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The Challenge of Wi-Fi: Providing a Consistent Customer Experience over Unlicensed Spectrum

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Consumption of mobile data continues to grow. It is estimated that by 2019 over 112 exabytes of data will be delivered via mobile networks every month including 89 exabytes from Wi-Fi networks alone. In response to this clear trend, Communication Service Providers (CSPs) and other high-tech companies are aggressively expanding small-cell technologies, and are looking to overcome the limitations of unlicensed spectrum in order to monetize their networks in new ways. As this expansion occurs, more focus needs to be placed on establishing and maintaining a consistent customer experience.

One critical network that requires an upgraded customer experience is Wi-Fi. Today, the portion of global IP traffic carried over Wi-Fi networks has grown to more than 42%[1]. As consumer consumption of data shifts to Wi-Fi networks, operators need to have in place an end-to-end customer experience strategy that brings together systems, instrumentation, operational protocols, and support personnel—permitting CSPs to operate at "carrier grade."

While "carrier grade" Wi-Fi has not yet fully been defined by the industry, Accenture believes that customers are increasingly looking for a set of features and performance in Wi-Fi that are virtually indistinguishable from those offered over licensed spectrum. Users now expect fast, high-quality, highly reliable,

and persistent/available Wi-Fi connections, with a streamlined authentication process. As a result, delivering "carrier-grade" Wi-Fi is becoming a business imperative for Wi-Fi operators looking to monetize their wireless network through new revenue opportunities and business models—including tiered and wholesale Wi-Fi services, which often require contractual SLAs for quality and availability.

The challenge for operators is that this "carrier-grade" experience needs to be delivered over unlicensed spectrum, which by its nature must be shared across many applications, including other Wi-Fi networks, cordless phones, Bluetooth devices, microwave ovens and more. The unlicensed bands are likely to get more crowded as wireless carriers look to offload traffic from the licensed band using technologies such as LTE-U.

Realistically, carrier grade Wi-Fi will never match the service levels available on licensed carrier-grade networks. Nevertheless, we believe that carrier grade W-Fi will achieve levels of service that will meet customer requirements and deliver a consistent customer experience. To do so, however, operators will need to use an iterative approach to continually improve the Wi-Fi customer experience. Our three-step approach is depicted in Figure 1: Define, Measure and Manage.

[1] Cisco Virtual Networking Index (VNI) Forecast 2014-2019
(http://newsroom.cisco.com/press-release-content?type=webcontent&articleId=1644203)

Figure 1: An Iterative Approach to Improving Customer Experience

Clearly articulate the desired customer experience, in an E2E fashion (Core through End-User) that drives engineering and operational requirements (thresholds).

Define

Customer Experience
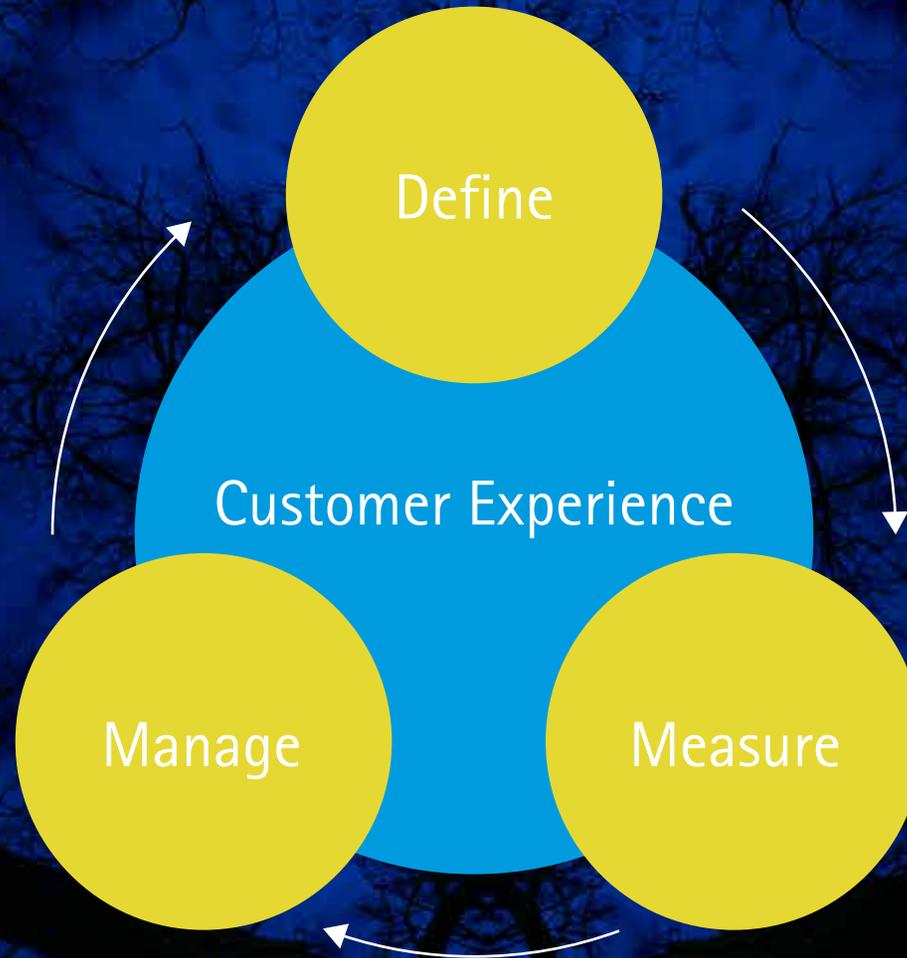
Ensure people, process, and technology are in place to meet/exceed network and customer thresholds.

Manage

Measure

Translate requirements into KPIs and thresholds, and ensure capabilities exist to measure and correlate impacts across multiple dimensions to generate value.

Defining the Customer Experience

First, in order to deliver a consistent customer experience, operators need to begin by determining what customers want and what levels of service their network will deliver. Service providers should establish a clear business strategy and define customer experience expectations for Wi-Fi both internally and with customers, which in turn can be used to drive measurement and capital expenditure decisions.

Defining customer expectations begins with research, ranging from primary research (such as focus groups, customer surveys and analysis of network usage) to secondary research into the points of view being articulated by trade associations, competitors, partners and vendors.

Based on a review of select Accenture and vendor research on the customer, certain themes continually emerge related to Wi-Fi and wireless data usage. These themes are typically centered on the speed of the network (throughput, latency), connectivity, ability to roam, and security.

Customer expectations in these areas are driven by customers' legacy personal experiences with licensed cellular technology on 3G/4G devices. The majority of customers do not delineate, or understand the technical differences between licensed (cellular) and unlicensed (Wi-Fi) spectrum, and the underlying levels of service provided by each. For Wi-Fi operators to move to carrier-grade service levels, therefore, it is important to understand what we mean by carrier grade.

What is Carrier Grade Wi-Fi?

"Carrier grade" or Carrier Wi-Fi LAN (CWLAN), as described by the Wireless Broadband Association, is only starting to be defined, and industry standards are still evolving rapidly in this changing ecosystem. CWLAN networks differentiate themselves from consumer or enterprise wireless networks in four ways:

1   They deliver a consistent user experience. Devices should automatically manage network selection and authentication to support specific applications such as streaming video and particularly VOIP; users should no longer distinguish between Wi-Fi and cellular connections with respect to data. Wireless networks must be secure and safe, and data integrity should be maintained throughout a session.

2   They provide full end-to-end integration and interconnection. CWLAN must be able to provide seamless access to network services, and should support interoperability via fast and seamless roaming between intra-network Wi-Fi access points (APs), Wi-Fi roaming partners, and 3G/4G networks. This interoperability should be supported across a wide selection of roaming partners and devices.

3   They have active network management capabilities. The user experience should be consistent and actively monitored. Operators must manage and support the defined QoS, with measurable results from user device to core. Faults in the network and user session should be detected and reported to the operator's management system.

4   They offer broad ubiquitous access with high availability. Networks are highly available and non-blocking. Service is available in high-user-density and high-user-desired areas, such as offices, homes, and dense urban settings.

It will be important for operators to focus on all four areas as they move away from coverage-based, "best effort" deployment towards truly "carrier grade" networks.

As of the writing of this article, there is no agreement on what specifically constitutes carrier grade levels of services. For this reason, it is imperative that operators clearly define service level targets for each area, and ensure that these targets can support their desired business models. Over the years, operators have coalesced around a number of basic business models, including free access (driving other services), pay-as-you-go and managed services. However, with the emergence of carrier grade Wi-Fi, operators will be able to move confidently beyond these basic models and further monetize their investments.

Measuring the Customer Experience

Traditionally, operators have focused solely on network-side measurements. However, Accenture believes that the move towards carrier-grade Wi-Fi will require operators also to include client-side measurements taken directly from customer devices. This more holistic view will provide insights not available from traditional network-side measurement.

As shown in Figure 2, operators have customarily focused on performance management of discrete network components, including RF, access points (APs), backhaul, core and others. However, measurement of these discrete components does not guarantee a good user experience, particularly in today's emerging environment. A more integrated approach is required.

Going forward, operators will need to instrument a new set of metrics that measures not only network performance, but all aspects of the customer experience. Three main parts of the user experience will need to be addressed: Discover, Connect and Use.
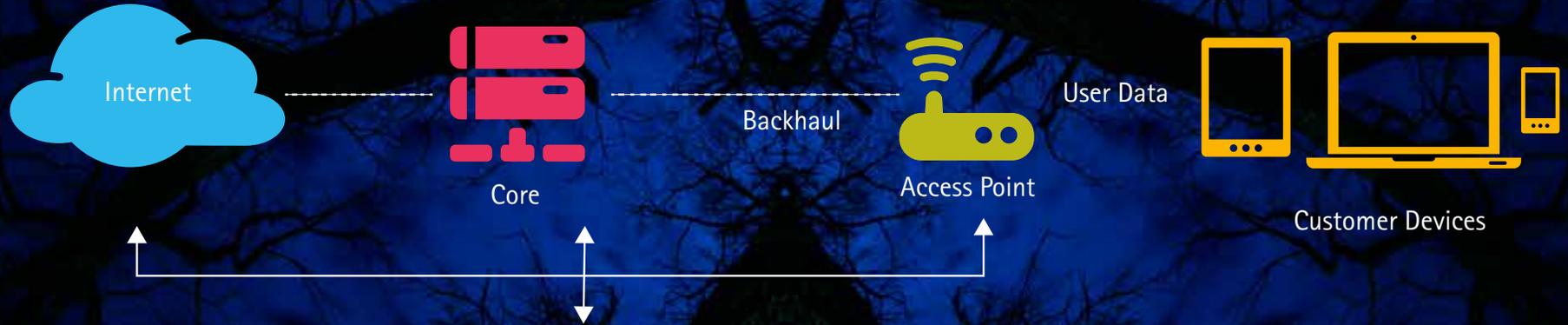
Discover

A quality Wi-Fi signal must be present at the points where customers expect service. The placement of APs is critical to providing good coverage, especially in high-density locations, where APs must be strategically placed and configured to account for capacity and RF concerns, including channel reuse, interference and channel utilization.

Figure 2: A New Paradigm for Performance Management

Legacy

Internet — Core — Backhaul — Access Point — User Data — Customer Devices

Discrete management of all network components

Carrier Grade

Integration support in operator's network: e.g. 3GPP, GRE, CAPWAP and GTP

Core — Backhaul — Access Point

Internet
- Secure handoff and management details to roaming partners
- Support for WRIX (roaming)

Core
- IPv6 support
- Network security (IPS, IDS, etc.)
- CWLAN NMS (fault, config and performance managment

User Data — Service Experience — Customer Devices

Next Generation Hotspot:
- WFA Passpoint Certified
- Enhanced network discovery
- Automatic authentication
- Support for WRIX (roaming)

CWLAN Devices:
- WFA Passpoint Certified
- Mechanism for measuring service experience

- End to end managment
- Reliable network performance
- Measurable KPIs
- Load Management
- Command and control capabilities

Connect

Allowing users to connect and browse as quickly as possible, and with as few steps as possible, is key to a positive experience. To achieve this, operators should look to streamlining their authentication process by adopting Next Generation Hotspot (NGH) or secure SSID standards that provide enhanced network discovery and automatic authentication.

Use

After associating to a Wi-Fi network, a user's perception and expectation of experience can be broken down into three categories: performance, continuity and security. Currently, no industry standards exist to monitor and measure user experience, or to define an associated threshold.

Performance

Different applications require different levels of network performance, and a user's satisfaction depends on whether the application he or she is trying to use works properly. Two users receiving the same level of performance could rate their experience very differently, if one was checking email and the other was trying and failing to stream a Netflix movie. For this reason, understanding requested vs. delivered performance will be key in establishing carrier grade Wi-Fi networks.

Continuity

Since connection drops can quickly impact user experience, connection continuity also needs to be carefully managed. Operators need to ensure their networks are capable of supporting mobility use cases, including session continuity between the operator's APs and the APs of roaming partners. This is especially true for operators looking to deploy VoIP services, such as a Wi-Fi First MVNO, on their networks.

Security

Security should be implemented in a robust way, while minimizing negative impacts to user experience (i.e., with minimal or no additional user actions required). If operators are capital constrained, advanced security should be implemented, with risks carefully prioritized according to the environments where potential threats are present, including SMB customers, venues, and outdoors.

As these carrier grade standards for discovering, connecting and using a Wi-Fi network mature, operators will be better able to use innovative business models to realize the full potential of their network.

Framework for Measurement

Based on the components of a carrier-grade network, and the different components, including end-user customer devices, Accenture recommends the use of the holistic end-to-end measurement framework shown in Figure 3 as a basis for categorizing and organizing key performance metrics for customer experience across the User, Environment, and Network. This logical grouping enables more clarity about which data needs to be collected, which elements are controllable or non-controllable, and which organizations in an operator's company are responsible.

Executive-level reporting should provide a snapshot of Wi-Fi health across the end-to-end framework for a given time period, identifying any performance issues for further investigation. Operational reporting should be developed in a manner that enables root-cause analysis of the larger issues that are identified in the executive-level reporting.

Accenture has successfully delivered Wi-Fi customer experience dashboards for a number of operators using this framework.

Figure 3: A Framework for Measuring the Customer Experience

User	Environment	Network
Customer Devices	RF	Access Point Core/ Infrastructure
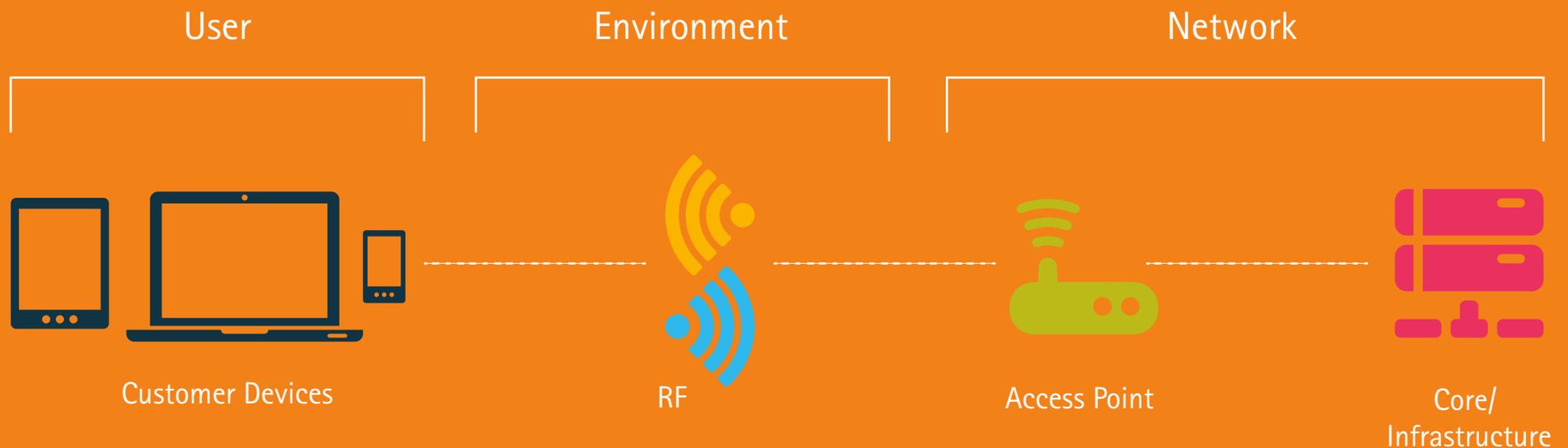
Managing the Customer Experience

Once customer experience is defined, KPIs are determined, and measurement capabilities are available, operators must ensure they have the tools, people, and process in place to ensure performance thresholds are met.

Beyond network coverage and reach, a key element of differentiation among operators is the quality of service as perceived by the end customer, regardless of the device used to access the service. Accenture research shows that quite often, there is a distinct difference between the experience operators believe they have delivered and the experience customers believe they have received.

As requirements for the customer experience increase, operators are being squeezed between the challenge of providing distinctive service quality and the need for cost-effective utilization of network resources. Building on the concept of quality of service, operators need to effectively manage their networks in a way that makes the most effective use of the proper tools, people, and process.

Tools

Operational software and tools are required to effectively manage the network. This includes systems for real-time monitoring of KPIs in order to ensure appropriate network and service levels are met. This real-time functionality can either be built in house or purchased. In either case, functionality should include alarms, ticket management systems, root cause analysis tools, and proactive identification. Analytics in particular will play a key role in carrier grade Wi-Fi networks.

People

Just as important as tools are the people responsible for the daily, real-time monitoring of network and end-user experience. Carrier-grade operators will typically have in place a dedicated Service Operations Center (SOC) and Network Operations Center (NOC), interacting with other organizations such as field engineer teams, care, and sales and marketing.

Process

Operators need a clear operating model that defines how these organizations and tools interact to deliver the customer experience. This includes defining the roles and responsibilities of each organization, the governance structure, change management processes, service levels, and escalation paths. The operating model should ensure that any issues are resolved in a timeline manner, with clear accountability and control.

Some Conclusions

For operators seeking a strategic path forward for Wi-Fi, several main points of guidance emerge based on a review of the key components of the customer experience outlined above.

Define your customer experience strategy

To establish a successful Wi-Fi strategy, operators need to clearly define the customer experience they want to deliver. This experience should be expressed in terms of both the expected levels of performance (i.e., what applications are being supported) as well as in terms of the features bring provided (e.g., seamless roaming).

Understanding what users are trying to do with the wireless network is a key consideration when developing these models. Without the clear definition of service thresholds, it is hard to determine whether the network is meeting expectations. Clear definition also helps drive technical requirements and engineering decisions that ultimately determine what business models can be supported. In our experience, operators who fail to clearly defined service levels tend to over- or under-engineer their networks, and struggle to deliver a consistent user experience.

Furthermore, the thresholds should also be revisited periodically as customer expectations evolve and technologies improve. This iterative process will allow operators to improve customer experience, and help to ensure the network stays carrier grade.

Instrument your network

Ensure all aspects of the customer experience can be measured by properly instrumenting the network. This should include instrumenting at least a subset of end user devices (via an app and embedded data collection agent, for example). It is not possible to consistently meet a service level threshold if it can't be measured properly.

Develop a robust service model

To ensure a consistent user experience, a comprehensive and robust service model should be developed which encompasses a dedicated SOC and NOC for Wi-Fi. The SOC's and NOC's primary goal will be to manage and monitor all aspects of the network that could affect customer experience, and deal with any faults that are detected. The SOC should focus on both real-time data, in order to detect/predict issues, and historical data, in order to identify areas for future network improvement.

As operators seek to take full advantage of the potential of their networks, Wi-Fi represents a major opportunity. To monetize effectively, however, operators will need to raise their game. As the lines blur in customers' minds regarding the difference between licensed and unlicensed spectrum, operators will need to chart new territory by pursuing an integrated approach to defining, measuring and managing the Wi-Fi customer experience.

For more information

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