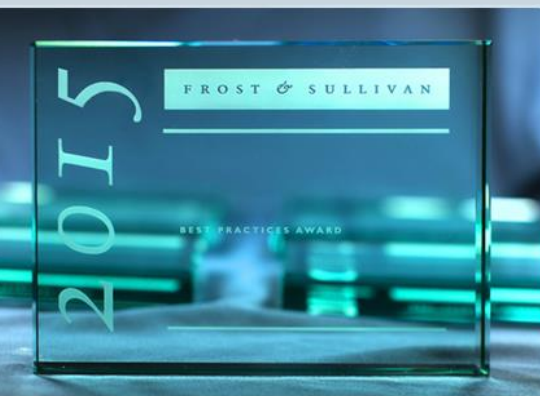


NOKIA

2015 North American Cyber Security Solutions for Utilities New Product Innovation Award



F R O S T & S U L L I V A N



50 Years of Growth, Innovation & Leadership

Contents

Background and Company Performance	3
<i>Industry Challenges</i>	3
<i>New Product Attributes and Customer Impact</i>	4
<i>Conclusion</i>	7
Significance of New Product Innovation	8
Understanding New Product Innovation	8
<i>Key Benchmarking Criteria</i>	9
Best Practice Award Analysis for Nokia	9
<i>Decision Support Scorecard</i>	9
<i>New Product Attributes</i>	10
<i>Customer Impact</i>	10
<i>Decision Support Matrix</i>	11
The Intersection between 360-Degree Research and Best Practices Awards.....	12
<i>Research Methodology</i>	12
Best Practices Recognition: 10 Steps to Researching, Identifying, and Recognizing Best Practices	13
About Frost & Sullivan	14

Background and Company Performance

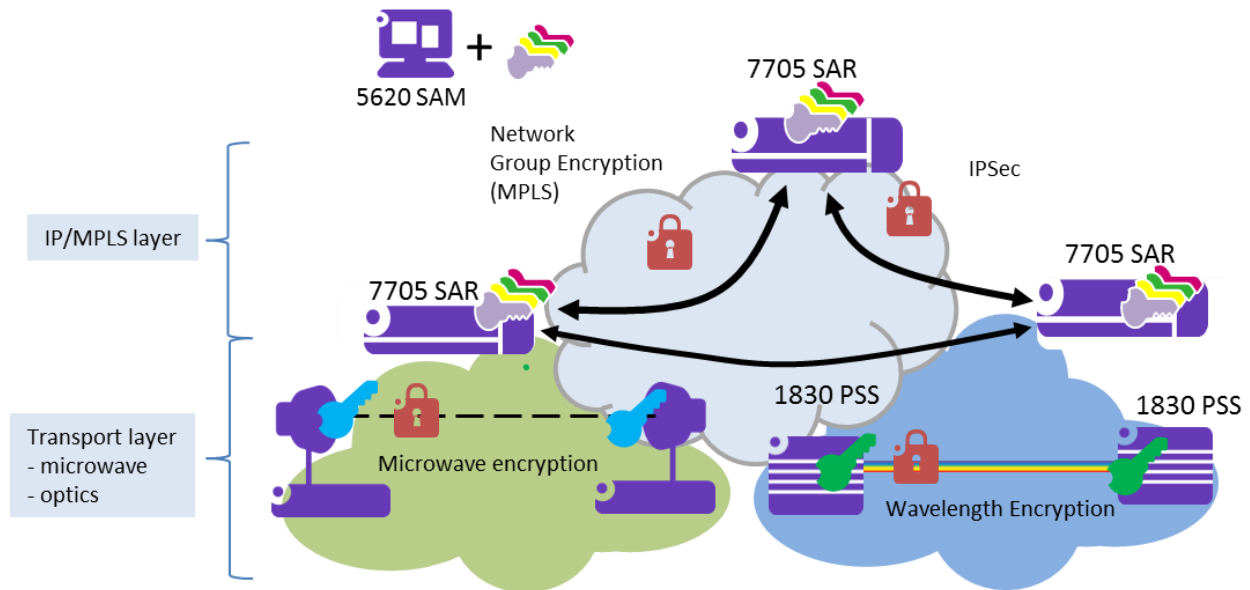
Industry Challenges

As utilities evolve, communications networks play an increasingly critical role in the implementation of their smart grid strategies. Routing and transport systems are being deployed not just in substations but also out in distribution and field area networks. From the utility perspective, these are quite difficult environments since they are not always under their physical control. These communications networks are often critical components of the grid management system as they enable the flow of data from teleprotection in transmission to advanced metering infrastructure (AMI) in the field area network. These applications, at some level, must be protected from intrusion from accidental or malicious events. It is of prime importance to utilities to keep their grid control traffic separated from their corporate traffic. This can be addressed with the segregation of traffic, which will isolate the control traffic from metering and other less critical utility traffic.

However, such technologies with appropriate security measures were unavailable until recently.

Also, time division multiplexing (TDM) technology is gradually becoming obsolete. The technology was fairly secure as it involved point-to-point circuits. However, the carriers who provided the technology, the business ecosystems that supported it and the vendors who supplied them are moving away from these systems. Most utilities currently have a plethora of TDM circuits which they use to run their grid systems. However, these will be unavailable very soon. Instead, utilities are transitioning from these old technologies to IP- and Ethernet-based technologies which enable ubiquitous connectivity. These technologies are typically transported across a multi-layer network infrastructure. Consequently, cyber security at multiple layers has become a top concern for utilities.

Nokia addresses the aforementioned challenges with a solution based on its 7705 Service Aggregation Router (SAR), 1830 Photonic Service Switch (PSS), 9500 Microwave Packet Radio (MPR) and 5620 Service Aware Manager (SAM). This solution provides not only IP/MPLS (multi-protocol label switching) routing/switching and optical/microwave transport functions but also immense flexibility in applying different levels of security to services at the IP/MPLS or transport layers. A conceptual diagram is shown below.



Nokia Multi-layer security solutions for utilities

New Product Attributes and Customer Impact

Criterion 1: Match to Needs

As explained previously, there is a pressing need to strengthen network security in the newer packet networks which are very often built with a mix of transmission technology: fiber, microwave or copper and even using carriers' services. The networks also carry a significant amount of non-IP traffic (such as legacy TDM, Ethernet and fiber channel) that needs to be secured.

The technology provided by Nokia enables the protection of universal traffic types in this aforementioned challenging environment, from grid applications such as teleprotection to the usual IT applications traffic to data center storage traffic. Nokia's technology enables encryption not only at the IP layer as a typical IPsec gateway does, but also at the MPLS and transport layers over both microwave and optical systems. Depending on their needs, utilities can choose the most suitable encryption scheme based on a best-fit approach. This flexibility completely eliminates the opportunity for anyone to launch any sort of man-in-the-middle attack or data theft in any part of the network using different types of transmission medium. Since the data is encrypted from end-to-end, or from the source to its destination, it ensures maximum protection. Therefore, even if somebody bends and couples into the fiber or intercepts a microwave signal non-invasively, they cannot read any data because it is all encrypted. Additionally, at the optics layer, received power levels are automatically monitored for variations that indicate line tampering. Any fluctuations create an intrusion alarm and may be pin-pointed with great precision.

Another feature of Nokia's approach is its protocol universality. The company's MPLS encryption feature, called Network Group Encryption (NGE), performs encryption at the MPLS layer for many data flow types including TDM, Ethernet and IP. Their wavelength encryption tackles fiber channel, FICON, HIPPI and Ethernet. This universal approach leaves no traffic 'naked' while traversing the network.

Criterion 2: Reliability

Because utility networks are mission-critical, the secure encryption tunnel also needs to be resilient. Nokia's NGE and wavelength encryption, being embedded at the MPLS and optical layers, fully leverage those layer's resiliency features. By design, these products are built for very high reliability through redundant equipment design and automatic protection switching.

Applying encryption usually means adding extra latency, which is a considerable challenge to some real-time grid and data center applications. Nokia designs these security technologies directly into the IP/MPLS, optics and packet microwave product lines which significantly reduced the latency to the range of microseconds. This is of critical importance while dealing with sensitive traffic, such as teleprotection and storage synchronous replication, whose latency requirements are in the range of 6 to 12 ms or 3 – 10 ms respectively. Therefore any extra milliseconds incurred by encryption can take a toll on protection reliability.

Criterion 3: Quality

Nokia offers a premium cyber security solution to utilities with its product suite consisting of various components, including the 7705 SAR IP/MPLS router, 1830 PSS optical transport platform and 9500 MPR packet microwave radio. The solution provides a full suite of encryption capabilities and additional security features including QoS-enabled service aware stateful firewall, NAT and of course, basic access control lists. All these are managed centrally with a policy-based approach from a multi-layer service-aware manager, the 5620 SAM. This combination is ideally suited to the needs of the utility market. This group of products gives the company a competitive edge in the market in terms of addressing security because an additional box or appliance is no longer required. There is also a Service Portal Express for Utilities management system, which is essentially a portal that works on the top of 5620 SAM to simplify daily tasks.

Criterion 4: Positioning

Nokia has embedded security features directly into its 7705 SAR and 1830 PSS. This has enabled the company to address the difficulties being faced by utilities so far. Making the security feature an inherent function of the IP/MPLS and transport platform enables it to support multiple security functions without performance degradation. A variety of Nokia's utility customers in both North America and Europe are deploying their IP/MPLS

technologies, which support these cyber security capabilities.

Nokia's strategy is to recommend the deployment of an IP/MPLS network atop microwave, wavelength division multiplexing (WDM)-based optics or dark fiber, supporting a whole range of services. Thus, security is of prime importance along with the capability to support different applications such as SCADA (supervisory control and data acquisition), teleprotection, and other critical services that can all run individually in different virtual private networks on top of a single network. According to Nokia, as it grows its business around IP routing and switching technologies, the company will continue to add more features to the product that enable utilities to further enhance security to address growing and changing threats. Nokia is also introducing new variants, such as the recently introduced 7705 SAR-Wx, which is an outdoor device fit for deployment out in distribution and field area networks.

As more bandwidth intensive grid and IT applications emerge, utilities can overlay IP/MPLS onto a dynamic WDM-based optical infrastructure with an 1830 PSS. As mentioned above, the 5620 SAM can provide cross-layer network management to optimize network operations.

When it comes to utility-specific developments, the needs of utilities are sophisticated, increasingly complex and often unique. To meet these needs, Nokia specifically tailors its utility solution to meet the feature requirements of its target utility customers.

Criterion 5: Design

On older IP platforms, security features were either implemented in a control processor which can be a scalability bottleneck, or in packet forwarding hardware which will see its performance reduced when security features are enabled. Nokia's IP/MPLS platform is designed with security features that can scale to meet its utility customers' requirements while retaining the needed forwarding performance. Its capability to embed encryption at the MPLS layer is unique in the market.

Nokia also recently introduced an optical encryption technology based on wavelength division multiplexing (WDM), where multiple wavelengths carrying separate traffic run over a single optical fiber. Nokia developed the encryption technology for its 1830 PSS which enables the encryption of individual wavelengths. Utilities may choose to encrypt individual wavelengths or an aggregate higher-rate optical line. This offers increased flexibility if different physical segmentation in the encryption process is required.

This has attracted considerable attention because wavelength-level encryption offers the ability to encrypt at the physical layer, agnostic to applications and protocols carried in the wavelength.

In addition, the company's 9500 MPR encryption also allows utilities to secure microwave

links rapidly and efficiently, independent of the traffic type carried.

Criterion 6: Price/Performance Value

The 7705 SAR is a fully featured IP/MPLS router with built-in firewall and encryption capabilities. Similarly, the 1830 PSS photonic switching and transport system offers integrated encryption as does the 9500 MPR. Through this approach of integrating encryption into all of its platforms for utilities, Nokia successfully improved the network's reliability by using fewer devices that take up less space and consume less power. This innovation is particularly useful to facilities such as utility substations, and makes the Nokia technology very cost effective.

Conclusion

The Nokia 7705 SAR, 1830 PSS, 9500 MPR and 5620 SAM form a high performance, security solution which makes it highly appropriate for use by utilities. Implementing these IP/MPLS and transport communications network building blocks aligns perfectly with the smart grid strategies adopted by various utilities. Moreover, Nokia brought together the best of its previous generation of technologies and addresses the modern day challenges with its innovation.

With its strong overall performance, Nokia has earned Frost & Sullivan's 2015 New Product Innovation Award for Cyber Security Solutions for Utilities.

Significance of New Product Innovation

Ultimately, growth in any organization depends upon continually introducing new products to the market, and successfully commercializing those products. For these dual goals to occur, a company must be best-in-class in three key areas: understanding demand, nurturing the brand, and differentiating from the competition.



Understanding New Product Innovation

Innovation is about finding a productive outlet for creativity—for consistently translating ideas into high quality products that have a profound impact on the customer.

Key Benchmarking Criteria

For the New Product Innovation Award, Frost & Sullivan analysts independently evaluated two key factors— New Product Attributes and Customer Impact—according to the criteria identified below.

New Product Attributes

- Criterion 1: Match to Needs
- Criterion 2: Reliability
- Criterion 3: Quality
- Criterion 4: Positioning
- Criterion 5: Design

Customer Impact

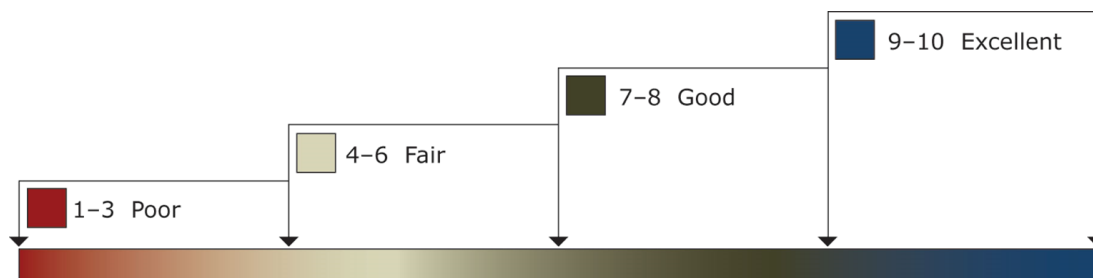
- Criterion 1: Price/Performance Value
- Criterion 2: Customer Purchase Experience
- Criterion 3: Customer Ownership Experience
- Criterion 4: Customer Service Experience
- Criterion 5: Brand Equity

Best Practice Award Analysis for Nokia

Decision Support Scorecard

To support its evaluation of best practices across multiple business performance categories, Frost & Sullivan employs a customized Decision Support Scorecard. This tool allows our research and consulting teams to objectively analyze performance, according to the key benchmarking criteria listed in the previous section, and to assign ratings on that basis. The tool follows a 10-point scale that allows for nuances in performance evaluation; ratings guidelines are illustrated below.

RATINGS GUIDELINES



The Decision Support Scorecard is organized by New Product Attributes and Customer Impact (i.e., the overarching categories for all 10 benchmarking criteria; the definitions for each criteria are provided beneath the scorecard). The research team confirms the veracity of this weighted scorecard through sensitivity analysis, which confirms that small changes to the ratings for a specific criterion do not lead to a significant change in the overall relative rankings of the companies.

The results of this analysis are shown below. To remain unbiased and to protect the interests of all organizations reviewed, we have chosen to refer to the other key players as Competitor 2 and Competitor 3.

DECISION SUPPORT SCORECARD FOR NEW PRODUCT INNOVATION AWARD

<i>Measurement of 1–10 (1 = poor; 10 = excellent)</i>			
New Product Innovation	New Product Attributes	Customer Impact	Average Rating
Nokia	9.5	8.5	9.00
Competitor 2	7	7.5	7.25
Competitor 3	6	7	6.50

New Product Attributes

Criterion 1: Match to Needs

Requirement: Customer needs directly influence and inspire the product's design and positioning

Criterion 2: Reliability

Requirement: The product consistently meets or exceeds customer expectations for consistent performance during its entire life cycle

Criterion 3: Quality

Requirement: Product offers best-in-class quality, with a full complement of features and functionality

Criterion 4: Positioning

Requirement: The product serves a unique, unmet need that competitors cannot easily replicate

Criterion 5: Design

Requirement: The product features an innovative design, enhancing both visual appeal and ease of use

Customer Impact

Criterion 1: Price/Performance Value

Requirement: Products or services offer the best value for the price, compared to similar offerings in the market

Criterion 2: Customer Purchase Experience

Requirement: Customers feel like they are buying the most optimal solution that addresses both their unique needs and their unique constraints

Criterion 3: Customer Ownership Experience

Requirement: Customers are proud to own the company's product or service, and have a positive experience throughout the life of the product or service

Criterion 4: Customer Service Experience

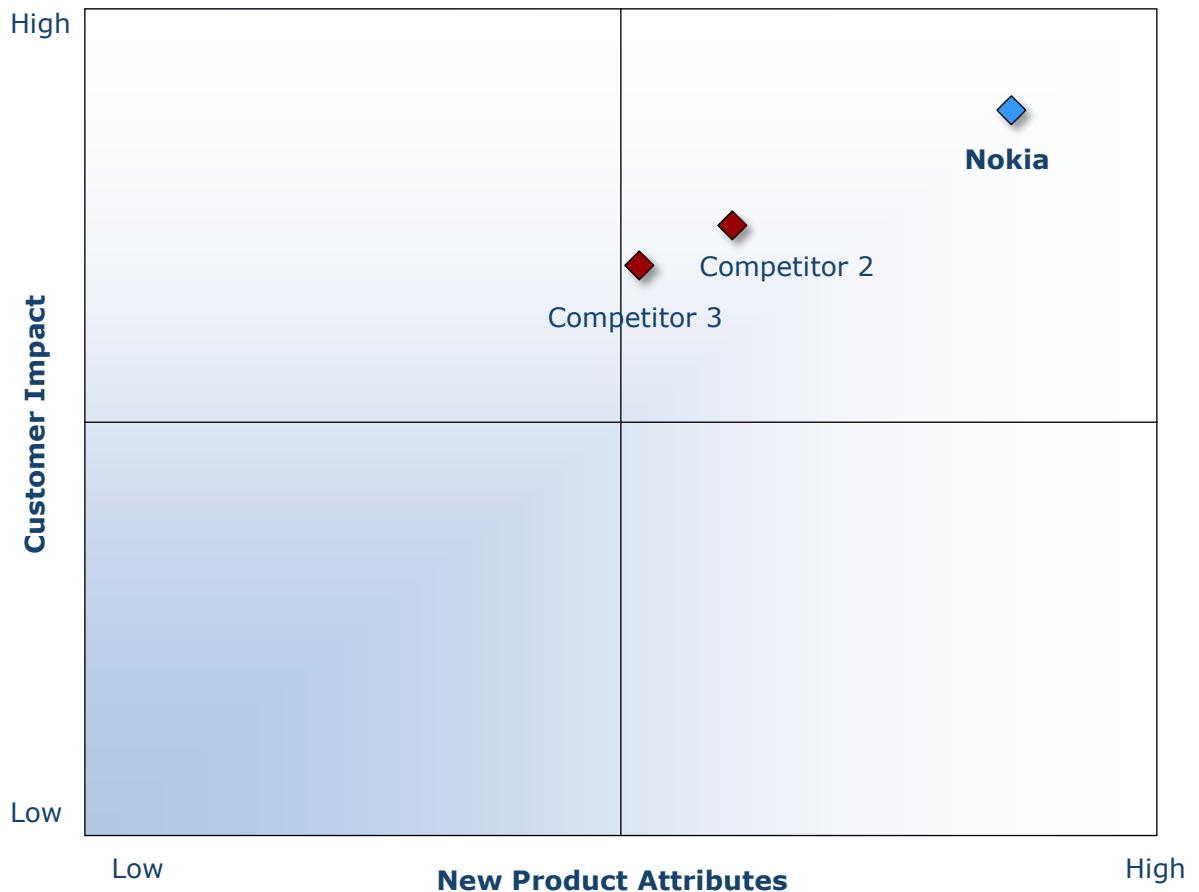
Requirement: Customer service is accessible, fast, stress-free, and of high quality

Criterion 5: Brand Equity

Requirement: Customers have a positive view of the brand and exhibit high brand loyalty

Decision Support Matrix

Once all companies have been evaluated according to the Decision Support Scorecard, analysts can then position the candidates on the matrix shown below, enabling them to visualize which companies are truly breakthrough and which ones are not yet operating at best-in-class levels.

DECISION SUPPORT MATRIX FOR NEW PRODUCT INNOVATION AWARD

The Intersection between 360-Degree Research and Best Practices Awards

Research Methodology

Frost & Sullivan's 360-degree research methodology represents the analytical rigor of our research process. It offers a 360-degree-view of industry challenges, trends, and issues by integrating all 7 of Frost & Sullivan's research methodologies. Too often, companies make important growth decisions based on a narrow understanding of their environment, leading to errors of both omission and commission. Successful growth strategies are founded on a thorough understanding of market, technical, economic, financial, customer, best practices, and demographic analyses. The integration of these research disciplines into the 360-degree research methodology provides an evaluation platform for benchmarking industry players and for identifying those

360-DEGREE RESEARCH: SEEING ORDER IN THE CHAOS



performing at best-in-class levels.

Best Practices Recognition: 10 Steps to Researching, Identifying, and Recognizing Best Practices

Frost & Sullivan Awards follow a 10-step process to evaluate award candidates and assess their fit with select best practice criteria. The reputation and integrity of the Awards are based on close adherence to this process.

STEP	OBJECTIVE	KEY ACTIVITIES	OUTPUT
1 Monitor, target, and screen	Identify award recipient candidates from around the globe	- Conduct in-depth industry research - Identify emerging sectors - Scan multiple geographies	Pipeline of candidates who potentially meet all best-practice criteria
2 Perform 360-degree research	Perform comprehensive, 360-degree research on all candidates in the pipeline	- Interview thought leaders and industry practitioners - Assess candidates' fit with best-practice criteria - Rank all candidates	Matrix positioning all candidates' performance relative to one another
3 Invite thought leadership in best practices	Perform in-depth examination of all candidates	- Confirm best-practice criteria - Examine eligibility of all candidates - Identify any information gaps	Detailed profiles of all ranked candidates
4 Initiate research director review	Conduct an unbiased evaluation of all candidate profiles	- Brainstorm ranking options - Invite multiple perspectives on candidates' performance - Update candidate profiles	Final prioritization of all eligible candidates and companion best-practice positioning paper
5 Assemble panel of industry experts	Present findings to an expert panel of industry thought leaders	- Share findings - Strengthen cases for candidate eligibility - Prioritize candidates	Refined list of prioritized award candidates
6 Conduct global industry review	Build consensus on award candidates' eligibility	- Hold global team meeting to review all candidates - Pressure-test fit with criteria - Confirm inclusion of all eligible candidates	Final list of eligible award candidates, representing success stories worldwide
7 Perform quality check	Develop official award consideration materials	- Perform final performance benchmarking activities - Write nominations - Perform quality review	High-quality, accurate, and creative presentation of nominees' successes
8 Reconnect with panel of industry experts	Finalize the selection of the best-practice award recipient	- Review analysis with panel - Build consensus - Select winner	Decision on which company performs best against all best-practice criteria
9 Communicate recognition	Inform award recipient of award recognition	- Present award to the CEO - Inspire the organization for continued success - Celebrate the recipient's performance	Announcement of award and plan for how recipient can use the award to enhance the brand
10 Take strategic action	Upon licensing, company may share award news with stakeholders and customers	- Coordinate media outreach - Design a marketing plan - Assess award's role in future strategic planning	Widespread awareness of recipient's award status among investors, media personnel, and employees

About Frost & Sullivan

Frost & Sullivan, the Growth Partnership Company, enables clients to accelerate growth and achieve best in class positions in growth, innovation and leadership. The company's Growth Partnership Service provides the CEO and the CEO's Growth Team with disciplined research and best practice models to drive the generation, evaluation and implementation of powerful growth strategies. Frost & Sullivan leverages almost 50 years of experience in partnering with Global 1000 companies, emerging businesses and the investment community from 31 offices on six continents. To join our Growth Partnership, please visit <http://www.frost.com>.