FROST & SULLIVAN

BEST PRACTICES AWARDS

cradlepoint

2020 GLOBAL 5G WIRELESS WIDE AREA NETWORK SOLUTIONS PRODUCT LEADERSHIP AWARD

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The scope of Frost & Sullivan's 5G coverage deals with all aspects of the mobile value chain, from network infrastructure to innovative services and use cases. This award focuses on one specific set of use cases for 5G: Wireless Wide Area Networks (WWAN).

A 5G Primer

The first generation of wireless communication technology (1G) was introduced when NTT launched the first commercial cellular network in Tokyo in 1979. Successive generations have followed, approximately every 10 years since. Analog voice was the primary 1G service. 2G brought digital voice and began to introduce data services with SMS text messages. Internet access came with 3G and became much faster with the introduction of 4G in 2009. 4G itself continues to evolve, starting with 4G Long Term Evolution (LTE), and progressing with 4G LTE-Advanced and 4G LTE-A Pro.

When a new "generation" comes about, the changes are significant enough to require updated devices to access this new technology. In other words, a 4G LTE device cannot access a 5G network. A 5G device, however, is backward compatible and can access 5G networks and previous generations of network technologies, including 4G LTE. 5G is designed to use the radio frequency (RF) spectrum differently and more efficiently; for this reason, 5G is referred to as 5G New Radio (NR).

4G LTE utilizes discrete frequency bands starting at 450 megahertz (MHz) and rising to nearly 6 gigahertz (GHz), most with channel bandwidths of 20 MHz or smaller. (The majority of 4G LTE coverage comes from the lower end of this range below 2 GHz.) Frequency bands for 5G NR are separated into two different frequency ranges; sub-6GHz frequency bands (some of which align with 4G bands and some of which are new); and new frequency bands from approximately 24 GHz up to (eventually) 86 GHz—the so-called millimeter wave range.[1] Channel bandwidths of the new 5G ranges are generally larger than for 4G LTE, with the channel bandwidths in the millimeter wave range being much larger.

If you found the previous paragraph confusing, you are likely not alone. However, a couple of key points can help simplify the intricacies of 5G spectrum. Think of "bandwidth" as capacity. If there is greater bandwidth, more data can be transmitted at one time, and data rates correspondingly increase. The lower frequency bands are quite crowded by multiple generations of cellular use, along with a considerable amount of other use, so the bandwidth that can be allocated is quite small. More bandwidth/capacity can be allocated at higher frequency bands, particularly in the millimeter wave range. Finally, without designated

[1] The millimeter wave region of the electromagnetic spectrum officially corresponds to 30 GHz to 300 GHz. As most of the new higher frequency range for 5G NR—24 GHz to 86 GHz—is in the millimeter wave region, it is common to refer to all of the new higher frequency ranges for 5G NR as "millimeter waves."

spectrum, which is typically assigned by and purchased from local government, communications service providers (CSPs) cannot launch 5G NR.

Hertz (Hz) is a unit of frequency and is defined as one cycle per second. One MHz is one million cycles per second, and one GHz is one billion cycles per second. As frequency increases, keeping all other things equal, more information can be delivered in a given amount of time; data rates also increase. Combined with more available bandwidth, spectrum plays a huge role in making 5G NR much "faster" than 4G LTE.

However, there are some big tradeoffs that need to be discussed around spectrum. Lower frequency bands can cover a much larger area than higher frequency bands. Cell towers enabling 4G LTE may be miles apart; but to utilize higher frequencies for 5G NR, there will need to be more antennas that are much closer together.[2] In addition, lower frequencies travel through buildings, trees, and weather, whereas higher frequencies can be disrupted. Lower frequency bands equal lower bandwidth, but greater coverage and reliability. Higher frequency equals enormous bandwidth with limited coverage that can be disrupted. The final word on spectrum is that 5G NR will need a wide range of spectrum in lower frequency bands, in higher frequency bands, and in the mid-ranges, as each enables different needs.

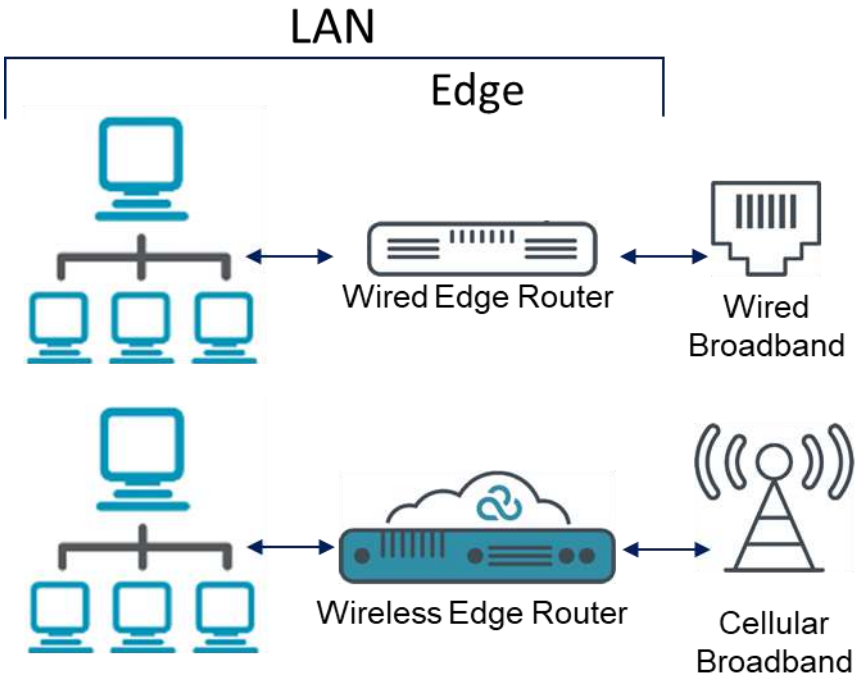
What is a WWAN and what does 5G have to do with it?

A local area network (LAN) is something most utilize at home and at work. A LAN connects computers and devices together, often within the same building. A LAN can be wired or wireless. The most common wireless LAN technology is WiFi.

A wide area network (WAN) connects many LANs over a larger physical area. This could be something like a college campus or a large enterprise with many buildings. This could also be something like a business with branches spread out over a city, a state, or even a nation. Each branch has a LAN, but each branch must also be able to connect to the larger corporate WAN. Think of a retail store that has its own LAN with computers and applications running, such as point-of-sale computers. For the corporate office to understand how all its branches are doing, the individual store LANs must connect to the corporate headquarters, which may thousands of miles away. The connection between a LAN and a WAN is through an "edge" router. (The router is at the "edge" of the LAN and connects to another network.) The connection may be wired or wireless. This is shown in the figure below. For most fixed locations, say a branch office, most connections are currently wired, but that may eventually change for reasons discussed later.

[2] Spectrum is only one driver for this "network densification." Adding capacity by adding more cell sites, often using small cells, is a normal activity in capacity-strained areas with 4G LTE. As 5G NR progresses, the requirements for both higher per-user data rates and an overall higher system capacity will require network densification even when operating in the lower frequency ranges.

Figure: LAN and Edge Routers



Source: Frost & Sullivan, Cradlepoint

WWAN goes beyond connecting branches. There are an increasing number of mobile "locations" that need to connect to a WAN; examples include field service employees and their vehicles, pop-up retail locations, or public safety personnel such as police officers and their vehicles. Because these connections move, a wireless connection is essential. The technologies that enable these wireless connections are primarily 4G LTE and 5G NR.

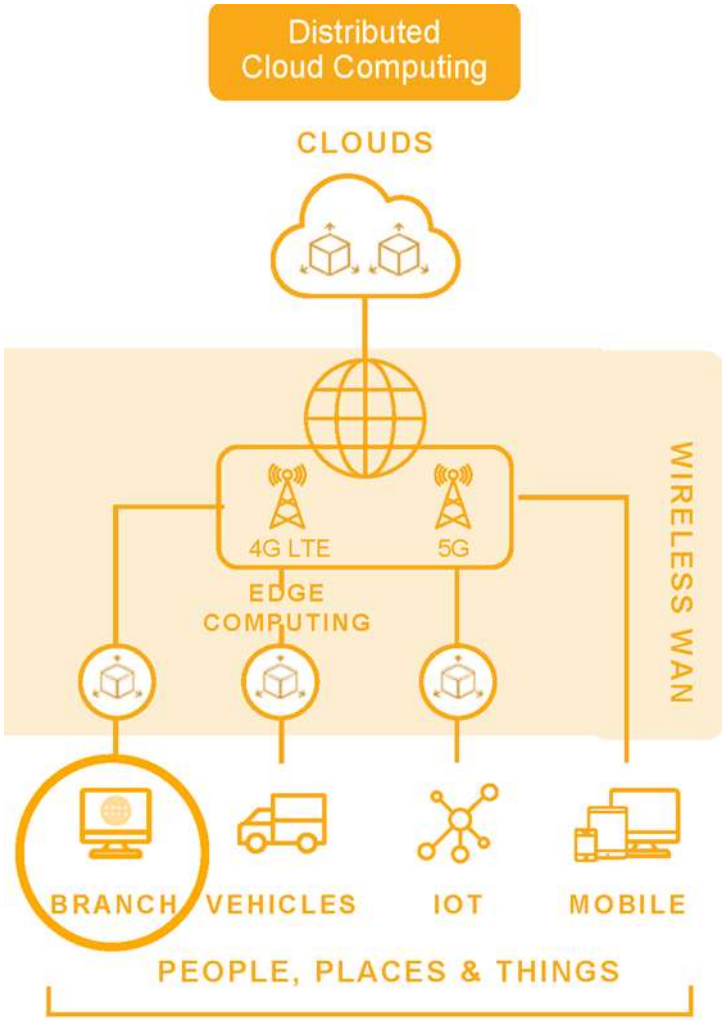
WWAN also connects devices and enables the Internet of Things (IoT). Discussions of IoT often talk of factories, but the devices being connected continue to expand. Police officers were discussed above, and it is easy to imagine connecting an officer's laptop to the WWAN. There a number of sensors in a police vehicle or on the police officer's body that also connect via the WWAN:

- When the siren is turned on, a sensor notifies police headquarters.
- When the shotgun in the car is removed from its holder, a sensor notifies police headquarters.
- When the police officer removes their Taser from its holster, a sensor notifies police headquarters.

These are just a few examples of IoT devices within this one specific police-related illustration.

As shown in the figure below, the WWAN connects people, places, and things utilizing 4G LTE and now, 5G NR.

Figure: Wireless Wide Area Networks



Source: Cradlepoint

As 4G LTE has evolved, becoming faster and more available, and as 5G NR promises even faster connections, the possibilities for WWAN have expanded. Initially, 4G LTE was used as a backup to fixed connections[3] and for those situations where the "location" was mobile. (Edge routers may have primary and backup connections and either may be wired or wireless.) The speed of 4G in some areas have increased enough that some fixed locations may now weigh the advantages and disadvantages of using a wireless WAN connection as the primary connection (and perhaps the backup connection with a different wireless service provider.) As the availability of 5G increases, WWAN becomes even more compelling.

[3] While fixed connections tend to be reliable, disruptions can occur, such as a fiber optics cable being accidently cut. For many businesses, being disconnected, even for a short period of time, can be very expensive. As such, having a primary and a backup connection can be prudent.

When comparing wired WAN and wireless WAN, there are a number of considerations, with these likely being top-of-mind:

- How do costs compare for installation and for ongoing operation?
- Who provides the wired or wireless service? Are there choices? Do these same providers operate in all the areas that need coverage?
- How many wired broadband providers does it take to cover my distributed WAN? Cellular is unique in its ability to cover the US and even global footprints with just a few wireless operators vs. 10's or even 100's of wired ISPs.
- Do both options cover technical needs (download speeds, upload speeds, reliability, etc.)?

(The above considerations and discussion below are branch- or campus-centric, where wired WAN is an option. In mobile situations, where wired WAN is NOT an option, factors to be considered are similar.)

As mentioned above, 4G LTE has progressed to where the technical differences have become less differentiated and 5G NR promises big improvements across the board. Different locations will have different coverage from 4G and/or 5G, so the answer for one branch may differ from another (and may change over time.) 4G speeds may vary. Gigabit LTE (LTE Advanced Pro) continues to rollout across the US and provides a stepping-stone to 5G. With 5G NR, the different frequency options will offer an even greater range of possibilities

Providers of wired and wireless connections compete, so the costs for ongoing operations should be competitive. (This also changes by location, as the number of competitors will be different in different areas.) However, there is also another ongoing operations concern: what if the edge router has issues? It is unlikely that every branch has an IT department…those operating the WAN are more likely in a different location. Ongoing operation must be able to be handled from a distance—in other word, management and operations of edge routers must be cloud-based.

Installation costs may be a differentiator, again depending on location. For a greenfield operation, establishing the wired connection may take considerable time and money. Or in an established location, the wired connection may be quicker and cheaper. Wired connection installation could take days or months (MPLS circuits typically talk anywhere form 30-90 days to be installed. Cable and DSL is often taking weeks or more.) A wireless connection should be more standard, with less dependency on location. Wireless connections should be able to be established in as little as a day.[4] (For both wired and wireless connection, there is the assumption that equipment needs to ship to the location to make that connection…that is why the low-end of the time estimate is days and not hours. Another consideration is the installation of the shipped equipment: does it need an

[4] Cradlepoint, for example, ships directly to the customer site overnight with a SIM already inserted.

IT specialist onsite or can a lesser trained person physically install the equipment and technical setup be done remotely?)

One key consideration is suppliers of wired and wireless service and perhaps not in the way one might think. There are hundreds of options across the US for wired WAN connections. There are essentially three national wireless service providers in the US. While more competition is good, there is a cost of doing business with many different suppliers—paying many suppliers every month costs more than paying fewer. One national company with over 10,000 branches was working with over 600 wired suppliers across the country. The overhead of dealing with that many suppliers adds expense (and complexity.) Those 10,000 branches could be covered by one, two, or three national wireless service providers.

One company that helps enterprises of all sorts with their wireless WAN needs, including support for 5G NR, is Cradlepoint.

Cradlepoint Profile

Established in 2006 and acquired by Ericsson in late 2020, Cradlepoint is a wireless networking company with headquarters in Boise, Idaho. The company also has a development center in California in the Silicon Valley and international offices in the UK and Australia. Cradlepoint delivers 4G LTE and now 5G NR network solutions to businesses, service providers, and government organizations. The company reports "more than 23,000+ customers worldwide in retail, financial services, healthcare, transportation, public sector, and other industries rely on Cradlepoint to keep their branch and mobile networks, and IoT devices, always connected and protected."

Cradlepoint primary focus is on WWAN solutions for enterprise, specifically wireless edge routers and endpoints that are managed from the cloud. The company has been a leader in cloud-managed 4G LTE and gigabit 4G network edge solutions and has become the first supplier of 5G NR edge solution for enterprise. The company has a range of edge routers and endpoints that serve branches, vehicles, and other mobile applications. The company also offers IoT solutions. Cradlepoint is the only company that covers the wide range of WWAN needs within the same product portfolio.

Cradlepoint solutions start with its NetCloud Service, a cloud-based management and orchestration solution. Each wireless edge solution can be managed from anywhere and all of a customer's Cradlepoint solutions—whether it is one edge router or thousands of routers and endpoints—can be managed from a single location (or many locations). The NetCloud Service enables zero-touch installation and ongoing management of the endpoint, including LTE and 5G connection management, WAN edge routing, security services, and IoT services. The service includes analytics and insights and extensibility tools.

While the company offers a number of solutions depending on the needs of the enterprise, this profile will highlight Cradlepoint's new portfolio of 5G-capable wireless edge solutions. Specifically, the Cradlepoint W-Series 5G Wideband Adapters that provide an Ethernet-remotable 5G modem and antenna system in both indoor and outdoor units that spans

low, mid, and high-band 5G connections, and the E-3000 Series described as a clean-sheet design of "the industry's first 5G-Optimized, all-in-one wireless edge router for enterprise branch deployment".

According to Cradlepoint:

> *The W-Series 5G Wideband Adapters are controlled and managed by the Cradlepoint NetCloud Service and are based on the company's software-driven modem technology. The W-Series is designed to support the wide range of 5G deployments by wireless operators around the world based on low-band, mid-band, and millimeter-wave spectrum, and can be remotely connected to a Cradlepoint E3000 or customer premise router using 1Gbps or 2.5Gbps Ethernet or a fiber connection. Integrated Wi-Fi 6 support enables local configuration and future use cases. A new 5G, field-upgradable 5G modular router modem for the E3000 – the MC500 -- is also scheduled for introduction in early 2021.*
>
> *The new Cradlepoint E3000 Series wireless edge router is 5G-Optimized and engineered to be a companion branch router for the W-Series, interconnecting over a high-speed 2.5Gbps Ethernet port. Pairing it with a W2000 indoor unit gives customers a complete wireless WAN solution for low-band and mid-band (Sub-6) 5G while pairing with the W4005 outdoor unit delivers high-band (millimeter wave). Additionally, the E3000 expansion port will accommodate the new MC500 field-upgradable 5G modular modem (Sub-6) planned for early 2021.*
>
> *Packaged as part of the Cradlepoint NetCloud Enterprise Branch Service, the E3000 Series utilizes the latest multi-core, wireless system-on-chip technology to deliver compelling price/performance relative to traditional wired branch routers. The all-new, all-in-one design provides a mid-sized, enterprise-class "branch-in-a-box" solution. In a compact footprint, the E3000 contains an embedded Gigabit-Class LTE modem, integrated Wi-Fi 6, gigabit Ethernet ports for WAN/LAN connectivity, and expansion slots accommodate a secondary LTE modem module today with 5G modem and Bluetooth 5.0 modules slated for later in 2020.*
>
> *The powerful E3000 can run processor-intensive WAN edge features within the NetCloud Service at gigabit speeds, including BGP routing and application-aware SD-WAN and security functions, such as firewall, analytics, IPS/IPS and content filtering. It also supports customizable services like Wi-FI guest portal and IoT edge computing capabilities.*
>
> *The Cradlepoint E3000 Series provides a graceful pathway to 5G and is ideal for branch-oriented industry sectors that need the flexibility and freedom of primary wireless connections with robust WAN and LAN networking and security capabilities. These include retail stores, restaurants, healthcare clinics, financial services locations — such as banking, insurance, and tax preparation — construction sites, and field service offices.*

Cradlepoint reports its solutions offer the most options for enterprise to move their WWAN from 4G LTE to 5G NR. This is essential, as 5G coverage is still limited in many (or most) areas.

Frost & Sullivan Perspective

Cradlepoint created a new market segment over the last 5 years: wireless wide area networks for enterprise. The company leads the 4G LTE WWAN market, with an impressive list of customers. In the process, the company reports "more than 23,000 enterprise and government organizations around the world — including 75 percent of the world's top retailers, 50 percent of the Fortune 100, and first responder agencies in 25 of the largest US cities — rely on Cradlepoint to keep critical fixed and mobile sites, points of commerce, field forces, vehicles, and IoT devices always connected and protected." In addition, the company reports one million NetCloud endpoints under subscription. **As a preeminent market-maker in 4G, and by delivering the world's first enterprise-grade 5G solutions, Cradlepoint is the demonstrated leader in 5G for business.**

Product Family Attributes and Business Impact

Frost & Sullivan's 2020 Product Leadership Award for 5G Wireless Wide Area Networks is judged based on ten criteria described later in this document. The following details a selection of the comparisons from the ten criteria.

Match to Needs

Wireless WAN is a relatively new concept, primarily because the wireless technology (4G LTE) had to reach a certain level of availability and capability for WWAN to make sense. Initially, WWAN was viewed as a backup mechanism or only for mobile endpoints.

Today, 4G LTE is highly available in most areas and in some locations, 4G LTE is now fast enough to make WWAN attractive to a much larger enterprise audience.

Cradlepoint has driven this new market and continues to enhance and evolve its offerings to **match the needs** of its large customer base. Examples include the company's NetCloud Service offering (tied to all its endpoints) and its new 5G NR endpoints. Cradlepoint's customers may have hundreds or thousands of branches, most with no technical staff, that they need to connect. NetCloud allows installation and operation of endpoints from anywhere. Cradlepoint is the first to deploy 5G NR routers and endpoints starting with its partnership with Telstra in Australia. The E3000 series edge router and the W-Series 5G Wideband Adapters are designed to help customers make the transition to 5G as it is possible and as it makes sense. These products support branches connecting with 4G LTE, gigabit-speed 4G LTE, or with any of the frequencies available for 5G NR, and also support fiber (STP+) and 2.5Gbps Ethernet. (The roadmap of these products enables the endpoints to evolve as the technology and availability of 5G NR evolves.)

Reliability and Quality, Product/Service Value

How does a company become a market leader? Simply put, they offer solutions that feature **reliability and quality** that meet the needs of a market at a level of **value** that meets the budgets of the market participants.

With a customer base that includes more than 23,000+ enterprise and government organizations and more than a million endpoints, Cradlepoint is doing something very well. With 75 percent of the world's top retailers, 50 percent of the Fortune 100, and first responder agencies in 25 of the largest US cities, Cradlepoint is meeting the reliability and quality and value requirements of a large portion of the market.

Financial Performance, Customer Acquisition, Growth Potential

The fixed WAN market is more established and larger, but with advances in wireless technologies with 4G LTE and 5G NR, the wireless WAN market is growing, with the potential to grow significantly over the next few years.

Cradlepoint is in a great position. The company helped define this market segment and controls a significant portion of the 4G LTE WWAN market, with a large customer base. The company continue to enhance and evolve its solutions, including by introducing 5G NR WWAN routers and endpoints this year.

As private company in the recent past, some financial details about Cradlepoint are not publicly known. However, Frost & Sullivan believes:

- The **financial performance** of Cradlepoint in general is strong, given its leadership position in the 4G LTE WWAN market. With the introduction 5G NR solutions, the company's position should only improve.
- The potential for new **customer acquisition** is high and improving. While Cradlepoint has a large customer base, the *potential* customer base is much larger. As 5G becomes more prevalent, the attractiveness of WWAN for enterprise increases. Many enterprises that utilize fixed WAN will evaluate the move to WWAN and Cradlepoint will benefit.
- The **growth potential** for Cradlepoint is excellent. The market for WWAN has been increasing as 4G LTE capabilities have increased. Even without 5G, Frost & Sullivan would rate the company's growth potential as high. With 5G rolling out globally and Cradlepoint ahead of its competitors in addressing this market, the company is poised to continue both its market leadership and its product leadership for the foreseeable future.

Conclusion

Cradlepoint has lead the new market segment, wireless wide area network over the last 5 years and has introduced the world's first 5G solutions for business. In the process, the company reports "more than 23,000+ customer worldwide in retail, financial services, healthcare, transportation, public sector, and other industries rely on Cradlepoint to keep their branch and mobile networks, and IoT devices, always connected and protected." In addition, the company reports one million NetCloud endpoints under subscription. Now, with first mover advantage in 5G WWAN, the company looks to continue its market and product leadership.

With its strong overall performance, Cradlepoint has earned Frost & Sullivan's 2020 Product Leadership Award for 5G Wireless Wide Area Network Solutions.

Significance of Product Leadership

Ultimately, growth in any organization depends on customers purchasing from a company and then making the decision to return time and again. A comprehensive product line filled with high-quality, value-driven options is the key to building an engaged customer base. To achieve and maintain product excellence, an organization must strive to be best in class in three key areas: understanding demand, nurturing the brand, and differentiating from the competition.

Understanding Product Leadership

Demand forecasting, branding, and differentiating all play critical roles in finding growth opportunities for your product line. This three-fold focus, however, must be complemented by an equally rigorous focus on pursuing those opportunities to a best-in-class standard. Customer communication, customer feedback, pricing, and competitor actions must all be managed and monitored for ongoing success. If an organization can successfully parlay product excellence into positive business impact, market share will inevitably increase.

Key Benchmarking Criteria

For the Product Leadership Award, Frost & Sullivan analysts independently evaluated 2 key factors—Product Family Attributes and Business Impact—according to the criteria identified below.

Product Family Attributes

Criterion 1: Match to Needs

Requirement: Customer needs directly influence and inspire the design and positioning of the product family.

Criterion 2: Reliability and Quality

Requirement: Products consistently meet or exceed customer expectations for performance and length of service.

Criterion 3: Product/Service Value

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

Criterion 4: Positioning

Requirement: Products or services address unique, unmet needs that competitors cannot easily replicate or replace.

Criterion 5: Design

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

Business Impact

Criterion 1: Financial Performance

Requirement: Overall financial performance is strong in terms of revenue, revenue growth, operating margin, and other key financial metrics.

Criterion 2: Customer Acquisition

Requirement: Product strength enables acquisition of new customers, even as it enhances retention of current customers.

Criterion 3: Operational Efficiency

Requirement: Staff is able to perform assigned tasks productively, quickly, and to a high quality standard.

Criterion 4: Growth Potential

Requirements: Product quality strengthens brand, reinforces customer loyalty, and enhances growth potential.

Criterion 5: Human Capital

Requirement: Company culture is characterized by a strong commitment to product quality and customer impact, which in turn enhances employee morale and retention.

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

Frost & Sullivan analysts follow a 10-step process to evaluate award candidates and assess their fit with select best practices 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 world	Conduct in-depth industry research Identify emerging industries Scan multiple regions	Pipeline of candidates that 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 practices criteria Rank all candidates	Matrix positioning of all candidates' performance relative to one another
3	**Invite thought leadership in best practices**	Perform in-depth examination of all candidates	Confirm best practices 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 practices 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 practices award recipient	Review analysis with panel Build consensus Select recipient	Decision on which company performs best against all best practices criteria
9	**Communicate recognition**	Inform award recipient of recognition	Announce 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 is able to share award news with stakeholders and customers	Coordinate media outreach Design a marketing plan Assess award's role in strategic planning	Widespread awareness of recipient's award status among investors, media personnel, and employees

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, resulting in 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 participants and for identifying those performing at best-in-class levels.

360-Degree Research: Seeing Order in the Chaos

About Frost & Sullivan

Frost & Sullivan, the Growth Partnership Company, helps clients 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 practices models to drive the generation, evaluation, and implementation of powerful growth strategies. Frost & Sullivan leverages nearly 60 years of experience in partnering with Global 1000 companies, emerging businesses, and the investment community from 45 offices on 6 continents. To join Frost & Sullivan's Growth Partnership, visit http://www.frost.com.