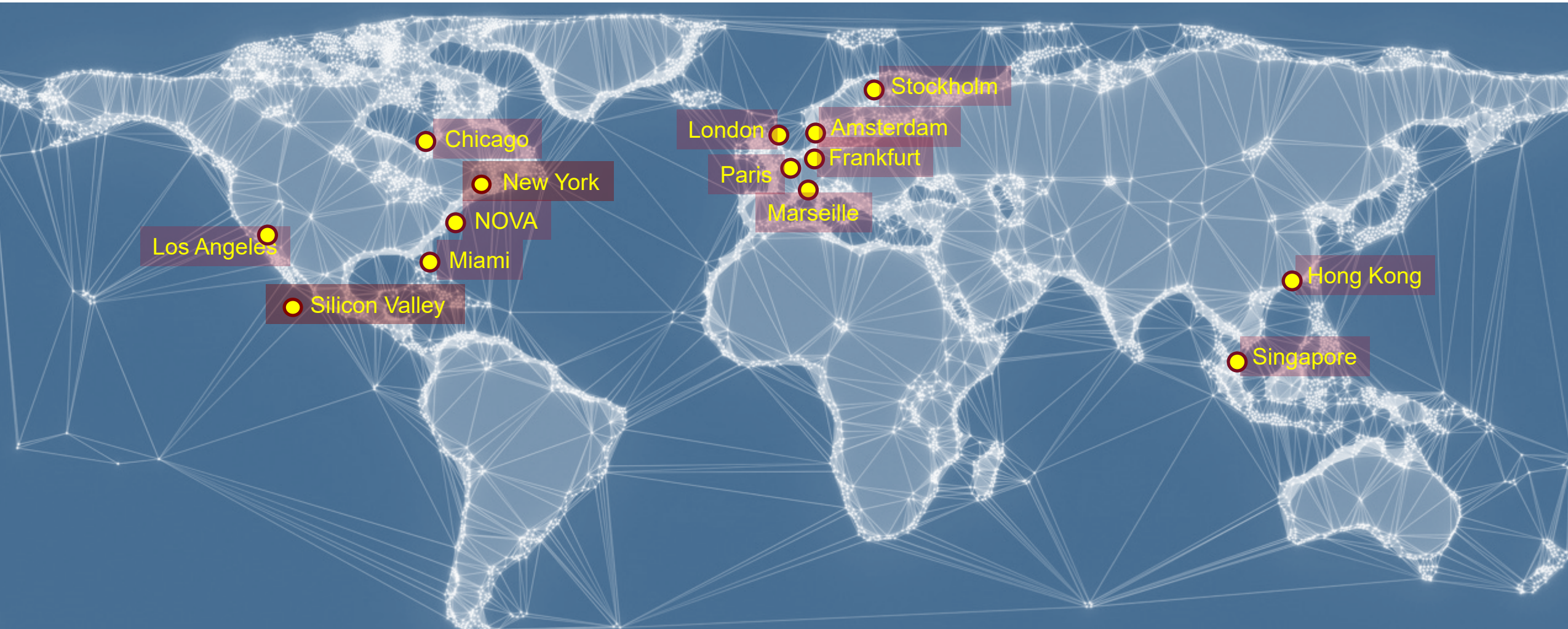
**Subsea
Cables**

Visualizing a **Global** Interconnection Hub



Recognized Leading Global Interconnection Hubs

 TeleGeography International research firm that tracks the development of global interconnection hubs





Why Being a GIH Is Important



7

Reasons Why a World-class
Regional Digital Infrastructure
Matters for the I-64 Innovation Corridor
(Richmond and Hampton Roads)

7. Being a GIH Will Build Higher Paying Jobs

Supports the Fastest Growing Jobs



The National Landscape: Top 10 Fast Growing Jobs

OCCUPATION	GROWTH RATE 2021-31	MEDIAN ANN PAY
Nurse Practitioners	46%	\$120,680
Wind turbine service technicians	44%	\$56,260
Ushers, ticket takers	41%	\$24,440
Motion picture projectionists	40%	\$29,350
Restaurant cooks	37%	\$30,010
Data scientists	36%	\$100,910
Athletes and sports competitors	36%	\$77,300
Information security analysts	35%	\$102,600
Statisticians	33%	\$95,570
Referees/sports officials	32%	\$35,860

Hypothesis



U.S. regions (MSAs) with a growing digital infrastructure have a similar growth in tech talent-related jobs.

(Correlation, not causality)

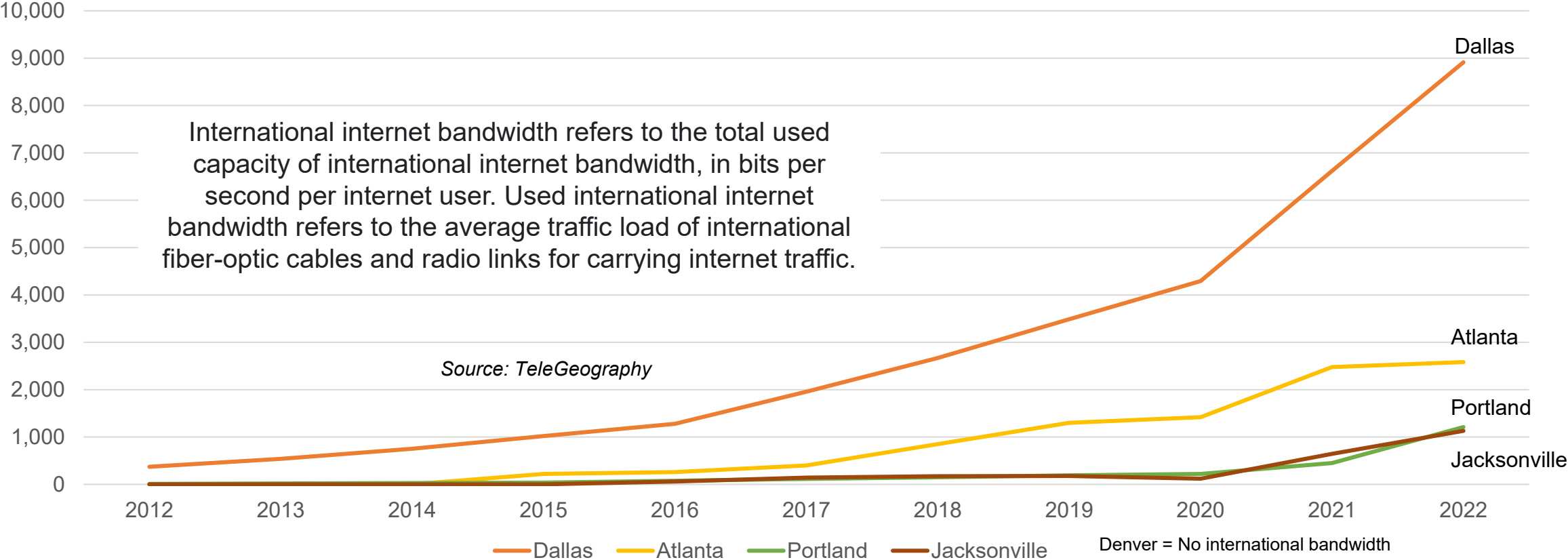
Research Process

- TeleGeography and InterGlobix identified the 5 top regions (MSAs) in the U.S. known for significant digital infrastructure growth over the past 10 years. This list included:
 - Atlanta - Dallas - Denver
 - Jacksonville - Portland/Hillsborough
- TeleGeography provided digital infrastructure growth data for these digital hubs – annual stats over the past 10 years.
- SIR applied JobsEQ data on tech-related talent occupation growth for these digital hubs – annual stats over the past 10 years.

These Leading Digital Cities Have Increased Their International Internet Bandwidth Over the Past Ten Years



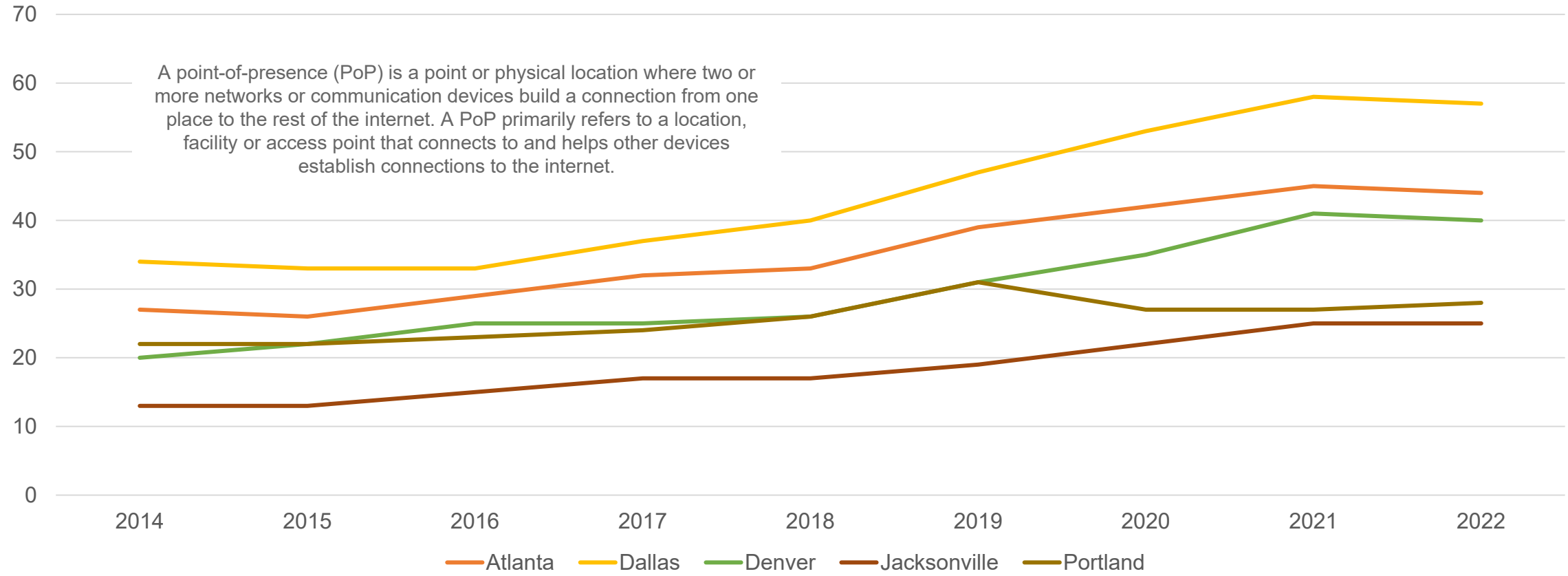
International Internet Bandwidth, Select U.S. Markets 2012-2022 (Gbps)



These Leading Digital Cities Have Increased Their Carrier PoPs in the Last 10 Years



Number of Carrier PoPs, Select U.S. Markets, 2014-2022



SOC Codes We Identified as “Tech Talent”

SOC	Occupation
15-1252	Software Developers
15-1232	Computer User Support Specialists
15-1211	Computer Systems Analysts
11-3021	Computer and Information Systems Managers
15-1299	Computer Occupations, All Other
15-1244	Network and Computer Systems Administrators
15-1253	Software Quality Assurance Analysts and Testers
15-1241	Computer Network Architects
15-1231	Computer Network Support Specialists
15-1212	Information Security Analysts
15-1251	Computer Programmers
15-1242	Database Administrators
15-1255	Web and Digital Interface Designers
15-1254	Web Developers
15-1243	Database Architects
15-1221	Computer and Information Research Scientists

Tech Talent:
Identified through an
analysis of most open
positions through
JobsEQ.

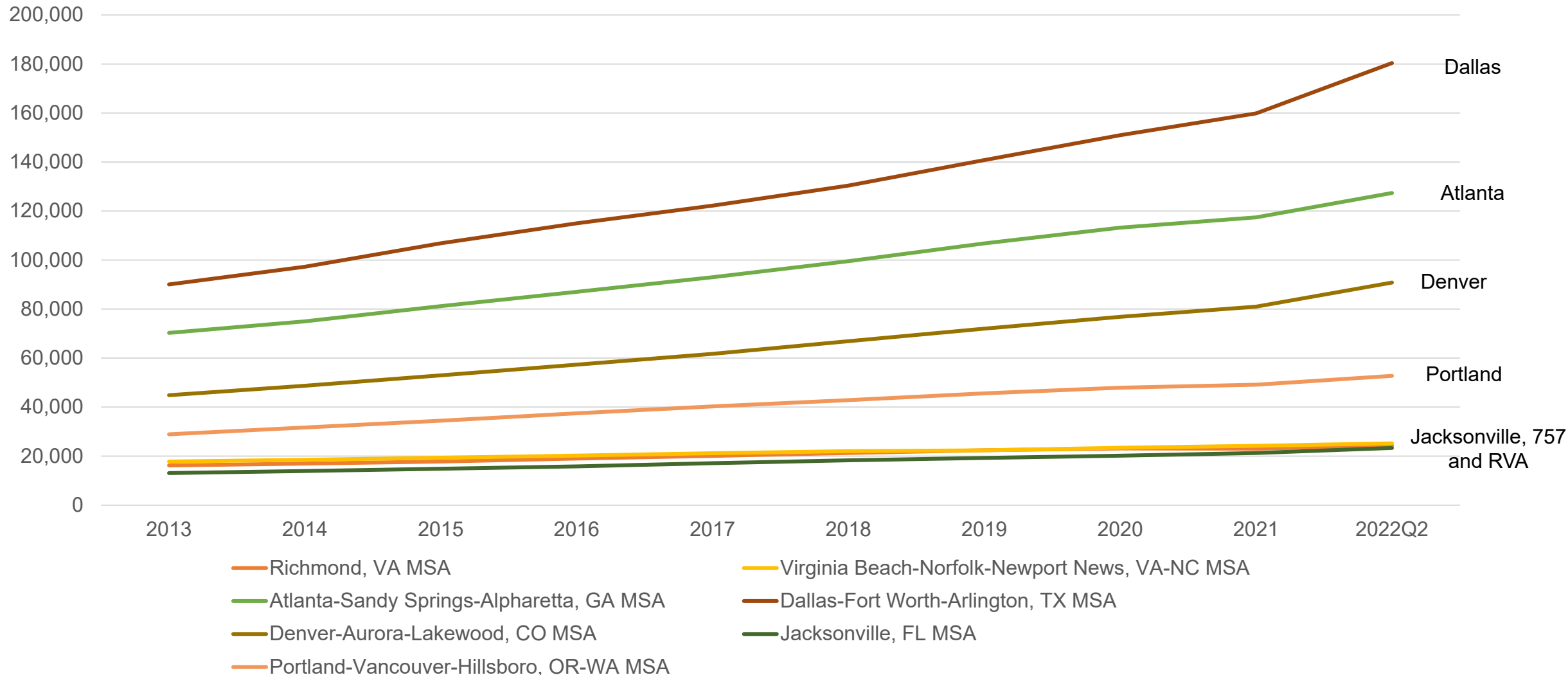
*Note that this is a VERY
tight list. We are not
including indirect or
induced jobs.*

Summary of 10 Year Growth in Tech Talent Occupations, 2013-2022

MSA	Total Jobs 2022	10 Year Annual Growth		Average 2022 Wages
USA	5,770,009	6.4%		\$111,400
Atlanta	129,922	6.9%	} 7.4% Average	\$113,000
Dallas	184,734	8.1%		\$109,900
Denver	93,017	8.3%		\$118,200
Jacksonville	23,878	6.7%		\$99,700
Portland	53,497	7.1%		\$112,400
Richmond	24,691	4.7%		\$107,700
Hampton Roads <small>(Virginia Beach/Norfolk)</small>	25,439	4.2%		\$103,700

The RVA-757 region is growing these jobs slower than the national average.

Other Regions Are Growing Tech Talent Jobs Faster Than Richmond (RVA) region or Hampton Roads (757) region



Over the Next 10 Years



The United States will need 2,285,932 Software and Web Developers, Programmers, and Testers (SOC 15-1250)

- 1,734,415 Software Developers
- 253,594 Software Quality Assurance Analysts and Testers
- 107,150 Web and Digital Interface Designers
- 97,310 Web Developers
- 93,463 Computer Programmers

Average 2022 salary: \$118,500

If Richmond and Hampton Roads Increase Tech Talent Job Growth Rate to the **National Average (6.4%)**



MSA	2022 Tech Talent Jobs	2032 Tech Talent Jobs (Projected)	Net Job Gain
Richmond (RVA)	24,691	45,915	21,224
Hampton Roads	25,439	47,306	21,867

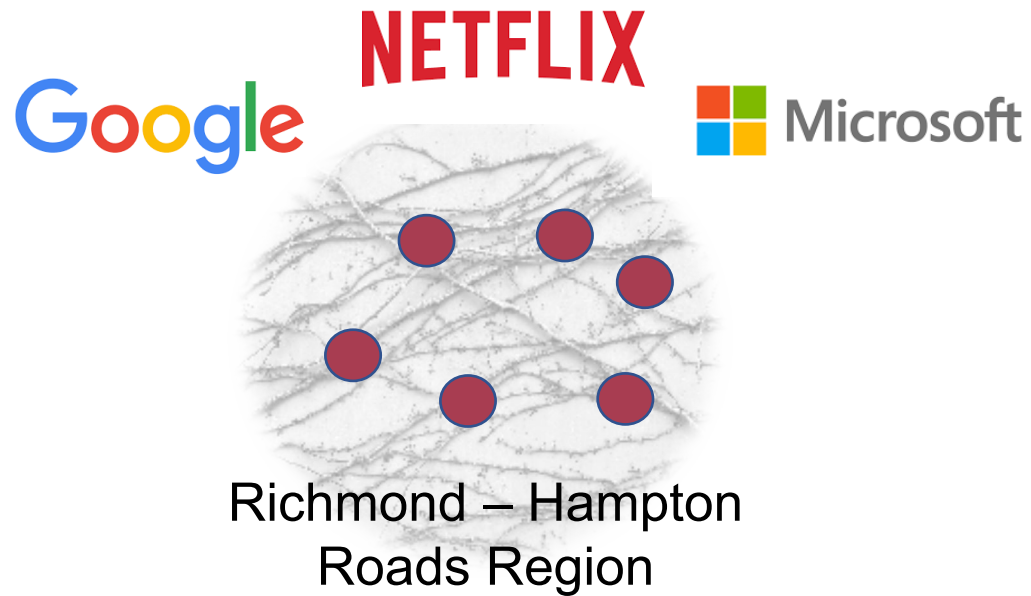
If Richmond and Hampton Roads Increase Tech Talent Job Growth Rate to the Average of 5 Digital Hubs (7.4%)



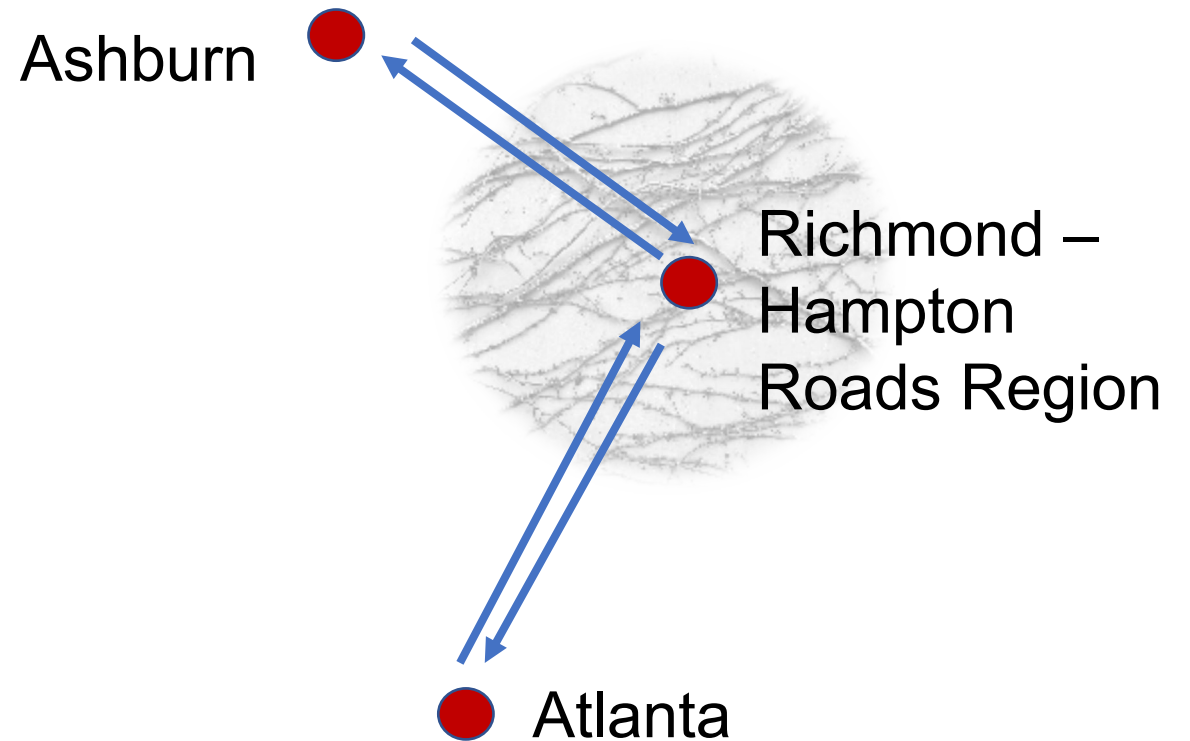
MSA	2022 Tech Talent Jobs	2032 Tech Talent Jobs (Projected)	Net Job Gain
Richmond	24,691	50,418	25,727
Hampton Roads	25,439	51,945	26,506

6. Provides Faster, More Reliable Service As a Competitive Advantage

With more robust the local infrastructure, the more content providers will store content on local cache (servers), consider on-ramps, and local investment.



The less mature a digital infrastructure is, the less likely content providers focus on the market.



5. Provides Additional Local Revenue

Loudoun County's total income from data centers is **\$650 million**. It's about 3% of the land base, providing over 30% of tax benefits.

"The thing that makes data centers great for us is that we're not bringing more people here. We're not building schools, we're not creating roads. We are not doing community services."

Buddy Rizer
Executive Director
Loudoun County Department of Economic Development

Contributes to Tax Base



For every \$1 in county expenditures that the data center industry caused, it generated:

Loudoun County

- \$15.10 in local tax revenue in Loudoun County
- Property taxes there would have had to rise by 21% without the data center-induced tax revenue.

Prince William County

- \$17.80 in tax revenue in Prince William County
- Property taxes there would have had to rise by 7% without the data center-induced tax revenue.

Data Center ROI: One Data Center = One corporate headquarters creating 1,700 jobs



- \$1 billion data center development.
- Generates upward of **\$200 million in total tax revenues** over a 10-year period.
- Plus, one-time construction phase and ongoing operations.
- This \$200 million fiscal impact is equivalent to a corporate headquarters creating 1,700 jobs with a \$130,000 average salary and making a \$40 million capital investment.

Source: CBRE Economic and Fiscal Impact Study

4. Supports Smart City Development

Improved public safety, mobility, government, health – everything.



Adtell Integration
Smart Cities Infrastructure - Adtell ...



TechTarget
What is a Smart City? Definition from ...



Skywell Software
What is a Smart City - Technologies ...



ARC Advisory Group
Technology Research for Smart Cities ...



Wikipedia
Smart city - Wikipedia



CIS Center for Internet Security
Smart Cities Need Smarter Security



Ribera Solutions



IoT World Today

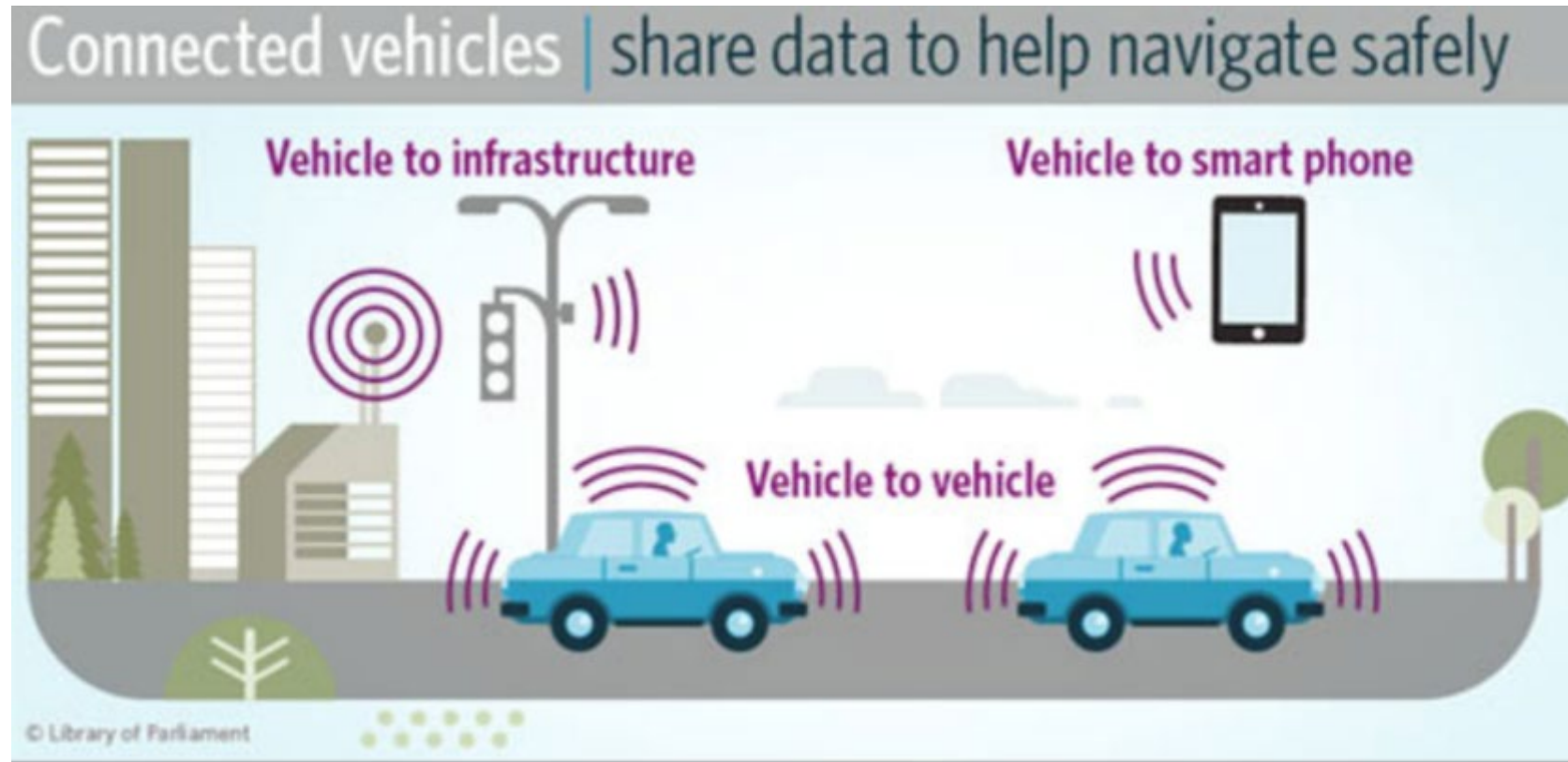


Cox BLUE

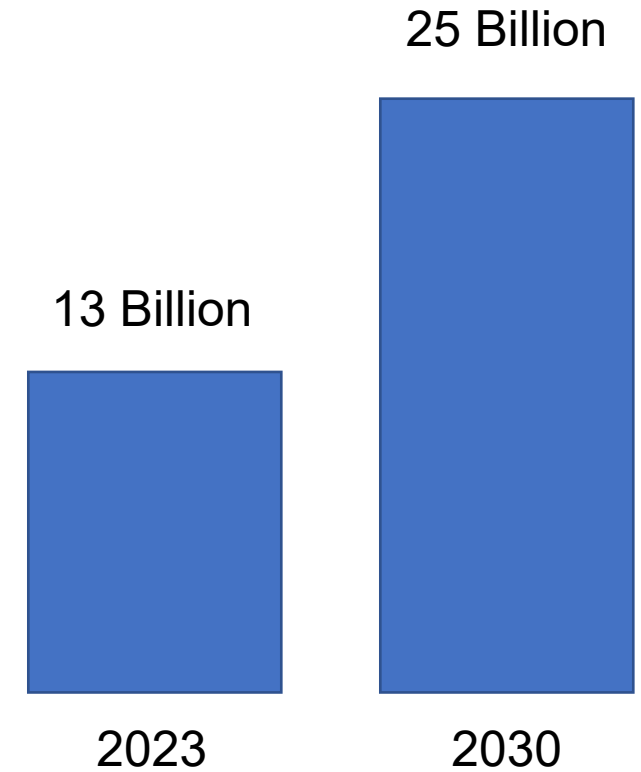
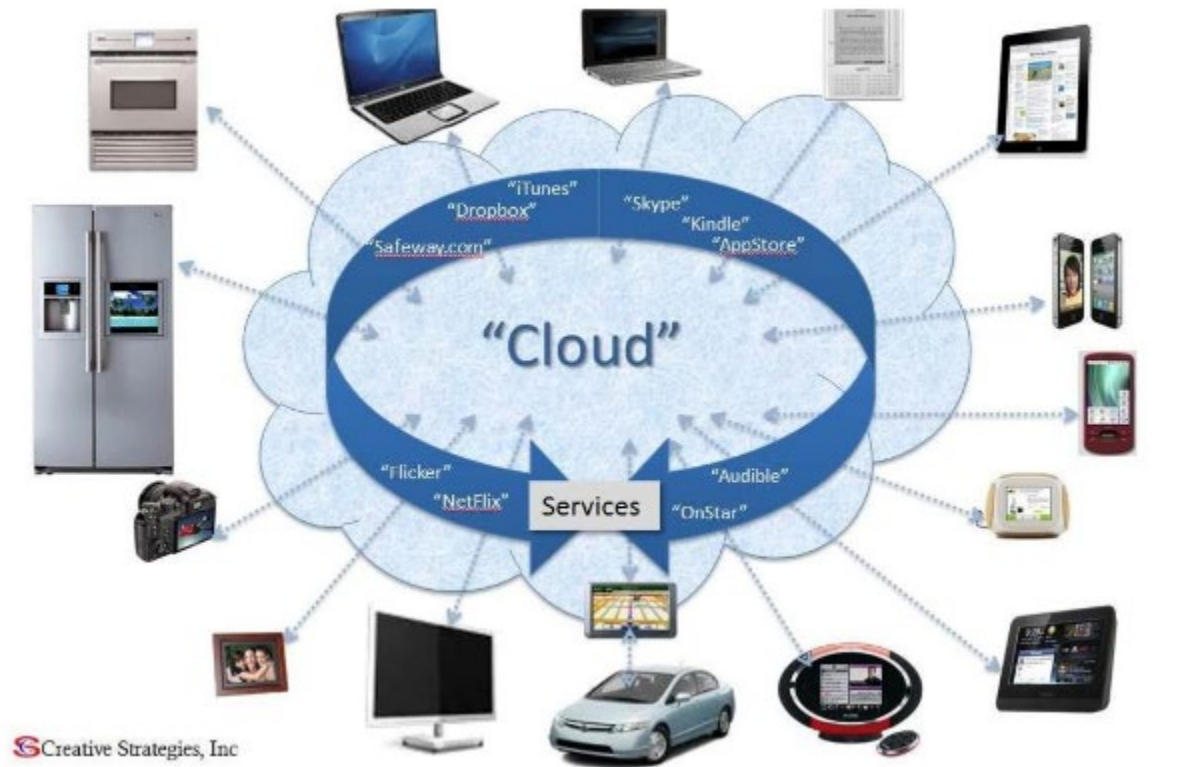
Everything is Connected:

- Energy
- Safety
- Transportation
- Healthcare
- Government
- Citizen engagement

This Includes the Coming Wave of Autonomous Vehicles



3. Supports Internet of Things Devices



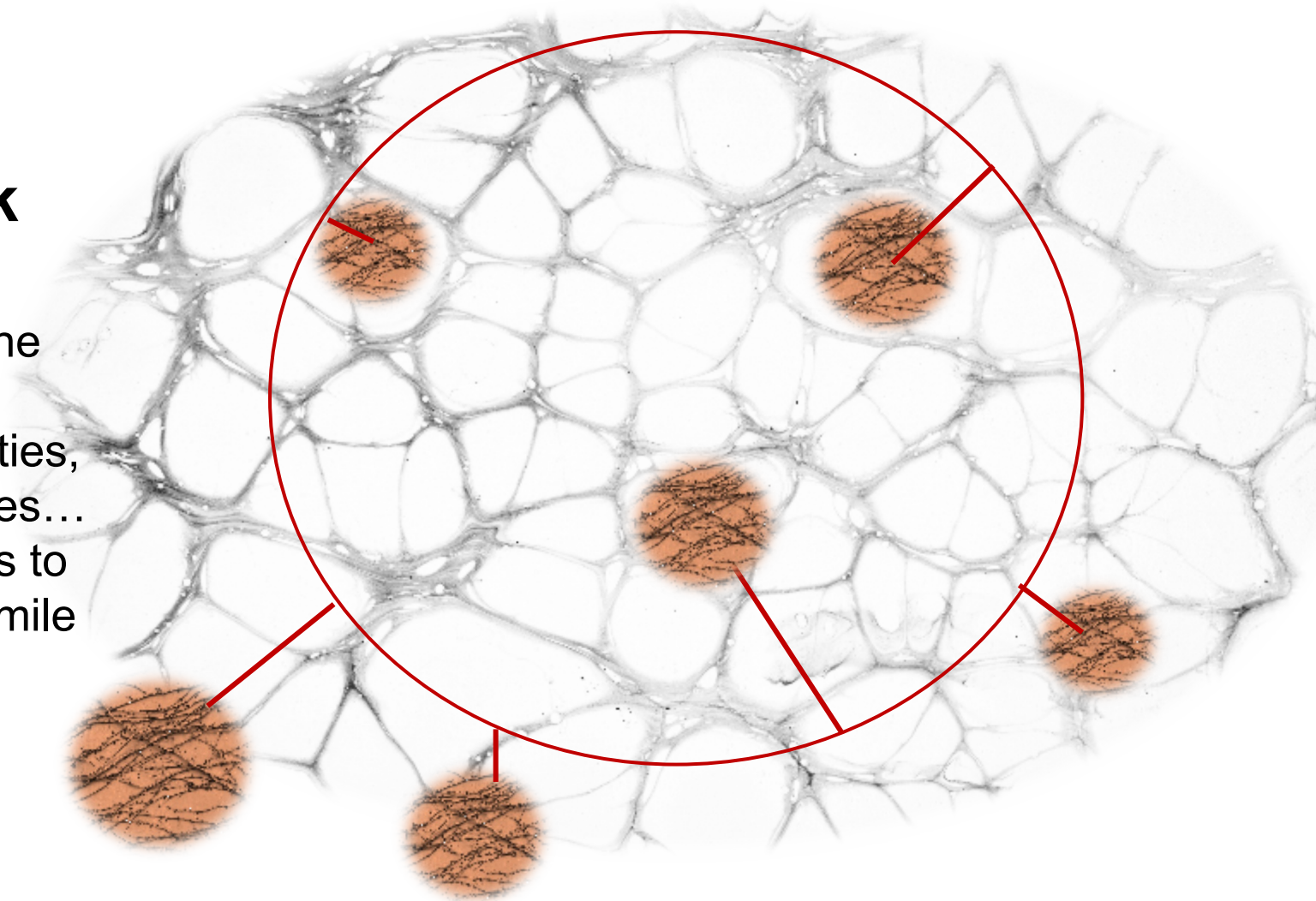
Any natural or man-made object that is embedded with sensors that are assigned an internet address and that transfers data coming from the sensors by connecting wirelessly via the internet to servers located in the Cloud.

Average from multiple sources

2. Serves Underserved Neighborhoods

Fiber Network Ring

to Connect the Region
Govt., universities,
large businesses...
easier for ISPs to
serve the last mile



Enables
more **ISPs**
to enter
and serve
the market
– the “**Last
Mile**” of
Service

1. Future-proofs a Community

Every “next generation” of technology adds new functionality, capacity, and performance, often by an order of magnitude.

In this industry, a generation is one to three years.

The leading-edge hub regions and users will have digital resources, tools, and capabilities that are not widely accessible to others – real-time massive data acquisition / analytics, use of augmented intelligence and creation of new, highly beneficial knowledge.

All of this will drive the winning cities of tomorrow – future economic growth and prosperity.

For a Growing Number of Industries, Faster and More Reliable Service Will Be a Competitive Advantage

70%

of new value created in the economy over the next decade will be based on digitally enabled platform business models.





How we will become a Global Internet Hub



Our GIH Strategic Plan's Vision

Unprecedented public-private partnership and digital infrastructure industry coordination that makes Virginia's I-64 Innovation Corridor a Global Internet Hub (GIH), the digital backbone and spark that transforms the Richmond region and Hampton Roads into one of the world's most equitable and dynamic economies.

Our GIH Strategic Plan's Vision

1. PUBLIC-PRIVATE PARTNERSHIP

At its core, our GIH Strategic Plan is based on unprecedented public-private partnership to accelerate the buildout of the needed infrastructure to drive a 21st century growing economy.

2. DIGITAL INFRASTRUCTURE INDUSTRY COORDINATION

Around the world, intentional collaboration and coordination among digital infrastructure companies and investors is the hallmark of ascendancy into global hub status. Our GIH Strategic Plan galvanizes the I-64 Innovation Corridor's digital infrastructure players into a unified and well-coordinated force.

3. GLOBAL INTERNET HUB

Our GIH Strategic Plan is designed to get the I-64 Innovation Corridor's on the map of GIHs:

Northern Virginia Miami Chicago
Silicon Valley Los Angeles
London Paris Stockholm
Amsterdam Frankfurt
Marseille Hong Kong
Singapore
Richmond-Hampton Roads
(I-64 Innovation Corridor)

Unprecedented public-private partnership and digital infrastructure industry coordination that makes Virginia's I-64 Innovation Corridor a Global Internet Hub (GIH), the digital backbone and spark that transforms the Richmond region and Hampton Roads into one of the world's most equitable and dynamic economies.

4. TRANSFORMATIVE

The Richmond and Hampton Roads economies are underperforming. We are behind our peer cities in terms of population growth, talent growth, GDP, productivity per worker, and wage growth. Our GIH Strategic Plan is bold and ambitious because that is what's needed to change our regions' economic trajectories.

5. RICHMOND – HAMPTON ROADS REGIONS TOGETHER

Our GIH Strategic Plan is based on the informed perspective that it takes the digital assets from both markets combined and working together to make us a true Global Internet Hub. Our plan calls for an integrated approach, one that makes us a world model and one that is starting to garner international attention.

6. EQUITABLE & DYNAMIC

Our GIH Strategic Plan is focused on the needed backbone and spark to ignite a growing economy defined by start ups, growing talent pool, business growth, and expanded higher-paying employment opportunities for all.

Our Strategic Framework

How we are organizing the presentation of the GH Plan's recommendations.

Bringing It All Together: What we have learned to date about *being... or becoming...* a global interconnection hub (aka GIH)



**To Become a
GIH, Regions
Must Perform
Well on these
10 Defining
Characteristics**



1. Robust internet networks – local and routes connecting other hub markets
2. Regional fiber network rings (if needed for local network)
3. Growing number of local data centers
4. Reliable and inexpensive power
5. IXPs – Internet Connection Points
6. Served by subsea cables
7. Growing tech-savvy workforce
8. Awareness and support among local stakeholders
9. Awareness among the global digital infrastructure community
10. Buzz and momentum

I-64 Innovation Corridor's GIH Strategic Plan Goals

I-64 Innovation Corridor's GIH Strategic Plan Goals:

1. Make Equity a Primary Goal.
2. Serve All Communities in the Corridor.
3. Generate Local Jobs and Local ROI.

We deliver on equity in two ways: 100% broadband access to ALL neighborhoods and access to good higher-paying jobs.

100% Access: It is vital to get carrier networks actively peering in Richmond and Hampton Roads, rather than in Ashburn in Northern Virginia. This, in turn, will lead to more data centers, more peering, more cloud, and more content interacting locally.

More local activity leads to a more competitive market where ISPs of all sizes and capitalization come to a market and serve the last mile, connecting to underserved neighborhoods.

The Hampton Roads community determined that a Fiber Network Ring was needed for their community. (*This may not be the case for RVA but should be examined*). One of the anticipated advantages of the 757 ring is the accelerated development of the local digital infrastructure. GTS, the fiber ring operator hired by the Southside Broadband Network, is now contractually incentivized to serve underserved neighborhoods by contracting with an expected increasing number of local Internet Service Providers (ISPs) who can now afford to install “the last mile of service” to underserved neighborhoods by directly connecting to the ring.

Good Higher-paying Jobs: Growing digital infrastructure creates jobs. Local training and development provides the employment pathways.

10 Strategic Imperatives

GIH Steering Committee's recommendations.

Our 10 GIH Strategic Plan Strategies

I-64 Innovation Corridor's GIH Goals:



1. Make equity a primary goal.
2. Serve all communities in the corridor.
3. Generate local jobs and local ROI.

1. Support the growth of robust internet networks – local and routes connecting other hub markets.
2. Explore the potential of the I-64 Innovation Corridor Network Ring from Hampton Roads to Richmond.
3. Encourage a growing number of local data centers.
4. Support reliable and inexpensive power and local transmission permitting.
5. Encourage the growth of IXs and IXPs.
6. Attract additional international subsea cables.
7. Ensure there is a growing tech-savvy workforce.
8. Increase awareness, familiarity, and support among local stakeholders for a growing digital infrastructure.
9. Increase international awareness among the global digital infrastructure community and investors.
10. Build momentum for all of this through an organized and united industry.

1. Support the growth of robust local internet networks and routes connecting other hub markets.

Current State of I-64 Innovation Corridor

The I-64 Innovation Corridor has established local terrestrial networks and routes connecting the region to other hub markets.

While existing networks are in place, some of the more rural portions of the megaregion still lack broadband access.

Desired Future State of I-64 Innovation Corridor

Make the I-64 Innovation Corridor the home to the most robust and growing local network. Ensure 100% broadband access to all residents across the entire megaregion.

Related Notes for the Steering Committee's Discussion

There are two recommendations for the GIH Strategic Plan to help ensure the I-64 Innovation Corridor is home to the most comprehensive local network:

1. To the extent possible, create a comprehensive inventory of established and planned networks. Publish and share this inventory on a regular basis with the local digital infrastructure industry leaders to ensure the development of the network is keeping up with market demand and anticipated future needs.
2. As part of the implementation plan, better understand the value of satellites as part of the I-64 Innovation Corridor's future regional digital infrastructure and intercity connections to other city hub connections. This exploration will take into account the fundamental characteristics of both terrestrial and satellite systems. Terrestrial networks can deliver high data rates, satellites can expand coverage over broad areas. Will the future include combining the advantages of both network types – an integrated satellite-terrestrial network architecture? Is this important for the upcoming 6G demand and ubiquitous market coverage that ensures universal internet access and support for the Internet of Things (IoT)? This is a topic for the GIH Steering Committee in its post-strategic plan life (see strategic imperative No. 10 later in this document).

2. Explore the Potential of the I-64 Innovation Corridor Network Ring from Hampton Roads to Richmond.

Current State of I-64 Innovation Corridor

Five cities in the Hampton Roads region have invested in a municipal fiber network ring that will eventually connect 17 localities providing faster, less expensive internet service for residents and businesses and service to underserved neighborhoods.

Desired Future State of I-64 Innovation Corridor

Potentially link the Hampton Roads and Richmond regions with an unprecedented loop network that will position the I-64 Innovation Corridor as one of the most robust, connected networks on the planet. Consider linking Hampton Roads' Ring with the Eastern Shore to advance the Shore's economic development (NASA's Wallops Island).

Related Notes for the Steering Committee's Discussion

Regions are effectively connected through a competitive mix of carriers with deep fiber access along with backbone services. In some markets, a municipal fiber network ring serves as an additional interconnection access resource.

Municipal rings loop around a region, connecting business centers, government centers, universities and colleges, workforce training facilities and underserved neighborhoods. The ring often affords more last mile service of underserved communities through ISPs. Additional benefits of rings include municipals' need for safety, smart cities support, and/or security.

A growing number of regions, like Hampton Roads, are investing in municipal fiber network rings. Five cities in the Hampton Roads region have invested in a fiber network ring that taps into the subsea cables. Eventually, this network ring will connect 17 localities. The ring is a public-private partnership between the Southside Network Authority and Global Technical Systems (GTS), which is leasing 96 stands of the 288 stands in the open-access fiber-optic network. Each city owns 6 stands. The ring is expected to attract new internet service providers, lowering prices and increasing speeds for residents and businesses. GTS has the rights to lease more stands if it meets goals of connecting underserved neighborhoods across the 757. ISPs are already entering the market to participate.

The Hampton Roads fiber network ring is estimated to cost \$107M when fully constructed: Southside: \$25M, Peninsula: \$45M; 757 outer counties: \$37M. The Southside portion is fully funded, and construction has started.

Fully appreciating that a municipal fiber ring is determined on a case-by-case basis by the jurisdictions in each market, the GIH Steering Committee recommends that the Richmond region jurisdictions thoughtfully examine this topic. Should it be included in our state funding requests?

In addition, the GIH Steering Committee recommends exploring the benefits of major corridor-long loop. We envision connecting Virginia state government's digital infrastructure in Richmond with institutions of higher education, NASA's Langley Research Center, Jefferson Lab, the Virginia Port Authority, Rocket Lab and all of the high-growth industries of tomorrow (Cyber, Logistics, Data, and Life Sciences/Pharma). This loop would build on and connect to the Hampton Roads fiber network ring and the Eastern Shore network, including Virginia's growing Rocket Lab launch facility and related R&D.

The I-64 Innovation Corridor Mega Loop Ring Network would position the I-64 Innovation Corridor as one of the most robust, interconnected regional networks in the world, another proof-point on why we are a GIH.

The I-64 Innovation Corridor Mega Loop Ring Network would also ensure broadband access to every resident in the 8,000-square-mile megaregion, making the last mile of service possible even in the most rural areas of megaregion.

An example of what the I-64 Innovation Corridor Mega Loop Ring Network could look like is Quantum Loophole's (QLoop) 40-mile hyperscale fiber ring linking data center development in Maryland with Northern Virginia's Data Center Alley: <https://quantumloophole.com/qloop/>

Next Steps:

- Help the 757 region obtain the remaining funds to complete their planned ring.
- Support RVA leaders – cities and counties – if they want to examine the need for a local RVA ring.
- Explore the concept of an the I-64 Innovation Corridor Mega Loop Ring Network connecting the assets of the I-64 Innovation Corridor from Richmond to Wallops Island.

3. Encourage a growing number of local data centers.

Current State of I-64 Innovation Corridor

The I-64 Innovation Corridor is highly connected to Loudoun County and Northern Virginia’s “international data center alley”. Northern Virginia has 151 data centers. The I-64 Innovation Corridor megaregion has 14 data centers. Loudoun is experiencing some headwinds. The future data center market in Virginia is going to be diverse.

Desired Future State of I-64 Innovation Corridor

Make the I-64 Innovation Corridor **THE** extension of the NOVA worldwide data center market. Collaborate and coordinate with NOVA to achieve a broader positioning goal for I-64 Innovation Corridor on a global scale. Position the I-64 Innovation Corridor as the East Coast’s digital port to Europe and South America and beyond.

Related Notes for the Steering Committee's Discussion

The I-64 Innovation Corridor is highly connected to Loudoun County and Northern Virginia's "international data center alley." Northern Virginia has 151 data centers. The I-64 Innovation Corridor megaregion has 14 data centers (Source VEDP).

Several factors are creating a tremendous opportunity for the I-64 Innovation Corridor's data center growth:

- The price of land. Land prices are substantially cheaper in the megaregion (from \$100,000 to \$150,000 per acre) compared with Loudoun County (recent transactions have touched about \$4 million per acre).
- NOVA transmission lines which are locally permitted are not being approved as fast as they are needed.
- Some NOVA residents are protesting data centers.
- There's significant movement in the data center industry to diversify and develop smaller markets.
- Amazon's announcement of \$32B in data centers in Virginia – locations TBD.
- Microsoft and Meta's data center expansion plans in Virginia.
- The number of available sites in the I-64 Innovation Corridor.
- The latest studies show positive ROI of data center incentives in the Commonwealth and localities.
- The Richmond area is attracting the attention of the data center world, according to a CBRE national report. The region has seen increased data center activity due to challenges with power delivery and site availability in other markets. "Richmond is a highly connected and cost-effective location for enterprise and hyperscale customers."

Make the I-64 Innovation Corridor THE extension of the NOVA worldwide data center market. Coordinate with NOVA to achieve a broader positioning goal for Virginia on a global scale. Given the subsea cables routes to and from Virginia Beach, position the I-64 Innovation Corridor as the East Coast's digital port to Europe and South America.

Next Steps:

- Create a collaborative action plan with NOVA.
- Support the Alliance and GRP in inventorying and packaging the viable data center sites in the I-64 Innovation Corridor. Ensure all options are listed like Naval Air Station Oceana's intention to place 1,000 acres of property back into the public stream of commerce for potential data center development.
- Make this inventory available to potential investors.
- This includes packaging the corridor's megasites as potential Mecklenburg/Microsoft-like data center operations complexes for Amazon and others. Use the Frederick County Maryland QLoop as the example of a 21st century megasite approach (<https://quantumloophole.com/qloop/>). The Alliance's study of the top 10 data center sites in Hampton Roads is expected to be completed in March 2023.
- Support VEDP's, GRP's, Alliance's, and local economic development agencies' digital infrastructure plans for any and all sites.
- Help VEDP eliminate the 2035 statewide sales tax sunset law on data center equipment. The looming 2035 deadline is already being discussed by digital data center leaders. Let's take it off the table.

4. Support reliable and inexpensive power and local transmission permitting.

Current State of I-64 Innovation Corridor

Data centers are one of the most energy-intensive structures. Data Center operators and investors are becoming increasingly concerned about the availability of reliable of power.

Desired Future State of I-64 Innovation Corridor

Dominion Energy has enough generation to meet Virginia's expanding data center energy demand. Turn the global digital infrastructure industry's increasing use of and concern about energy availability into a major advantage for the I-64 Innovation Corridor.

Related Notes for the Steering Committee's Discussion

Data centers are one of the most energy-intensive structures. For every one input of data, five other inputs are produced, relaying the information to other data centers. This requires substantial electricity to keep the systems running.

Supporting data centers is a priority for Dominion Energy. This segment accounts for 20% of the electricity sold by the utility. Dominion Energy has connected 69 data centers with 2,637 MW of capacity since 2019 (which is equivalent to 659,000 residential homes).

Dominion has enough generation to meet Northern Virginia's expanding data center demand. But new data centers require new transmission infrastructure. This requires local permitting which takes time and many of the permitting variables are out of Dominion's control.

The data center industry also wants to use carbon-free energy. Meta (Facebook's parent company), Microsoft, Google, and Amazon each plan to power 100% of their data centers' long-term future operations with some form of carbon-free energy.

Turn the global digital infrastructure industry's rising concern into a major advantage for the I-64 Innovation Corridor.

Given that the I-64 Innovation Corridor has rural areas between the major urban hubs, adding transmission lines should not be a significant challenge.

Support the permitting of transmission lines to viable data center locations. Work with Dominion Energy to map the most logical extensions of transmission service lines to viable data center megasites in the I-64 Innovation Corridor. Work with these locations now to permit these designated locations.

Package and advance Meta's success in eastern Henrico where Meta-contracted projects will add 850 MW of new renewable energy in Virginia.

5. Encourage the growth of IXs and IXPs – Internet Exchanges and Internet Connection Points

Current State of I-64 Innovation Corridor

The Richmond region has one IX (DE-CIX) at three IXP (locations). The Hampton Roads region does not have an IX – *yet*.

Desired Future State of I-64 Innovation Corridor

The desired future state is for the 757 region to have its first IX and IXPs (and additional ones as well) and for the Richmond region to have an additional IX and more IXPs.

Related Notes for the Steering Committee's Discussion

One of the keys to a robust digital infrastructure is having Internet Exchanges (IXs) at Internet Exchange Points (IXPs). IXPs are also called a Network Access Point (NAP).

IXPs are a "fabric" of Ethernet switches within one or more big data centers. They provide a platform for interconnections between networks.

Local networks rely on bigger networks to get to the internet. IXs allow them to supplement some of this dependence by exchanging free traffic directly with each other. And IXs make the process of setting up peering connections much faster. As more networks join the exchange, connect to each other, and exchange traffic, momentum builds. More networks join as they see their peering possibilities grow. As members and traffic ("eyeballs") build, major carriers, CDNs, cloud, and content providers start to join as well, and a thriving local ecosystem develops. More ISPs follow. This, in turn, enables service to underserved neighborhoods.

The Richmond region has one IX (DE-CIX) and three IXPs. The Hampton Roads region does not have an IX – yet. The GIH Plan will encourage and support investment in IX and IXP in the 757 region and additional IX and IXPs in Richmond.

Three paths are under consideration for the realization of an IXP in the 757: 1) Globalinx is working toward becoming a full IXP and expects to have one in 2023. 2) PointOne expects to get funded in 2023 to build a data center in Virginia Beach that it expects would have an IXP. 3) Other potential developers are looking to build data centers that would have the capability of having an IXP.

There is a significant opportunity for universities and colleges in the I-64 Innovation Corridor to get connected to an IX. This will result in better performance of internet traffic for the institutions and also give the universities/colleges direct access to all the networks connected to the IX. By definition of a "distributed" IX, anytime the IX platform is extended to a region/industry, anyone connected to the platform instantly gets access to all the networks that are already on the IX platform (regardless of the location they are connecting from).

The growing number of local student "eyeballs" will attract and encourage international content providers and investors to focus on the I-64 Innovation Corridor, fueling the region's digital infrastructure success cycle.

6. Attract additional international subsea cables.

Current State

of I-64 Innovation Corridor

Virginia Beach has three subsea cables in operation today serving Europe and South America. These are three of the fastest, most advanced cables serving the East Coast.

Desired Future State

of I-64 Innovation Corridor

Attract three to four more cables in the next 10 years. Make our region the East Coast digital gateway to Europe and South America and beyond with the fastest and largest bandwidth capacity on the East Coast.

Related Notes for the Steering Committee's Discussion

The presence of subsea cables is directly tied to a region's importance to the world's global internet infrastructure. Subsea cables provide the fastest direct connection between continents.

Hyperscalers (Google, Meta, Microsoft, Amazon) are major investors in subsea cables. In some cases, they privately build their own systems. Hyperscalers will often swap fiber pairs with each other and with carriers on one another's systems.

One subsea cable that crosses the Atlantic costs approximately \$150M-\$200M (\$40K per mile).

TeleGeography's international expert on subsea cables has shared key insights about our situation related to attracting more subsea cables:

1. The fourth cable from Virginia Beach to South Africa is not likely to happen in the next decade. The equipment and construction are not ordered. The first leg from SA to Asia will be first. There is not enough demand in SA to VB for this to make any sense.
2. Many of the legacy cables that go into the New York and South Florida regions are 20+ years old. They are becoming obsolete.
3. TeleGeography estimates that 10-12 new subsea cables will be built on the East Coast over the next 10 years.
4. Subsea cable investors want to diversify their landing sites within a region and between regions. Virginia has an opportunity to secure probably two or three of these new cables in the next 10 years.
5. TeleGeography's subsea cable expert has responded to our questions about the viability of cables running up Virginia's rivers and potential Eastern Shore landing sites. Going up any of Virginia's rivers is too shallow to be protected from boat anchors. Metal plates as a solution are too costly. This is not done anywhere in the world. Cables must be buried. The Eastern Shore does not serve hyperscalers' number 1 destination need – a mega data center site. You can't come across the Chesapeake Bay as cables would be at risk to boat anchors. The elevation is too low for a megasite.
6. Hampton Roads needs official protected channels from anchoring, aligned with the U.S. Coast Guard's and Virginia Maritime Association's mapping work.
7. The best way for the I-64 Innovation Corridor to attract additional new cables is to follow the Laguna Beach cable recruitment model – *"build it and they will come."* Get all approved permits for an additional landing site and speculatively build bore pipes out into the ocean. Get the largest players to approve the design. Make this turnkey.
8. TeleGeography reports that fewer than 35 people make decisions on all of the world's subsea cable planning investments. We can meet with these people with a definitive plan. Virginia Beach Economic Development would obviously be the lead in this effort.

Related Notes for the Steering Committee's Discussion

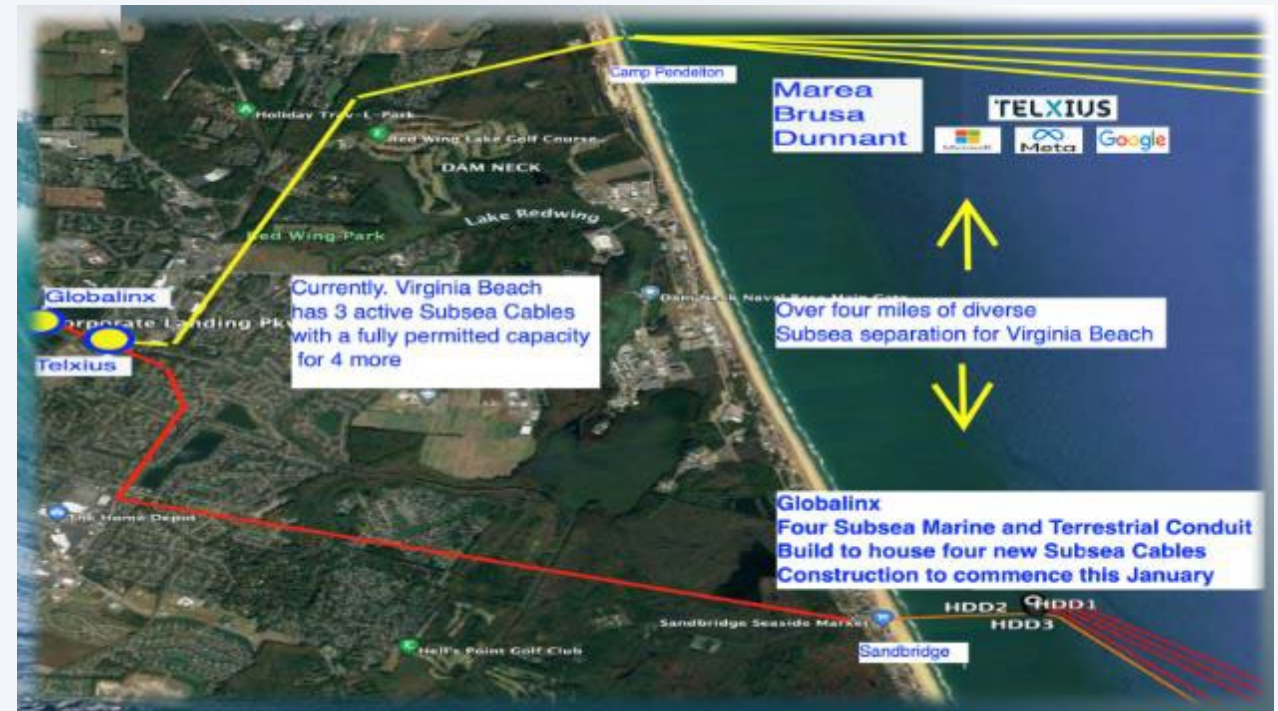
Globalinx in Virginia Beach is following the Laguna Beach “build it and they will come” spec model. Globalinx has received approvals from Virginia Beach and other agencies for a second subsea cable landing point in Sandbridge. Construction on infrastructure for four subsea cables is expected to start in November 2023. This includes 1) the bore pipes from the beach manholes going about 1 kilometer into the ocean; 2) four conduits going from the beach manholes' front hall and terminating at Globalinx's cable landing station in Corporate Landing Park. This will take about six months to complete,

Greg Twitt, president of Globalinx, says he has commitments from two operators for this landing site, leaving room for two more subsea cables.

Strategic Issue for the Steering Committee: Do we ask Virginia Beach to identify a third landing site and the costs for a spec proposal to include in our request to the Commonwealth? Or do we leave this out of our request? If we kept this in, would this third landing configuration qualify as a megasite currently being approved by the General Assembly?

Per InterGloblix, the ideal diversification of a region's landing sites should follow the Marseilles model where there is 100% diversification in the cable infrastructure: Diversify the front haul sites – have multiple spec pipes into the ocean. Diversify the cable landing stations – have multiple sites where the pipes come ashore. Diversify the backhaul network to data centers – have multiple connections.

Globalinx Plan 2023



Related Notes for the Steering Committee's Discussion

Subsea cables get damaged by anchors. The global internet infrastructure industry is full of stories of cables being damaged by large ship anchors.

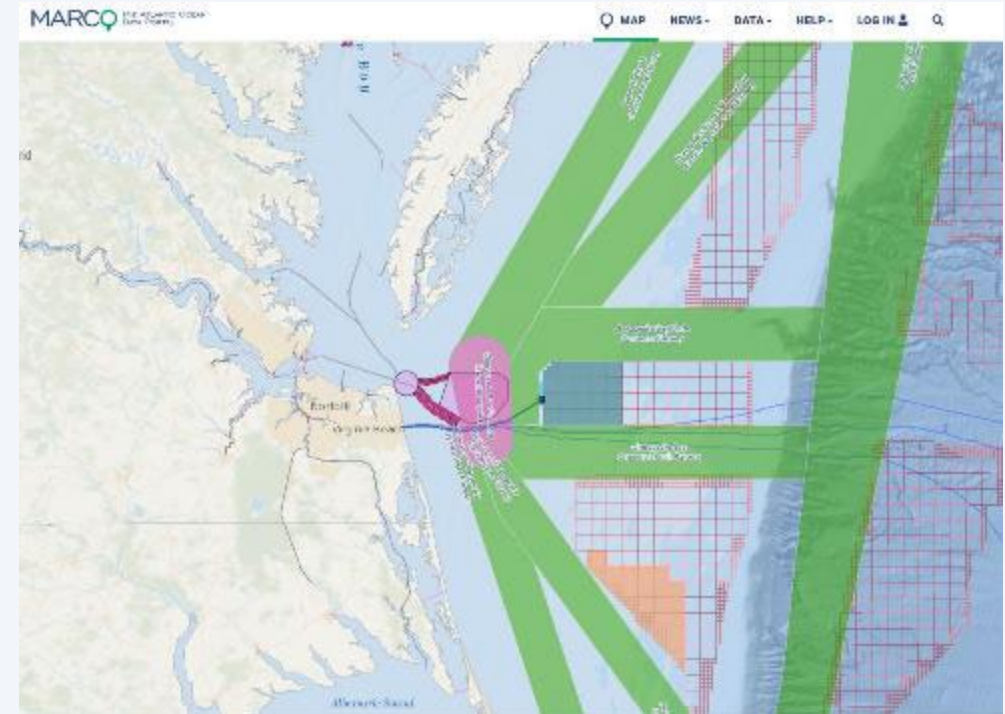
This is an industry risk that persists as most subsea cables come into port cities.

Consider the enormous volume of shipping traffic that takes place in and around Hampton Roads. The harbor is one of the busiest ports on the East Coast. It is home to the largest naval base in the world.

Virginia Maritime Association is working work with the Coast Guard to develop a subsea cable corridor(s) no-anchorage zone map to protect current and future cables from anchor strikes.

Endorse this work in the Strategic Plan. Make Virginia subsea cable landings the safest place in the world to land. Endorse more collaboration between relative state and federal regulatory agencies and corporate stakeholders to coordinate and share planning efforts.

Question for Steering Committee: How can Virginia Administration and/or General Assembly help advance and/or approve this work?



7. Provide a growing tech-savvy workforce.

Current State of I-64 Innovation Corridor

The I-64 Innovation Corridor has a wealth of technical certifications, badges, and degrees in tech-related jobs. Additionally, there are currently several initiatives advancing greater coordination across these institutions.

Desired Future State of I-64 Innovation Corridor

A seamless coordination of all job training and development for the growing number of digital infrastructure-related jobs. This includes the full pathway from K-12 to higher education.

Related Notes for the Steering Committee's Discussion

A robust and growing digital infrastructure requires a growing tech talent pool and this workforce development and training needs to start long before college.

Virginia became the first state in 2016 to include computer science as a mandatory part of the curriculum in all public schools.

Programs such as CodeVA and GO TEC help to bring computer science education to Virginia's K-12 schools and to develop teacher training programs. The programs also are part of an effort to interest students early on to consider getting college degrees in computer science and related fields that will help expand workforce and talent pipelines in growing digital industries.

There are 44 colleges and universities along the I-64 Innovation Corridor. In addition, there are dozens of community colleges and technical schools.

Most of these colleges and universities, along with the Commonwealth, are invested in tech talent development and training. In fact, the Tech Talent Investment Program was created with the Commonwealth of Virginia, donors, and corporate partners investing more than \$2 billion to expand Virginia's tech talent pipeline, with plans to double the number of graduates each year in computer science and closely related fields.

This talent pipeline, however, has room to grow to include more digital infrastructure occupations needed today and tomorrow.

The GIH Strategic Plan should call for the creation of a world-class tech talent pipeline for digital infrastructure. This will include immediate, mid-term, and long-term solutions:

Immediate Talent Pipeline:

Utilize existing training and certification programs. For instance, VCU has a basic training program that offers students the opportunity to earn credentials in digital technology. This program is being offered by the Greater Washington Partnership. Immediately work with VCU to see how aligned this program is to digital infrastructure jobs.

Work closely with the community college system to align workforce training and credentialing with digital infrastructure jobs.

Mid-term Talent Pipeline:

Align digital infrastructure jobs with the entire tech worker pipeline. An example of this is tying into CodeVA.

Long-term Talent Pipeline:

Create a major and master's degree program in digital infrastructure that is taught by I-64 Innovation Corridor universities and colleges. There is only one other similar program that exists – Southern Methodist University in Texas. This program was just launched. Dallas is a major hub.

8. Increase the awareness, familiarity, and support among local stakeholders for a growing digital infrastructure.

Current State

of I-64 Innovation Corridor

Development of a region's digital infrastructure and pursuit of international hub status requires the growing support of regional stakeholders – businesses, government agencies, elected officials, etc. Most are simply unaware of what this is all about.

The growing debate over the value of data centers is not associated with the facts.

Desired Future State

of I-64 Innovation Corridor

Educate all stakeholders in the I-64 Innovation Corridor – city and county government officials, elected leaders from all levels, business leaders, etc.

Build awareness of and familiarity with the facts and benefits of being part of a growing world-class digital infrastructure.

Related Notes for the Steering Committee's Discussion

Development of a region's digital infrastructure and pursuit of international hub status requires the growing support of regional stakeholders – businesses, government agencies, elected officials, etc.

Over the past year, RVA757 Connects through the work of the Steering Committee has advanced awareness and knowledge of what a Global Internet Hub is and why it is important to the future of both Richmond and Hampton Roads regions. But more and continuous stakeholder education is needed on the facts and benefits of being part of a Global Internet Hub.

Two immediate programs are envisioned to help inform and educate stakeholders. Both would be delivered in partnership with others.

Stakeholder Education Program

Develop an outreach education program to help local leaders and officials understand the power and return on investment of a robust digital infrastructure.

Locality Education and Certification Program

Create a program to certify localities as “Global Internet Hub-ready” communities. This includes an education program, a designated certification checklist, and community recognition. Recognize communities that become certified.

9. Increase international awareness of the I-64 Innovation Corridor among the global digital infrastructure community and investors.

Current State of I-64 Innovation Corridor

The I-64 Innovation Corridor is not well known across the global digital infrastructure world. Loudon County (Ashburn area) in Northern Virginia is top of mind when people think of Virginia and digital assets.

Desired Future State of I-64 Innovation Corridor

The I-64 Innovation Corridor is well known across the global digital infrastructure community and especially so among investors as the extension of Loudon County and the East Coast's digital gateway to Europe and South America.

Related Notes for the Steering Committee's Discussion

The digital infrastructure world is organized around network, content, data center, and subsea cable vertical topics, not an entire digital infrastructure, not GIHs.

Currently, there is an absence of an organized industry around Global Internet Hubs and intentional digital infrastructure industry collaboration across the component sectors.

One of the takeaways from the Internet Ecosystem Innovation Committee (IEIC) conference held in Henrico in November 2022 and the findings of InterGlobix and TeleGeography is that the scope of our GIH planning effort is a first in the world and we are getting noticed.

Both InterGlobix and TeleGeography expect more GIH strategic planning may follow. As RVA757 Connects and the I-64 Innovation Corridor are on the ground floor of this movement, we can package our foresight to raise international awareness of who we are, what we offer, and where we are headed – to global hub status.

The strategic plan envisions a future where the I-64 Innovation Corridor is well known across the global digital infrastructure community and especially so among investors.

Specific steps will be detailed in the final strategic plan to make this happen.

As the Greater Richmond Partnership, Hampton Roads Alliance, and VDEP are responsible for external marketing, all of these ideas will be vetted and approved by them.

- Maintain and update the GlobalInternetHub.org (and .com and .net) website. We own the three URLs.
- Place an Executive Summary of the RVA757 Connects I-64 Innovation Corridor's GIH Strategic Plan in a copy of a future editions of various publications including InterGlobix.
- Create a roadshow presentation and whitepaper brochure about the I-64 Innovation Corridor as a GIH for VEDP, Hampton Roads Alliance, Greater Richmond Partnership, and local economic development agencies to use as they need it.
- Consider attending and speaking at several key GIH international events.
- Create a list of industry investors. Prepare and pitch customized opportunities. This could include megasites for data centers. Again, this would be very thoughtfully prepared with VEDP, Hampton Roads Alliance, Greater Richmond Partnership, Henrico, Virginia Beach, and other leading local economic development agencies.

10. Build momentum for all of this through an organized and united industry.

Current State of I-64 Innovation Corridor

Today, the organizations and businesses in the I-64 Innovation Corridor's digital infrastructure category are not an organized industry. The level of intentional industry collaboration in the corridor can be improved dramatically.

Desired Future State of I-64 Innovation Corridor

Transform the GIH steering committee into a formal and ongoing industry GIH Council. Members will include the I-64 Innovation Corridor's digital infrastructure industry stakeholders and supporters.

Related Notes for the Steering Committee's Discussion

The organizations and businesses in the I-64 Innovation Corridor's digital infrastructure category are not an organized industry.

In 2022, RVA757 Connects identified the opportunity and related economic benefits of accelerating collaboration and cooperation among the I-64 Innovation Corridor's digital infrastructure stakeholders to accelerate the region's ascendancy in becoming a Global Internet Hub (GIH).

To this end, RVA757 Connects created a Steering Committee to help formulate a strategic plan. More than 60 leaders are members of the committee representing companies and digital infrastructure firms as well as those representing subsea cable owners, broadband firms, cyber companies, utilities, planning agencies, chambers, economic development entities, and four branches of the military.

This group is providing considerable input and through this collaborative process is seeing the benefit of working as a coordinated team.

Transform the GIH Steering Committee into a formal and ongoing industry GIH Council. Members will include the I-64 Innovation Corridor's digital infrastructure industry stakeholders and supporters.

The GIH Council will start off as a division of RVA757 Connects. The GIH Council's charge will be the management and coordination of plan implementation. Sponsorships, grants, and annual meetings will fund the work of the GIH Council. Specific task areas could include:

- Market the I-64 corridor as a Global Internet Hub among international investors (Strategy No. 9). Again, do this through close coordination and partnership with VEDP, Hampton Roads Alliance, Greater Richmond Partnership, and local economic development agencies.
- Educate I-64 Innovation Corridor stakeholders on the what, why, how, and when of being a Global Internet Hub (Strategy No. 8).
- Work with education and workforce development leaders to provide a growing tech-savvy workforce (Strategy No. 7).
- Create a public-facing dashboard of key performance indicators (KPIs) that report the relative success and growth of the I-64 Innovation Corridor's digital infrastructure and related workforce.

When appropriate, spin out the GIH Council into a stand-alone 501(c)(3) – I-64 Innovation GIH Council.

Priorities, Partners, and Budget Planning

*The GIH Strategic Plan implementation is
envisioned as an ongoing, long-term process.*

Emerging Strategy	Priority: 1 Immediate 2 Mid-term – Next 2 Years 3 LT – 3-4 Years	Potential Partners	Funding Required
1. Support the growth of robust local internet networks.	#2 – As part of the GIH Plan, inventory current and needed networks.	TBD	Smaller Subcommittee of the GIH Steering Committee is working on specific and detailed budgets for each strategy.
2A. Support the competition of 757 fiber ring. 2B. RVA region explores need for local ring. 2C. Examine the potential of an I-64 Corridor Loop.	#1 – Decide if this should be included in the preliminary budget request. #2 – Detailed study and implementation plans will require all parties to be involved, united, and well-coordinated.	City, Counties, RVA757 Connects	
3A. Encourage a growing number of local data centers. 3B. Work on eliminating the sunset law on data center tax.	#1 – Now is the time given Amazon’s announcement and NOVA’s Issues.	VEDP, Alliance, Greater Richmond Partnership, Gateway Region All chambers All stakeholders	
4. Support reliable and inexpensive power and local transmission permitting.	Need feedback and input from Dominion Energy.	Dominion Energy	
5. Encourage the growth of IXs and IXPs – Internet Exchanges and Internet Exchange Points.	#2 – 757 leaders must understand importance and formulate a plan. #2 – Explore university and college plan.	HRPDC Southside Broadband Authority Colleges and Universities in the Corridor	
6. Attract additional international subsea cables.	#1 – Planning and building subsea cables takes 6-8 years. Now is the time to influence the next 10-12 cables needed for the East Coast. #2 – The grid anchor protection zone must be finished and approved.	City of Virginia Beach leads Alliance VEDP Maritime Industry and Coast Guard	
7. Provide a growing tech-savvy workforce.	#2 – Work with education partners.	HRWC and CRWDB Community Colleges Colleges and Universities Existing Programs – CodeVA VCU Certification	
8. Increase the awareness, familiarity, and support among local stakeholders for a growing digital infrastructure.	#1 – We must build awareness of topic and the GIH Strategic Plan. Create and implement certification program.	All chambers RVA757 Connects Board & MIC Econ. Development Associations City Councils and County Boards	
9. Increase international awareness of the I-64 Innovation Corridor among the global digital infrastructure community and investors.	#1 – We must build awareness ASAP.	VEDP, Alliance, Greater Richmond Partnership, Gateway Region	
10. Build momentum and execute plan implementation through an organized and united industry.	#1 – Turn Steering Committee into GIH Council.	RVA757 Connects	