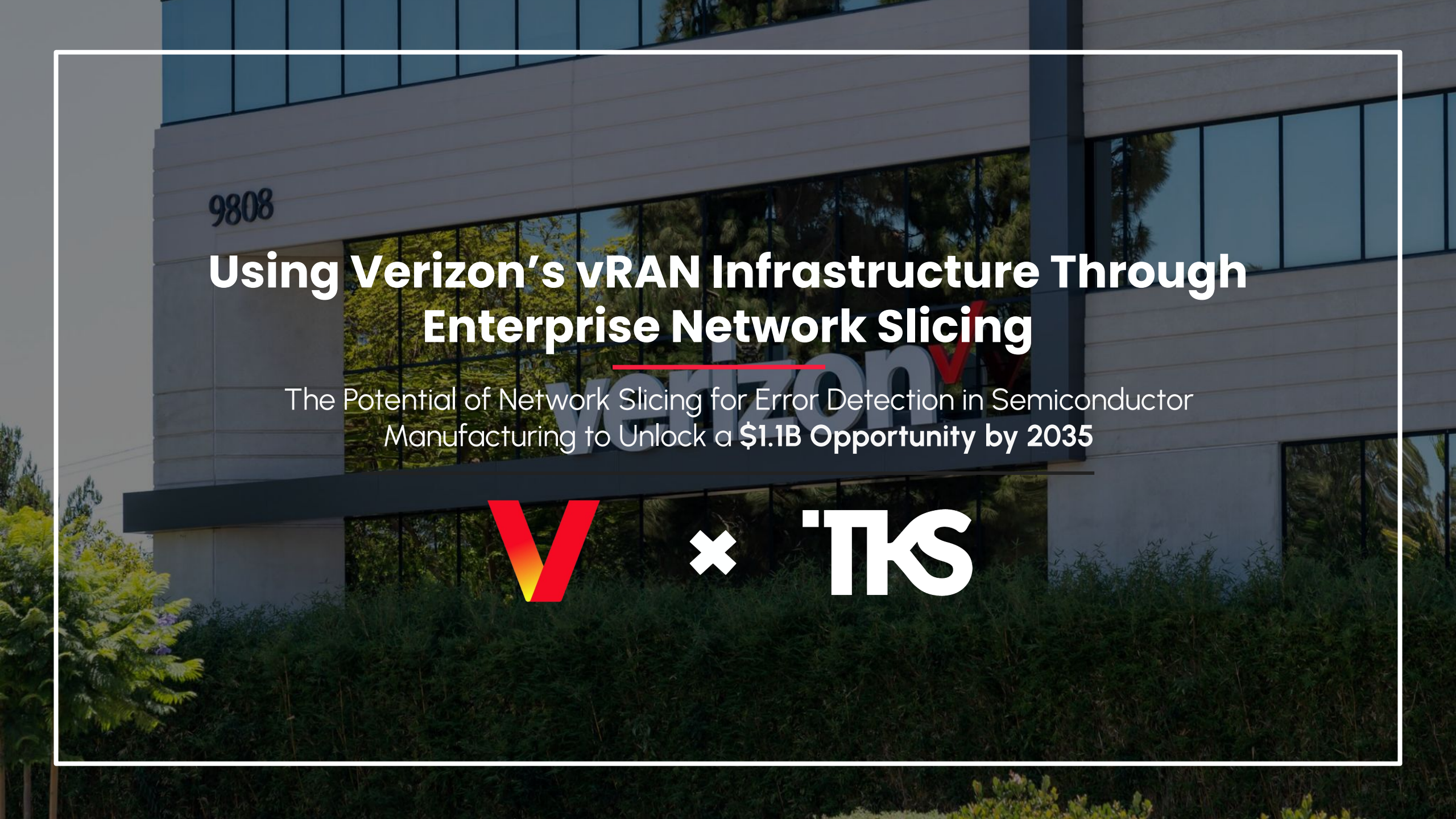


Using Verizon's vRAN Infrastructure Through Enterprise Network Slicing

The Potential of Network Slicing for Error Detection in Semiconductor Manufacturing to Unlock a **$1.1B Opportunity by 2035**

× TKS

Executive Summary

An overview of implementing network slicing for low-latency IoT

Problem + Opportunity

Verizon is focusing on its vRAN deployments and low-value network slicing

- Although Verizon is a leader in vRAN deployments, it is still behind T-Mobile in 5G standalone towers, which are critical for IoT applications
- This means that Verizon cannot focus on high-value verticals such as semiconductor factories, losing out on many opportunities
- Verizon will start to fall behind as it starts to fall behind competitors

Product + Solution

Implement network slicing for low-latency IoT, starting with semiconductor manufacturing

- Allocate specific portions of Verizon's network to semiconductor factories in the process called network slicing
- This enables <10ms latency for AI-based error detection models for chip manufacturing, a necessity for these factories
- Verizon will also provide management for these services, creating a SaaS platform for the factories to manage their network slice

Outcome + Impact

Create $1.08B in new revenue by capitalizing on new investments in the industry

- Verizon stands to make $1.08B dollars through two pathways: one-time CapEx revenue, and recurring SaaS revenue
- Verizon will make $975M in one-time CapEx revenue, and will make $112M per year in recurring revenue
- As Verizon continues to develop its 5G infrastructure, funded by the CHIPS act, Verizon can also enter other verticals

Key Terms

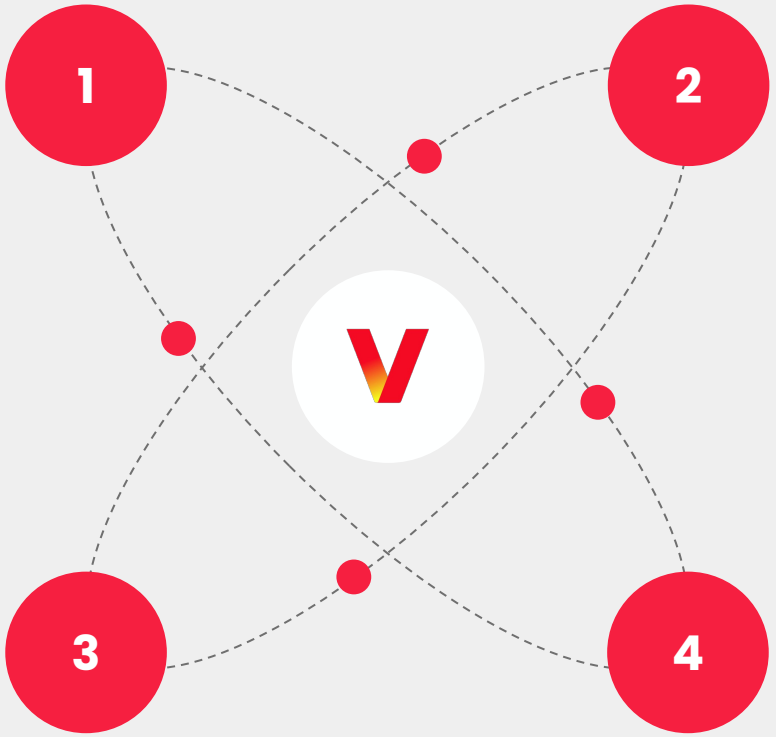
Technology and government funding form the core of Verizon's status quo and future

vRAN

vRAN (Virtualized Radio Access Network) replaces traditional, hardware-based cell tower systems with software running on standard servers, making mobile networks more flexible and cost-effective. Instead of relying on specialized equipment, vRAN allows operators to manage and upgrade networks remotely using cloud technology

Network Slicing

Network slicing is a 5G technology that creates multiple virtual networks on a single physical infrastructure, each customized for different needs like high-speed streaming, low-latency gaming, or secure business communications.



5G Standalone Towers

5G standalone towers are dedicated 5G networks that don't rely on older 4G infrastructure, enabling faster speeds, lower latency, and advanced features like network slicing. Unlike non-standalone 5G, which still depends on 4G for certain functions, SA towers unlock the full potential of 5G for applications like ultra-reliable industrial automation.

CHIPS Act

The CHIPS and Science Act is a U.S. law enacted in August 2022 to bolster domestic semiconductor manufacturing and scientific research, aiming to enhance competitiveness with nations like China, allocating $52.7 billion in subsidies.

Verizon Stands To Lose $1B+

By not implementing a stronger presence in the 5G network slicing market, Verizon could lose out on many opportunities to enter new markets

1

Status Quo

Verizon continues to focus on its vRAN deployments and network slicing in the public sector, ignoring the potential of network slicing for IoT and other high-value verticals

2

T-Mobile

T-Mobile starts to capitalize on its 5G standalone coverage, With its <15ms POS terminal performance becoming a benchmark for low-latency industrial applications

3

CHIPS Act

As CHIPS Act funding rolls out, semiconductor companies prioritize network slicing solutions from providers who can demonstrate proven 5G SA coverage and industrial IoT expertise.

$1B+ Loss

If Verizon fails to aggressively pursue network slicing for semiconductor fabs and is usurped by rivals, they could miss out on a significant portion of the projected $1B+ revenue. Let's consider a conservative scenario:, including both one time CapEx revenue and recurring SaaS revenue, Verizon stands to lose more than $1B

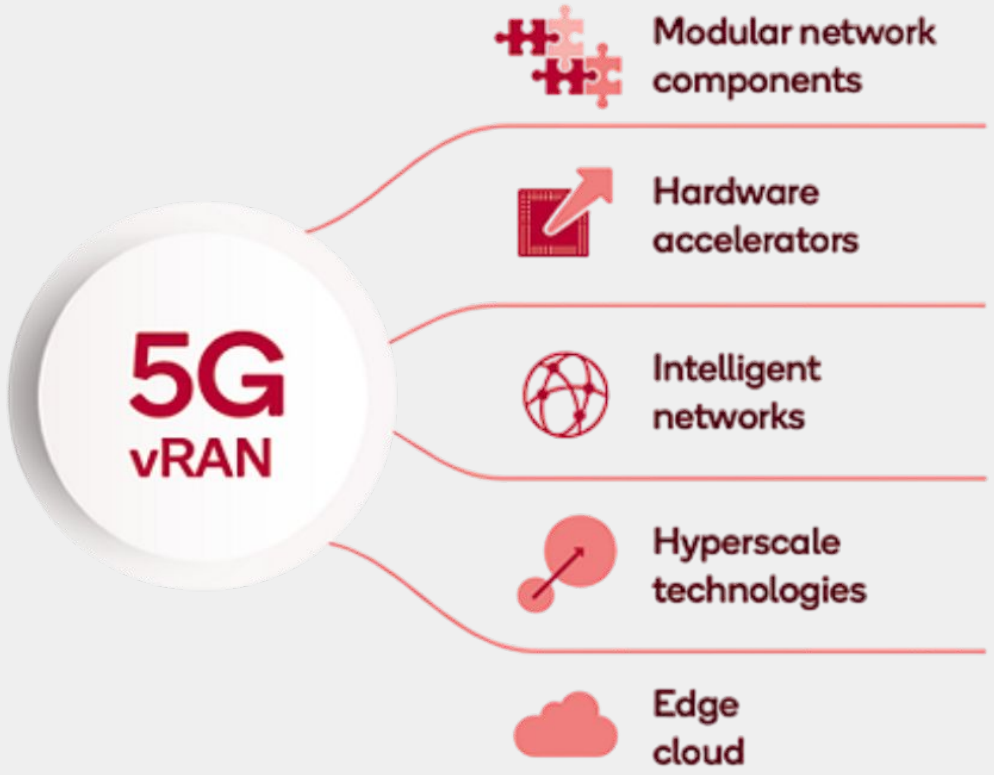
Missed Revenue Details + Calculations

Understanding Verizon's Position

A strong vRAN infrastructure creates high-value verticals through network slicing

Verizon has a big advantage in the telecom space: its vRAN infrastructure. With 8,000+ sites, there are many opportunities to implement network slicing. This practice of allocating high-speed internet to specific customers has been used by Verizon in the public sector (for first-responders), but there are many opportunities to integrate it for enterprises.

To do this, however, Verizon will need to expand its 5G standalone coverage, which T-Mobile currently is the leader in. This is critical for successful deployments of low-latency IoT.



Verizon leads in vRAN with 8,000+ sites, enabling enterprise slicing, but lags T-Mobile's 5G SA coverage—key for low-latency IoT—while proving ROI in high-value verticals worth $1.1B.

Chip Fabs Require Defect Detection

With the increasing importance of semiconductors, manufacturers are looking for better ways to increase yield through defect detection

Details on Defect Detection

Chip Error Correction

- Chip manufacturing fabs require robust error detection. Defects can form through particle contamination, micro-cracks, electrical shorts
- This waste cost accumulates, often costing **$10,000** per defected wafer.
- For this reason, semiconductor manufacturing companies are looking for new ways to increase the yield of working chips.

AI for Defect Detection

- With the vast amount of data generated by checking for errors (mostly through scanning electron microscopes) can be used to train **AI error detection models**
- A 2021 study, in collaboration with Hitachi ABB Semiconductors, demonstrated a **21.7% reduction in yield loss** in transistor chip manufacturing through the use of an explainable AI decision model

Telecom's Role in This

- One necessity for efficient defect detection is **ultra-low latency**, as it allows for the chips to be accurately grouped as either proper or defected
- if a defect is detected, the manufacturing line might need to **adjust parameters immediately** to prevent further defects
- Telecom companies can provide these low-latency network slices

"Detecting material impurities is critical to ensure high-quality semiconductor devices with improved performance, yield, consistency and reliability."
Brewer Science

Research Paper

A Defect Detection Model Achieves 92% accuracy

> A 2023 Padua University study, which developed a CNN-based defect detection model for semiconductor wafers achieved 92% accuracy, highlights a critical opportunity for telecom hyperscalers like Verizon. While the study focused on the AI model itself, the underlying infrastructure required to deploy and scale such a solution in a semiconductor fab environment is where telecom companies can play a pivotal role and generate significant revenue.

If semiconductor fabs adopt this model as part of their operations, telecom companies become essential for: **Low-Latency** Data Transport for Real-Time SEM Image Processing, **High Bandwidth** for SEM Image Data Streams, **Edge Computing** for Low-Latency AI Inference, and more.

Case Study

ASML uses AI to detect errors in chip making

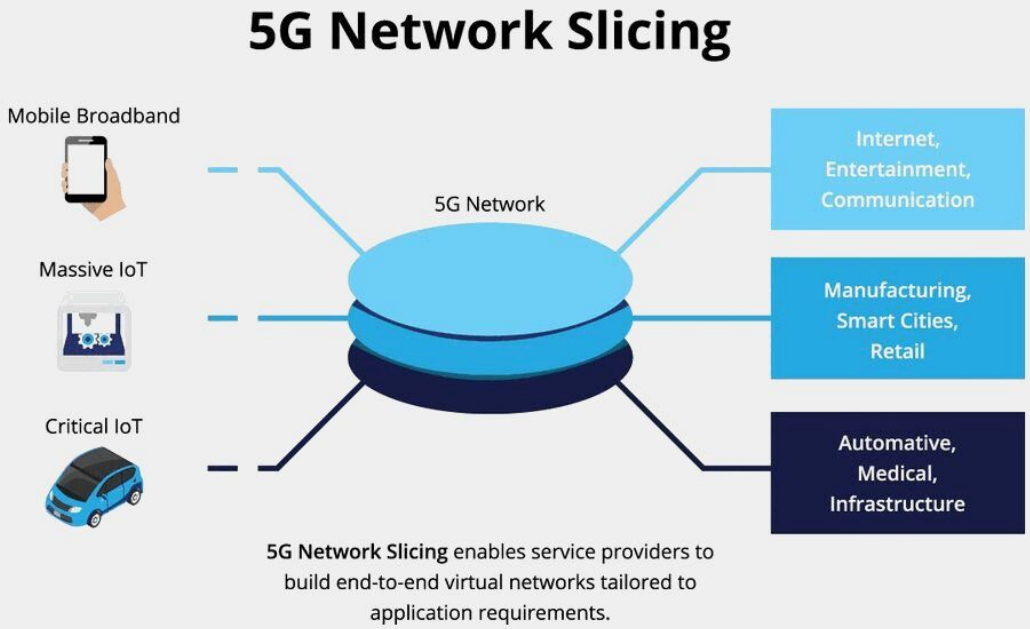
ASML is the world's leading EUV lithography supplier, an important part of chip manufacturing. To enhance their machines, they are using AI for advanced pattern analysis and defect prediction. This is primarily used in the YieldStar machines, which are important for measuring overlays and critical dimensions when making semiconductors.

"Thanks to advanced machine learning technology, and in combination with specifically designed training marks on the reticle, the YieldStar 1375F can learn to accurately measure overlay, while remaining insensitive to other stack variations. This allows for an extremely robust measurement, even in fluctuating conditions."

– ASML

The Solution

Verizon can use a Network as a Service business model



"As the 5G Standalone Core expands, we'll also see network slicing enabling more differentiated services for new applications beyond enhanced video calling"

Yago Tenorio, CTO of Verizon

Verizon needs four things for this plan

To run a **network as a service model**, the four steps are:

01 Create dedicated network slices within fabs that guarantee **<10ms latency**

02 Offer **AWS integration**, including GPU-accelerated instances for AI

03 Design an AI-powered defect detection **SaaS platform**

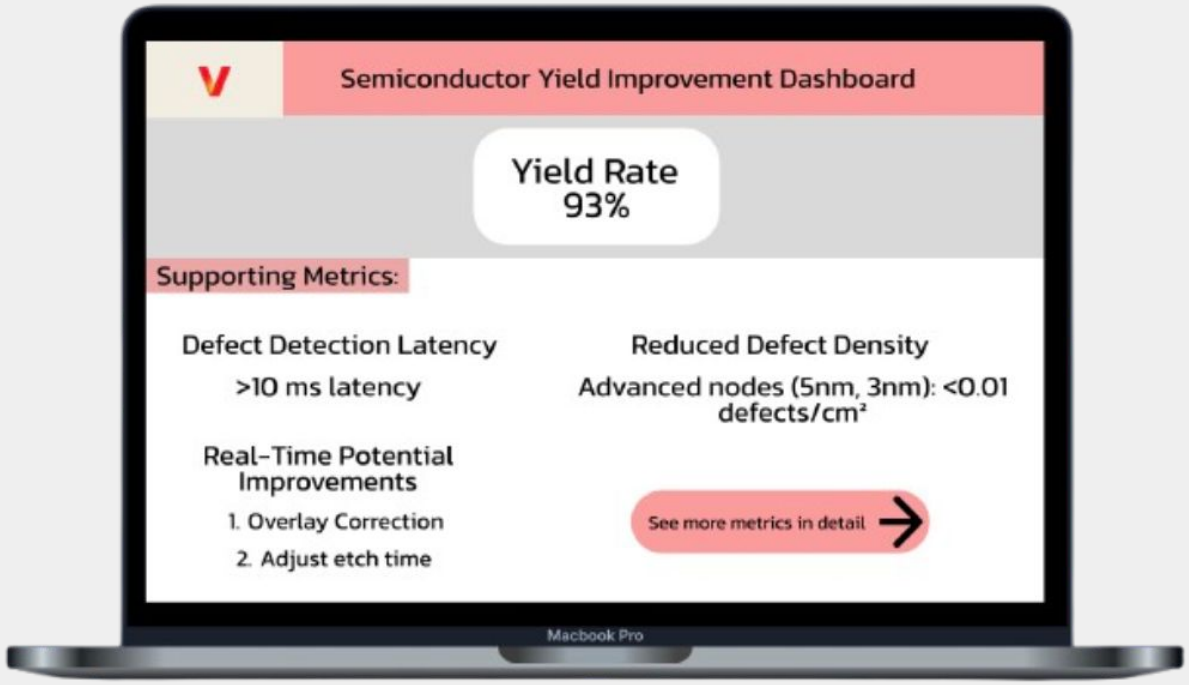
04 Provide **end-to-end** solution management, along with **24/7 monitoring**

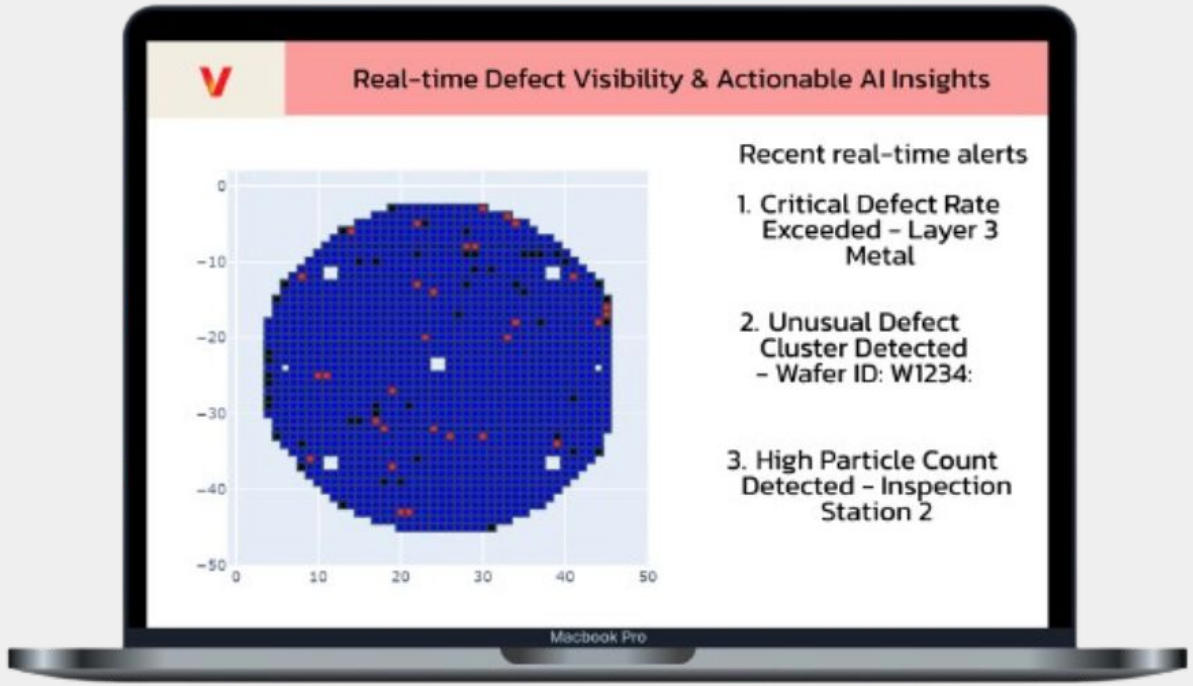
$5-20M
in revenue per fab that signs with Verizon

From deals with chip fabs, Verizon will make revenue off of the immediate, CapEx fees, plus the recurring management fees

Technical Details

Verizon can design a platform for semiconductor fabs to manage their network slices



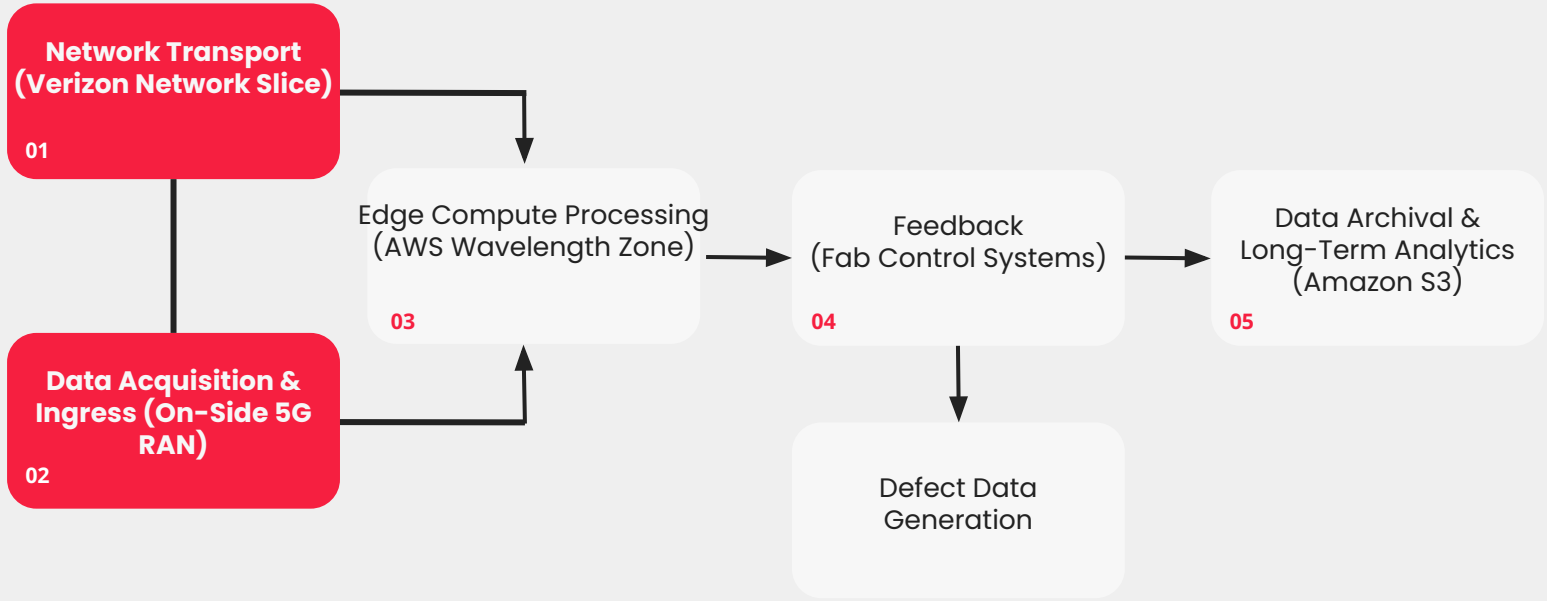


"At the testing stages, a flawless yield management software that can work synchronously with Automated Test Equipment (ATE) to capture, process, and analyze vast amounts of data is needed"

Chetan Arvind Patil
indie.inc Senior Staff Product Engineer

Diagram

Technical Architecture of Verizon NaaS



Full Diagram

01 Verizon's 5G core enables end-to-end slicing with a dedicated NaaS traffic slice for the semiconductor fab. Secure tunneling ensures isolation, while prioritized routing and strict QoS guarantee reliable, high-performance connectivity.

02 Verizon's high-density 5G small cell network using Ultra Wideband spectrum. Raw defect data is transmitted wirelessly via 5G uplink channel. Optimized with short TTIs and UL/DL configuration, ensures minimal latency.

03 AWS Wavelength Zones at Verizon's MEC sites enable low-latency AI processing near the semiconductor fab. Dedicated EC2 instances run AI defect detection models, analyzing incoming data in real time.

04 The AI engine generates defect maps, classifications, and severity scores. Insights are sent back with ultra-low latency via Verizon's 5G network. They integrate with fab control systems for real-time optimization.

05 Raw defect data and AI insights can be archived in AWS storage for compliance, trend analysis, and model optimization, with latency-tolerant processing in the cloud with Amazon S3.

Verizon Can Capitalize on its AWS Partnership

AWS Wavelength essentially carves out "Wavelength Zones" within Verizon's 5G Ultra Wideband network. These zones are miniature AWS infrastructure deployments, not just simple points of presence.

Ultra Low Latency

Wavelength Zones are directly connected to Verizon's 5G network at the Radio Access Network (RAN) level. This "deeply embedded" architecture is what enables the ultra-low, single digit millisecond latency

Deep AWS Integration

Developers use standard AWS APIs, tools, and services to deploy and manage applications on Wavelength. This seamless integration is a major draw for developers already invested in AWS.

Leadership in vRAN

Verizon provides the high-performance 5G network, including spectrum, RAN infrastructure, and backhaul, which is the foundation for Wavelength. Their vRAN deployments make their network more agile and edge-ready.

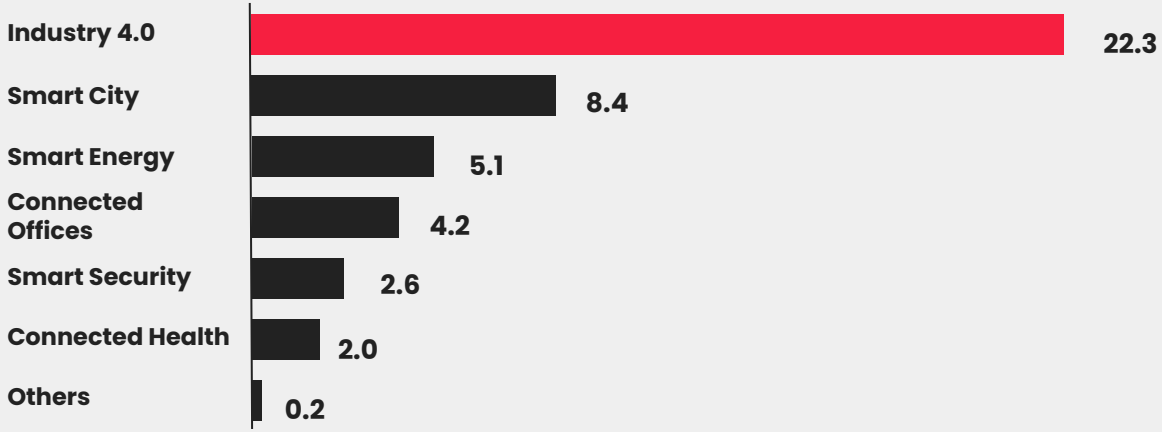
Compute at the Edge

Wavelength Zones house AWS compute (EC2 instances, including GPU instances for AI workloads) and storage (EBS volumes) right within Verizon's mobile edge computing (MEC) locations.

Predictions around the growth of Industry 4.0 verify the strength of Verizon's NaaS strategy

Industry 4.0 refers to the fourth industrial revolution, characterized by the **integration of advanced digital technologies into manufacturing and industrial processes**. It builds on automation and data exchange, enabling smart factories where machines, devices, and systems communicate and make decentralized decisions.

Forecast 5G IoT unit sales, distinctive use cases in 2030 (Million Units)



For distinctive B2B use cases, almost half of all sales will be linked to Industry 4.0 applications

This data directly validates Verizon's NaaS strategy for semiconductor defect detection. Semiconductor manufacturing is at the forefront of Industry 4.0 adoption, demanding increasingly sophisticated and data-driven solutions to enhance yield, quality, and efficiency. Real-time defect detection, enabled by ultra-low latency connectivity and edge compute, is a **prime example of a distinctive Industry 4.0 use case** that directly aligns with this projected market growth.

The Benefits for Verizon

By expanding its 5G vRAN capabilities, Verizon stands to gain significant leverage as it capitalizes on the lucrative semiconductor industry. Through serious growth, below are just some of the benefits Verizon could get by entering this market.

1. High Value Vertical Market

Semiconductor manufacturing is a high-value, strategically important industry, and securing a strong position in this vertical can generate substantial revenue and enhance Verizon's reputation as a leader in industrial 5G solutions.

2. Network Slicing Monetization

Semiconductor fabs are ideal candidates for network slicing due to their stringent requirements for low latency, high bandwidth, and security. Success can validate Verizon's network slicing strategy and provide a compelling use case for monetizing this advanced 5G capability elsewhere.

3. Competitive Advantage

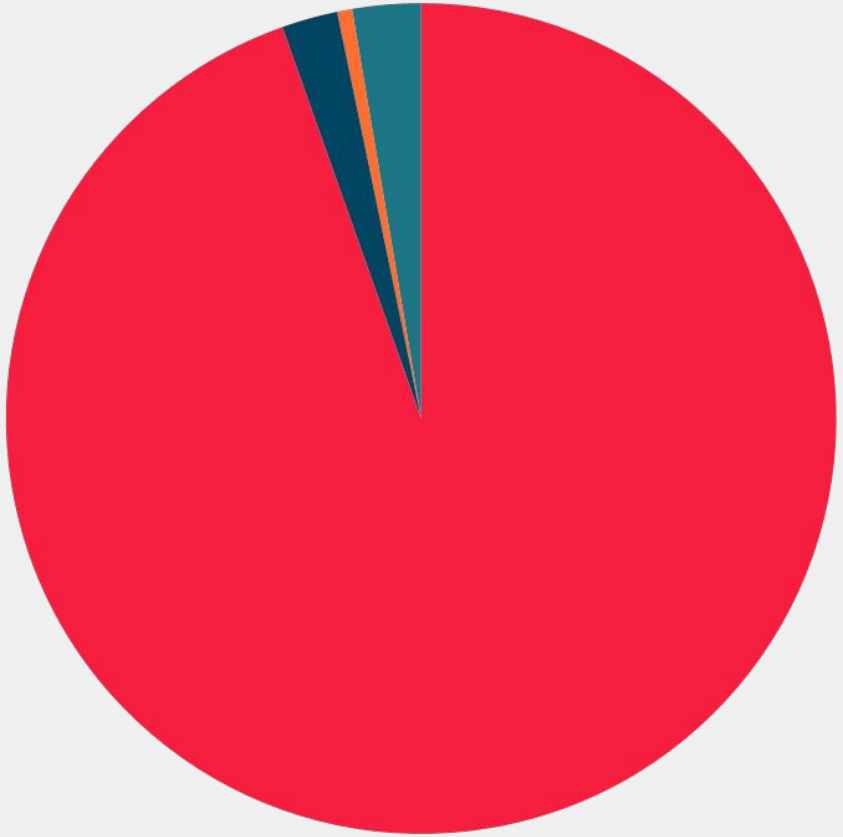
While other telecom players are also targeting the industrial 5G market, Verizon can leverage its vRAN leadership and edge computing partnerships to offer a superior and more integrated solution.

4. Long-Term Revenue Stream

The demand for semiconductors and the drive for continuous improvement in manufacturing processes are long-term trends. Establishing a strong position in the semiconductor defect detection market can give Verizon a sustainable and growing revenue stream for years to come.

Calculations

Verizon Stands to Make $1.08B



These areas of new revenue for Verizon create not only $1.08B* of revenue in the first year, but also $112M/year.

Verizon gets to build out its 5G infrastructure, and prepare to enter more lucrative markets in the future

CHIPS Act Revenue: $975M

SaaS Revenue: $45M/year

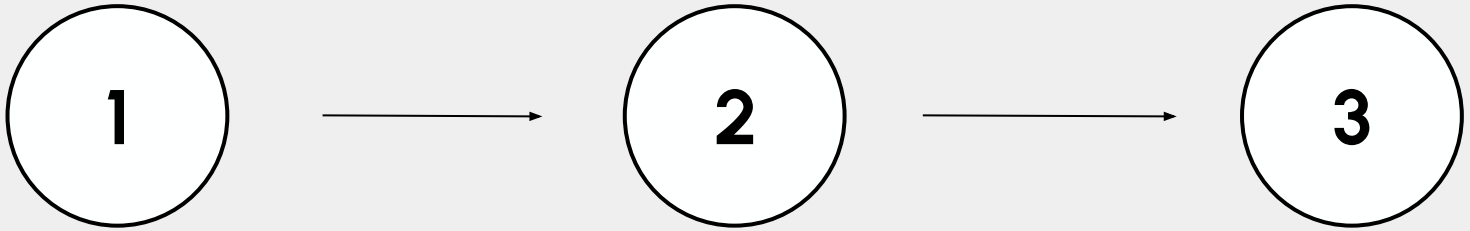
Slicing Revenue: $12M/year

Edge Compute: $55M/year

* Revenue calculated based on numbers described in the “lost revenue” document (slide 3)

Implementation

Verizon Can Implement This Strategy in 3 Phases



TSMC Arizona Pilot

Verizon's "Land and Expand" strategy starts with a pilot at TSMC Arizona, using 5G and cloud technology to improve chip defect detection with faster speeds and more accurate results, laying the foundation for broader adoption, joint marketing, and long-term revenue growth in semiconductor manufacturing.

Fab Expansion

Verizon's next phase focuses on scaling its semiconductor fab NaaS solution, expanding to more fabs under the CHIPS Act, launching a tiered SaaS platform, and building an ecosystem of AI and automation partners, while a specialized sales team and industry marketing efforts drive adoption and long-term growth.

International Expansion

Verizon's final phase focuses on global expansion into major semiconductor hubs, diversifying revenue through AI model licensing, data monetization, and predictive analytics, while strategic acquisitions and partnerships strengthen its leadership in industrial NaaS and next-gen manufacturing connectivity.

Instant Implementation: Smoothing out onboarding for fabs

Verizon can simplify adoption with **pre-packaged NaaS solutions** and a streamlined onboarding process, making deployment as seamless as possible for semiconductor fabs. A **"Verizon Validated"** ecosystem ensures pre-integrated AI SaaS solutions, reducing complexity and guaranteeing compatibility. **Pilot programs and executive-level sales materials** will demonstrate value upfront, lowering adoption risks and clearly communicating ROI.

Challenge: Semiconductor Inspection Has Risks

The global semiconductor inspection system market size was valued at $5.2 billion in 2021, and is projected to reach $8.9 billion by 2031, growing at a CAGR of 5.4% from 2022 to 2031.

Challenge: Slow Customer Adoption

Semiconductor manufacturers are risk-averse, and **NaaS** is a new approach. There is an estimated risk value of **$100-400M** in lost potential revenue over 3–5 years, assuming Global Semiconductor Market reaches $8.9B by 2031.

Challenge: Data Security and Privacy Concerns

Security and Privacy concerns in sensitive semiconductor fabs are a major challenge. The estimated risk value is **$30-120M** in lost sales, reputational damage, and compliance fines over 3–5 years.

Challenge: Market Competition

There is competition for Verizon, specifically from established vendors and cloud providers. The estimated risk value is **$50-150M** in reduced revenue and market share over 3–5 years, assuming competition will drive down ASP for NaaS by 15%-20%.

Strategy: Aggressive PoC and Pilot Programs

Verizon will invest in Proof of Concept PoCs, demonstrate yield improvements, develop case studies, and offer SLAs. The estimated mitigation cost is **$15-40M** investment in PoC infrastructure, personnel, and subsidies over 2 years.

Strategy: "Security by Design"

With certifications, transparent documentation, and security by design, Verizon can avoid data and privacy leakage concerns. The estimated mitigation cost is **$40-150M** in increased sales, faster adoption, and avoided costs related to security and compliance over 3-5 years.

Strategy: Value + Partnerships

Verizon will need to develop a Unique Value Proposition and should emphasize securing partnerships to mitigate the effects of competition. The estimated mitigation cost is **$15-35M** investment in marketing, partnerships, and specialized solution development.

Although there are many challenges Verizon faces during the implementation of this strategy, the benefit that could be attained by entering one of the fastest-growing industries in the world trumps the risk. By executing this plan, Verizon not only creates a lot of revenue, builds out its 5G infrastructure, and enters a futuristic industry, but it also prepares itself to enter other, more lucrative verticals using the same strategy.

With its semiconductor experience, Verizon can expand to other areas such as financial services

Latency is worth $5B

In high-frequency trading (HFT) and financial markets, **a faster trade execution can secure a better price** before competitors react. Low latency is worth billions to financial firms because even a 1-millisecond advantage can result in **significant profit gains over thousands of trades per second**. 5G network slicing allows financial institutions to have dedicated, ultra-low-latency network segments, ensuring faster data transmission, reduced congestion, and improved security

Using the 5G infrastructure built for the semiconductor fabs, Verizon could build a financially lucrative solution for financial institutions, leading to more opportunities to make new revenue. The connectivity Verizon would offer minimizes delays in market data retrieval and order execution, making it a major advantage in algorithmic trading and real-time risk analysis.

1 → **Build 5G Network with funding from CHIPS Act**

2 → **Start Pilot with HFT Financial Institution**

3 → **Expand to National and International Institutions**

Verizon can use this implementation plan to increase their presence in the financial district. While the semiconductor industry provides the resources to build out the 5G infrastructure, the financial industry provides a large amount of revenue.

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PERSONAL NOTE

Thank You!

We'd like to give our **sincere thanks to Verizon** for the opportunity to dramatically change the company's vRan Infrastructure.

We have **learned invaluable things** from the making of this pitch deck, and we hope our work on this issue reflects that.

If you have any questions, feel free to **reach out at any time**.

Arjun, Atharva, Divyan, Melyne