FROST & SULLIVAN

BEST PRACTICES AWARDS

csg

2020 GLOBAL 5G MONETIZATION NEW PRODUCT INNOVATION AWARD

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5G – A Catalyst for Hyperconnectivity

5G represents a fundamental shift in communication network architectures that will accelerate revenue generation through innovative services facilitated via 5G-enabled smartphones, tablets, laptops, and Internet of Things (IoT) devices. 5G will deliver a potent combination of network capabilities and flexible options for network deployments, service delivery, and network management to improve the ability to deliver a differentiated, customized, and scalable wireless service experience. 5G networks will be optimized to support various traffic profiles, including Enhanced Mobile Broadband (eMBB) for video/streaming, Ultra-Reliable and Low-Latency Communications (uRLLC) for a wide range of industry use cases, and Massive Machine Type Communications (mMTC) to support large-scale machine-centric communications such as the IoT.

Diversity of Use Cases Complicate Monetization

5G networks are significantly more dynamic than 4G networks, with new capabilities such as network slicing and microservices provided by logical network nodes distributed dynamically using the core tenets of distributed cloud computing. The interfaces into the network from a monetization perspective are more dynamic as well. The core network functions for charging and billing interfaces are rapidly instantiated and automatically scaled in 5G. Moreover, the evolution from physical network infrastructure to network function virtualization (NFV) that took place with IMS deployments continues with cloud native network functions for 5G, further adding to the complexity of implementing and integrating 5G monetization solutions.

The key challenges for 5G monetization include:

- **Charging volumes**. High capacity 5G core and radio network will support a large number of devices, the majority of which will be IoT. While these devices may not generate real time charging transactions, a massive volume of devices will still create processing and performance challenges for charging systems.
- **Dynamic networks**. The ability to create network slices to support different quality-of-service (QoS) or performance profiles dynamically will create more variability in charging. The demands on charging will have significantly more variability than what has been experienced with 4G.
- **Protocol evolution**. In the near term, there exists an integration challenge related to the inability to directly integrate the 5G core network functions into the currently deployed 4G Online Charging System (OCS) and offline BSS as the protocols (Diameter vs. HTTP2/JSON) are fundamentally different.
- **Technology enhancements**. Aspects such as service based interfaces (SBI), expanded role of the charging functions, dynamic network function discovery and integration, support for business model experimentation, 5G QoS enablement, low

latency operations and billing for enterprise functions introduce new requirements for charging that require newer technologies and implementation approaches.

- **Auditing challenges**. 5G Core networks do not create event data records (EDR); they rely on the charging function to capture all online and offline usage. Volatile charging interfaces and dynamic instantiation of network functions for new slices make auditing 5G Core more difficult. This can be compounded by 5G roaming scenarios for cases such as QoS-based charging, where the charging function will play an important role.
- **Enterprise enablement**. 5G networks are, by design, expected to be multi-tenanted and will support complex revenue share models. Instantiating network slices for mobile virtual network operators (MVNOs) or enterprises with distinct use cases will lead to complex revenue sharing models that must be accommodated.
- **Value-based pricing**. 5G networks aim to offer true session-based charging. In 4G session-based charging was based on essentially coordinating network resources on the basis of an IP address. In 5G, with the help of the Session Management Function (SMF), the session can now be anchored on the basis of the session itself, regardless of where the content is delivered. Thus, multiple simultaneous sessions can be monetized separately, based on the value delivered.

Next-generation Services Need Next-generation Monetization Technologies

5G charging systems will play a central role in enabling communications service providers (CSP) to deliver personalized, omni-channel and real-time customer experiences. Frost & Sullivan believes a clear understanding of the types of services that will be launched with 5G, coupled with early preparedness for their monetization, is essential for the success of 5G rollouts. Monetization strategies should evaluate the full range of consumer and enterprise-centric services. Given that the 5G will spawn newer service models customized to address the specific needs of industries and customers, CSPs should have the flexibility to rapidly explore any business model.

In 5G, the concept of the 'customer' is going to change as well. With the expected growth in intelligent, mobile and autonomous IoT supported over 5G, CSPs will support more digital 'customers' than human 'customers' which will have to be supported through real-time network operations, orchestration, analytics and monetization capabilities. To meet the requirements of a hyper-connected ecosystem (speed-to-market, agility, scalability cost structure), CSPs must transition legacy technology infrastructure to a combination of private and public cloud technologies to support billions of device connections. Frost & Sullivan firmly believes that 5G converged charging and billing systems should have an IT-based cloud-native architecture, and should be containers-based, dynamically orchestrated and microservices-oriented.

New Product Attributes and Customer Impact

CSG Systems International, Inc. is a leading, global provider of revenue management, customer experience, and payment solutions. Leading companies from communications, financial services, healthcare, media and entertainment, and government sectors rely on CSG to monetize new revenue streams, protect and maintain existing revenue streams,

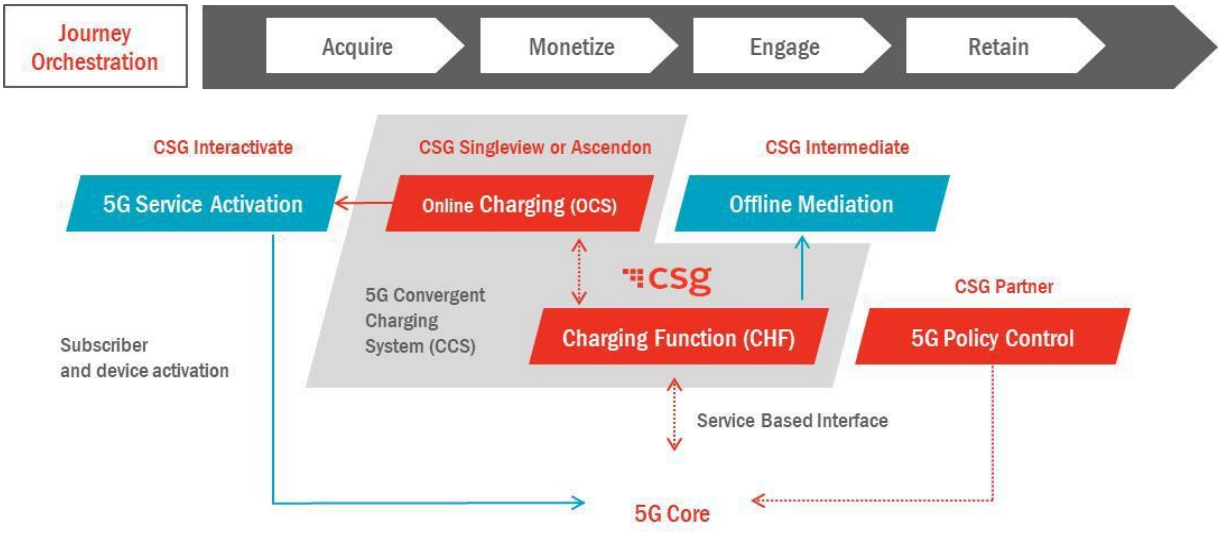
optimize business costs, and adapt quickly and efficiently to industry changes and innovations.

New Product Attributes

CSG offers a complete infrastructure stack for 5G monetization to help CSPs optimize next-generation 5G customer experiences. CSG offers a customer journey solution on top of its 5G infrastructure solutions to enable CSPs to gather customer intelligence around every customer touch point, including acquisition, monetization, engagement, and retention. This enhances data-driven decision-making and improves customer communication. Frost & Sullivan believes that the ability to support fully automated customer experiences, coupled with a full range of 5G monetization solutions, differentiates CSG in this intensifying competitive environment.

CSG Ascendon and **CSG Singleview** offer comprehensive charging and billing capabilities that are equipped to support the flexibility and scalability needs of 5G. Ascendon is a software-as-a-service (SaaS), cloud-based platform, which enables CSPs to dynamically evolve through quarterly software updates—guaranteeing predictability, speed-to-market, and agility. The solution allows CSPs to automatically scale to support the variability of demand expected with dynamic, instantiated 5G network slices for different use cases. Singleview is available as a licensed or CSG managed solution, with an on-premise or cloud-agnostic platform. Singleview is the only real-time charging, billing and customer care solution designed from the ground up for converged markets and B2C, B2B and B2B2X business models.

Exhibit shows the CSG Complete Stack for 5G Monetization.



Source: CSG, Frost & Sullivan

Customer Impact

By embracing the principles of microservices, distributed computing and cloud-native deployments, CSG's products can automatically scale to meet the needs of each individual

5G use case. The various ways in which CSG addresses the 5G core monetization needs are described below.

- **Preserves existing investments.** With CSG's Dynamic Charging Function, operators can monetize 5G core at scale with no changes to existing OCS integration. A truly vendor-independent implementation, the Dynamic Charging Function provides charging offload to shield legacy OCS from 5G core volumes and variability. Dynamic Charging Function is 5G cloud and NFV ready, and offers deployment flexibility for network slicing and microservices (for example, through multiple distributed instances). A future-proof implementation such as the Dynamic Charging Function is critical to allow CSPs to define and evolve their mediation business logic and processing as business requirements become clear. This is particularly important in 5G where standards are still being developed and operators are yet to fully identify the use cases suitable to help them differentiate.
- **Supporting on-premise deployments.** CSG's 5G Convergent Charging System (CCS) based on the Singleview OCS runs on-premise and can be delivered in 90 days. For existing Singleview OCS customers, the CHF can be delivered for production-readiness in less than 30 days. The CSG 5G CCS supports charging per Network Slice and QoS Flows, and the CHF component can run either in the IT domain with the OCS or in the 5G Telco Cloud network.
- **Rapid Deployment of end-to-end monetization stack**. Based on CSG's Ascendon platform for fast SaaS delivery, CSG's Distributed CCS helps CSPs quickly stand up complete end-to-end monetization stack for new business lines such as MVNE enablement for new 5G MVNOs or for 5G enterprise private mobile networks. As a purpose-build SaaS cloud-based platform, Ascendon delivers important benefits for 5G, enabling CSPs to keep up with changes through quarterly software updates, and real-time online charging (OCS) functionality and rating capabilities. The CSG 5G Distributed CCS also supports charging per Network Slice and QoS Flows, and the CHF component can run either in the IT domain with the OCS or in the 5G Telco Cloud network.

Competitive Comparison

CSG is prepared to support 5G; it has the deployment experience and has committed to 5G roadmap investments. CSG's broad portfolio of on-premise, cloud and pre-integrated solutions allows CSPs to efficiently manage their traditional businesses, while being able to quickly and cost efficiently deliver new digital services personalized at scale. For example, in competing solutions that use containers and Kubernetes in an on-premise deployment, the underlying infrastructure must still go through the procurement-testing-commissioning cycle, potentially lasting several months. The fully-cloud native Ascendon OCS, on the other hand, automatically scales to help CSPs meet the needs of each individual 5G use case.

Preserving existing BSS investments for CSPs can go a long way in the seamless migration to 5G. Providers such as CSG, with a proven set of solutions and committed 5G roadmap

investments, will play an important role in helping CSPs realize the vision of 5G. As CSPs reevaluate their OCS strategies, vendors that offer a standalone CHF enable 5G integration without the need to reinvest in changing the overall BSS stack. This provides significant cost and time-to-market savings for CSPs.

Conclusion

CSG continues to raise the bar in next-generation network services monetization. Frost & Sullivan expects the company to continue to experience robust growth on the strength of its standards-based products for 5G monetization. Comprehensive product capabilities, a strong focus on new product innovation, and flexible deployment capabilities are some key differentiators of CSG's monetization solutions. For its strong overall performance, CSG has earned Frost & Sullivan's 2020 New Product Innovation Award in the 5G monetization market.

Significance of New Product Innovation

Ultimately, growth in any organization depends on 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 2 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

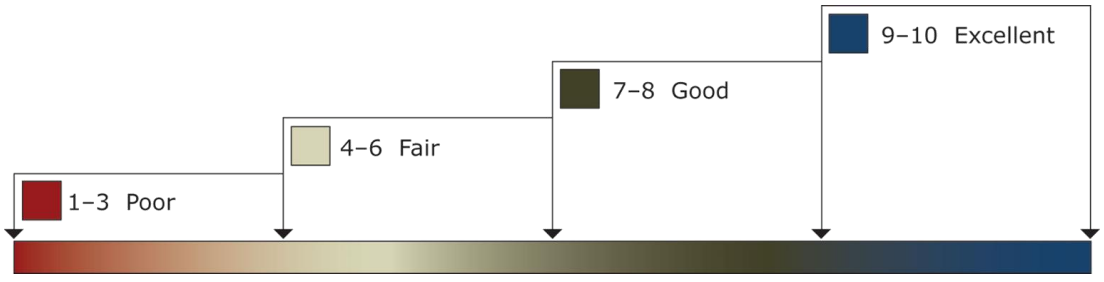
Criterion 1: Price/Performance Value
Criterion 2: Customer Purchase Experience
Criterion 3: Customer Ownership Experience
Criterion 4: Customer Service Experience
Criterion 5: Brand Equity

Best Practices Award Analysis for CSG Systems

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 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 considers New Product Attributes and Customer Impact (i.e., the overarching categories for all 10 benchmarking criteria; the definitions for each criterion 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, Frost & Sullivan has chosen to refer to the other key participants as Competitor 1 and Competitor 2.

Measurement of 1–10 (1 = poor; 10 = excellent)			
New Product Innovation	New Product Attributes	Customer Impact	**Average Rating**
CSG	**9.2**	**9.0**	**9.1**
Competitor 1	8.5	8.0	8.3
Competitor 2	8.0	8.0	8.0

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 functionalities.

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 they are buying the optimal solution that addresses both their unique needs and their unique constraints.

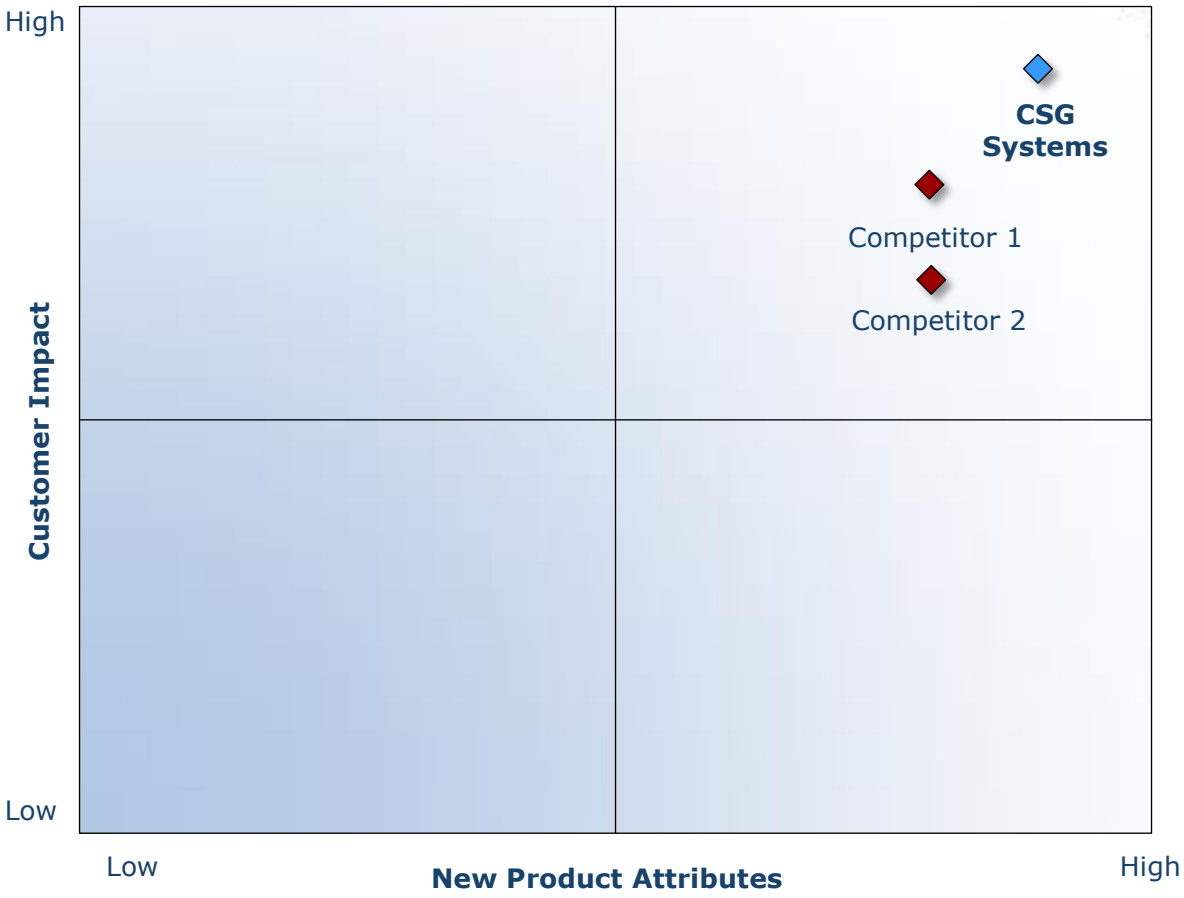
Criterion 3: Customer Ownership Experience
Requirement: Customers are proud to own the company's product or service and have a positive experience throughout the life of the product or service.

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 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.



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 practices 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	• 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 the 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

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