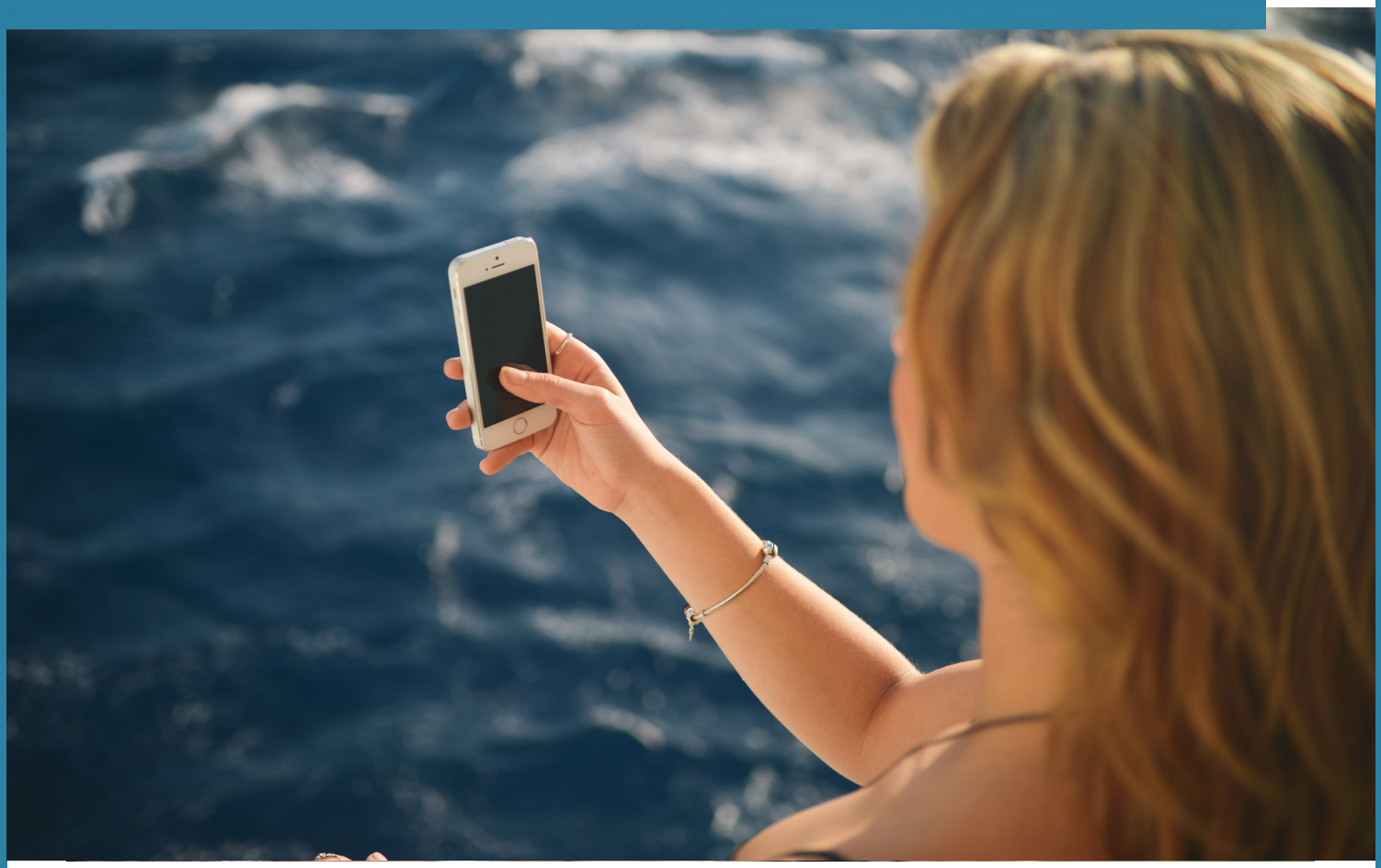
Voice Over WIFI
OPPORTUNITY TODAY!

A NewNet Mobile Communications White Paper



NewNet
MOBILE COMMUNICATIONS

VoWiFi - Opportunity Today!

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INTRODUCTION

Voice over WiFi (VoWiFi) allows users to make calls over a wireless internet connection as opposed to using a cellular network. Rapidly expanding availability to broadband internet access especially in homes coupled with widespread use of Smartphones that are increasingly WiFi enabled right out of the box are fueling demand for VoWiFi.

Why? From a fundamental level a call is a call. Do communication service providers or their customers really care if it's a packet or circuit switched interaction? The answer is a resounding yes, with significant VoWiFi benefits that will be realized by subscribers as well as carriers and mobile operators.

This White paper looks how VoWiFi is one of those unusual technologies that offer clear benefits for both sides of the house; users and providers. Detail will be provided on why VoWiFi benefits, issues to consider when deploying WiFi calling, and how Communication Service Providers can leverage this technology to improve quality, reduce costs and differentiate from their competitors.

VOWIFI FUNDAMENTALS

At a high level there are 3 primary components within a VoWiFi communications framework; the WiFi network, the user's device, and the communication provider's infrastructure.

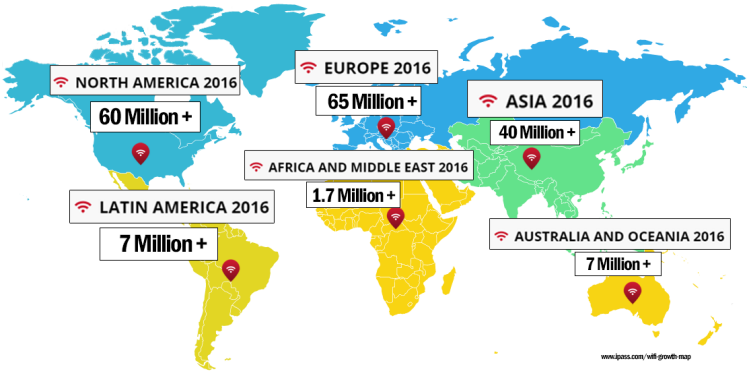
WiFi Networks

WiFi networks are exploding with indoor and outdoor public access point (retail, cafes, hotels), transportation trains, planes airports), and home use contribute to growing coverage around the world.

Homespots are contributing widespread access of WiFi. A homespot occurs when a carrier adds an extra SSID to an home gateway to support public access for WiFi. This is in addition to the homeowners network located on a separate SSID within the same WiFi router device.

Comcast leads the way with over 11 Million homespots deployed. However, Communication Service Providers around the world such as BT in the UK and Orange in France have deployed 5 million each[1], and many others in virtually every major geography around the world are deploying homespots..

According to WiFi network access provider IPass[2] worldwide hotspots are approaching 200 million with growth expected to reach 340 million WiFi hotspots by 2018.



Standards are working to help fuel WiFi growth by making the experience of using mobile devices within and between WiFi networks similar to that of cellular roaming.

HotSpot 2.0 is an emerging standard that seeks to deliver these ease of use characteristics for subscribers as well as carriers. It's a standard from the WiFi Alliance and the Wireless Broadband Association for public access to WiFi, designed to that enable seamless and automatic network selection over a secure WiFi connection. Key components include:

- WPA2 – For encryption and mutual authentication to make a radio link as secure as 3G and LTE networks.
- EAP (Extensible Authentication Protocol) – Defines how security credentials are handled between a mobile device and servers. HotSpot 2.0 also includes EAP-SIM which enables SIM cards to be used on WiFi networks.
- 802.11u – Defines how devices collect information from a WiFi network before authentication.

Smartphone manufacturers are adding parts or all of these standards to their devices to make it easier to connect to a WiFi network.

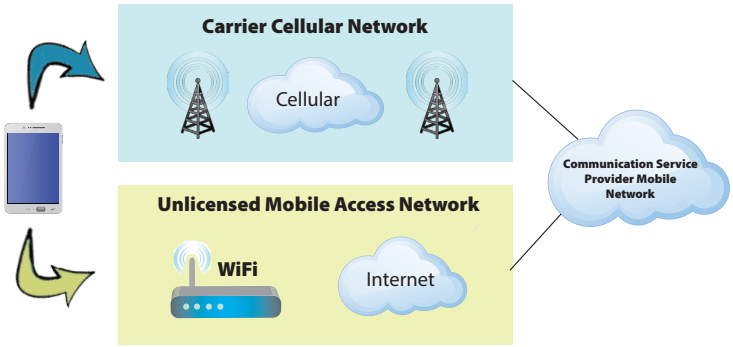
WIFI ENABLED DEVICES

Research firm Strategy Analytics predicts that by 2017 there will be over 7 billion WiFi enabled devices in use around the world. WiFi enabled cell phones and tablets account for over half of the total,

with a myriad of other "Internet of Things" devices such as cameras, wireless speakers and household appliances are also adding WiFi. This represents the bulk of deployments, with routers and femtocells participating to also extend reach of 4G networks.[3]

Mobile phones are increasingly being delivered with WiFi enablement "right out of the box". Research indicates that more than 90% of Smartphone are WiFi enabled with chipsets and firmware supporting relevant protocols such as 802.11u or 802.11n to discover and connect to a WiFi network.

Dual mode service is key for WiFi enabled mobile phones. This means that GSM (Global System for Mobile) or CDMA (Code Division Multiple Access) phones will use the telephony channel in the absence of a WiFi signal, and WiFi when IP connected.

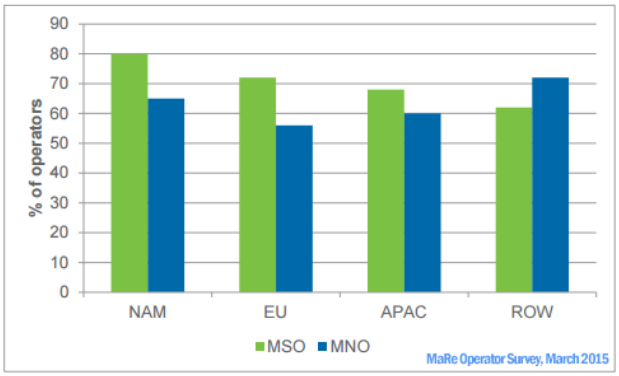


SERVICE PROVIDERS INFRASTRUCTURE – WIFI

Hotspots and WiFi enabled phones require that their associated telecommunications carrier is capable of supporting WiFi calling. For service providers that support LTE this is relatively easy as LTE and WiFi are packet switched technologies. 3G and earlier technologies are more challenging as circuit and packet switched technologies need to be integrated.

Communication Service Providers around the world are adding or evaluating voice over WiFi service, seemingly as a priority in many cases. As of 2016 all major operators in the United States support WiFi calling. According to research by the Wireless broadband Alliance "By 2018, 80% of North American MSOs will offer WiFi Calling, the group with the highest uptake, but even the lowest level, among European MNOs, will have reached 56%."[4]

The following chart from The Wireless Broadband Alliance details the percentage of MNOs (Mobile Network Operators) and MSOs (Multiple System Operators - also know as Cable companies) deploying IMS-based VoWiFi applications between 2015 and 2018 around the world.[5]



VOWIFI DRIVERS

It's not just about an infrastructure in place that is driving interest in Voice over WiFi. Voice over WiFi is one of those unusual technologies that offers great benefits for users as well as for the organizations that need to invest to deliver what the technology offers:

Subscribers

- ***"Max Bars"*** – Better service by taking advantage of a WiFi signal is a strong driver for VoWiFi. WiFi connectivity can also speed data download, making it easy for subscribers to communicate via voice as well as download data and video. Cellular coverage in some geographies can also be challenging, causing frustration with dropped calls and intermittent service. Additionally, cellular service is challenged to penetrate modern buildings. LTE networks running on high frequency bandwidths may have difficulty as well. WiFi service for voice and data resolves many of these issues.
- ***Availability*** – WiFi service is readily available, especially in many homes and offices.
- ***Cost Savings*** – Minutes saved from a cellular plan can save subscribers money. Roaming is also less expensive as long as a carrier supports plans for WiFi roaming service. For example, calls from anywhere in the world would be charged as a mobile call in your home network whenever making that call over WiFi. Communication Service Providers may also provide WiFi messaging.

- ***Seamless usage*** – Calls from WiFi to circuit switched are seamlessly managed by the Communication Service Provider, providing global reach for subscribers. This is also where VoWiFi differentiates from any OTT (Over The Top) voice service
- ***Support for multiple devices*** – Even non SIM-Card devices can become voice enabled on a WiFi network, adding flexibility for subscribers.

A return on investment for supporting VoWiFi is derived from a number of customer satisfaction and cost savings factors providing incentive to enable VoWiFi service for subscribers.

- ***Loyalty*** – "VoWiFi allows Service Providers to maintain a stronger service relationship with customers. T-Mobile US, for instance, claims that it is experiencing fewer customer disconnects from its service, at least in part due to its Uncarrier 7.0 announcement of WiFi Calling". Dell'oro "expectation is that offering VoWiFi service may also reduce reliance on services like Facetime, Skype or their alternatives." [6]
- ***Offload capacity*** – Communication Service Providers can take advantage of WiFi networks to offload capacity from their cellular networks. This is especially important for the exploding requirements of data downloads. The alternative is to invest in additional spectrum which will require significant capital expenditure.
- ***Coverage*** – Carriers everywhere are challenged by poor cellular service areas that may be resulting from lack of cell towers, geographical barriers, and radio penetration into homes and buildings.
- ***Cost Savings*** – Yes, there is investment required to support VoWiFi, but its for communications integration and not WiFi footprint. The alternatives are likely more costly and ultimately less effective. Ongoing deployment of femtocells to improve connectivity adds cost and support headaches. Building out infrastructure with towers and spectrum is expensive. VoWiFi service will offer cost savings along with the aforementioned subscriber benefits.
- ***OTT Competition*** – Competition is increasing. The emergence of Google Fi, Cablevision Freewheel and other VoWiFi alternatives continues to grow. There are plenty of options for subscribers who would like to take advantage of the benefits VoWiFi offers.

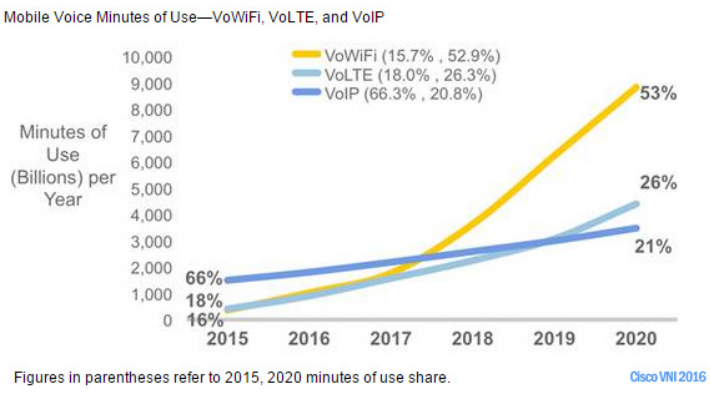
VOWIFI CHALLENGES

VoWiFi service is not without its risks. There are some issues that should be considered.

- ***Quality of Service*** – Service providers have no control over the quality of a WiFi network. Service providers will be challenged to troubleshoot WiFi issues and could be unfairly blamed for poor service. This issue can be overcome by making use of an app that can monitor WiFi network quality and revoke service when below thresholds.
- ***Capacity planning*** – Offloading cellular traffic to WiFi will free spectrum bandwidth. However, additional devices will now become voice and roaming enabled. This means planning for WiFi to cellular integration and more complexity when planning infrastructure upgrades.
- ***Security*** – Secure communications must be managed with the IP component of VoWiFi. Authentication and encryption, frequently utilizing IPSec must be implemented and managed.
- ***Emergency Calls*** - A WiFi network is a challenge as a WiFi access point MAC address does not provide a location. Communication Service Providers may need to find alternatives, When using an app to provide VoWiFi service the operator may circumvent this issue by forcing the emergency call out over the mobile network instead of the WiFi network.

4G DEPLOYMENT AND SMS MESSAGING

Benefits for subscribers and Communication Service Providers clearly appear to outweigh the challenges. Subscriber's are demonstrating enthusiasm with WiFi usage that will outpace VoLTE in 2016! [6]



HOW CAN OPERATORS DEPLOY VOWIFI

There are two primary options for the deployment of VoWiFi in a mobile network. The most commonly known deployment method is by using the IMS (IP Multimedia Subsystem) core to integrate with the WiFi radio network via an ePDG access gateway. This method is also described in the GSMA IR.51 profile.

Another less commonly applied method is by utilizing IR.92 best effort VoIP technology from the RCS specifications. In this case an RCS (Rich Communication Services) platform is used to enable the VoWiFi service in the mobile network. Vendors of IR.92 solutions based on RCS offer the flexibility of deploying VoWiFi even without an IMS core Each of these methods are associated with their own Pro's and Con's. These will be outlined in further detail in the paragraphs below.

WITH AN IMS

Deploying an IMS (IP Multimedia Subsystems) core allows the operator in conjunction with a 4G LTE radio infrastructure to provide its subscribers with VoLTE (Voice over LTE). In this case an operator takes advantage of a single network technology for all the major services for its subscribers (Voice, Messaging and Data).

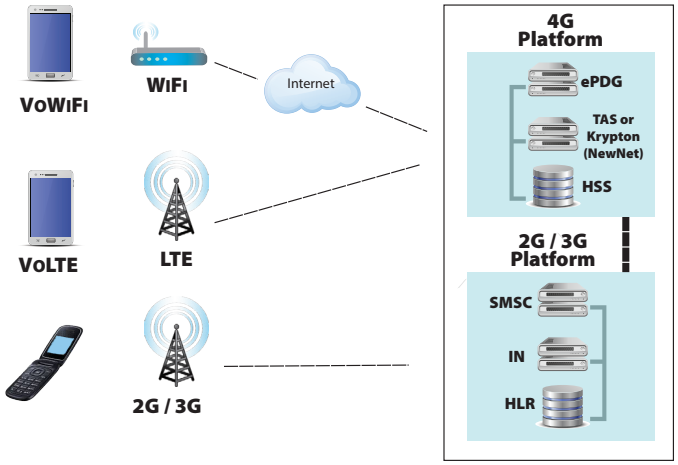
In a 2G/3G network infrastructure there are different network technologies used for voice and messaging, which is not the case in a 3G or 4G network. This requires the operator to maintain two types of networks as opposed to one in the IMS/LTE network infrastructure.

The more efficient 4G infrastructure is a powerful motivator that is pushing operators towards the IMS network infrastructure as a communication foundation. The flexibility of an IP infrastructure enables new services such as those outlined by the RCS and Joyn™ standards. This enables the subscriber for Chat, File share, video share, location share, presence and best effort voice call services.

With an IMS core in place, the operator has the ability to also deploy a native VoWiFi solution. This means that devices that are inherently equipped with the possibility to perform VoWiFi such as the iPhone 6 (IOS) and the Samsung S6 can be used for VoWiFi. There are however a set of "extra's" that need to be integrated within the IMS-core for each handset manufacturer in order for native VoWiFi (According to IR.51 standards) to work. Some of these are unique to a particular handset manufacturer.

In the following diagram a Communication Service Provider must deploy an evolved Packet Data Gateway (ePDG). This is because a WiFi network by definition is not secure. Infrastructure must be in place to initially setup a VPN session via the ePDG to ensures that same level of security found within mobile radio networks is applied to WiFi access.

A Telephony Application Server (TAS) or the Krypton Platform from NewNet manage communication from the WiFi environment, as well as between 2G/3G and the 4G networks. Intelligent Network (IN) services provided device/subscriber detail to the 4G systems.



Device compatibility is also a concern for operators, particularly with IOS. A Communication Service Provider must deploy a Mobile Device Management (MDM) solution that in the case of IOS support requires interaction with the Apple Push Notification Service (APNS).

This is required to allow the operator to enable the function of VoWiFi in the device, and to allow the subscriber to switch on/off the service from the settings menu on the device. Also the operator needs to have a device carrier settings file that is signed by Apple in order for VoWiFi settings to be changed. When the device is notified by the operators MDM via the APNS that a new carrier settings file is ready, then the file is downloaded and the device becomes WiFi enabled.

According to the IR.51 standards the device will now perform its SIM authentication over a WiFi radio network and through the established VPN tunnel just as it does over the mobile radio network. For example, when it registers for VoLTE services to the IMS-core the same authentication and encryption standards will be applied.

So the following elements or functions are at a minimum necessary in addition to the IMS-core to provide the native VoWiFi solution:

- MDM,
- APNS-subscription from Apple,
- Signed carrier settings file from Apple
- ePDG

With the above an operator can provide VoWiFi service ONLY to devices that support the IR.51 standards for VoWiFi. In addition the service is limited to the way in which VoWiFi is implemented/ integrated in the devices. For example, the operator will be dependent upon the device manufacturer to implement DRVCC (Dual Radio Voice Call Continuity service) upon handover of the Voice service on 2G/3G.

Currently this is not supported by Apple. Only the handover towards VoLTE is supported with operator limitation for the QoS that can be provided to subscribers based on what Apple makes available.

Many operators may not be thrilled by this Business model that involves customized efforts for one handset manufacturer to this extent.

WITHOUT AN IMS

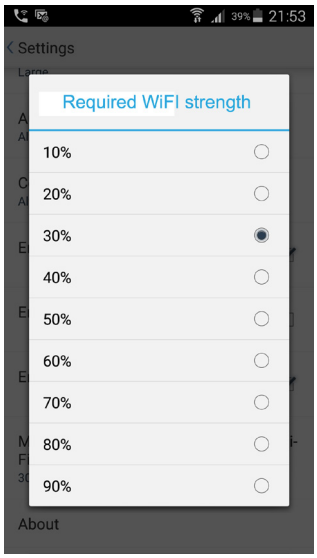
For those operators that are not attracted to the native VoWiFi solution as described in the previous paragraph, or simply do not have an IMS-core network (yet) there is the option to choose a non-native VoWiFi deployment. Simply described, this solution makes use of a downloadable client for the VoWiFi service, and a platform upgrade that supports elements of the IR.92 standard. By doing so it enables the operator to provide VoWiFi services with more enhancements and customization to its subscriber base than a native solution allows.

In practice, a non-native VoWiFi deployment allows an operator to provide the subscriber with a near native experience for VoWiFi, especially with Android devices. For Android, a service app can be provided that integrates with the native dialer of the device causing minimal changes to the way that the subscriber operates the device for placing and receiving calls.

Device Apps

A previously downloaded VoWiFi service is invoked for each outgoing call when a WiFi registration is available as the user accesses the native dialer of the Android device. At this point the call will be re-directed over the WiFi path rather than the mobile path.

Client apps for mobile devices are provided by organizations such as Callup and Neusoft. The client is a service that operates in the background of smartphones without any significant UI overhead, or as a replacement dialer (depending upon the mobile brand). Users in a designated WiFi (home-SSID) are automatically prioritized to make a WiFi call access cellular service if WiFi is unavailable or if service falls below a specified threshold which could be a user setting within the app..



Client apps can be customized by the Communication Service Provider. Potential exists to add new services, especially when working with a platform that supports Rich Communication Services for adding presence, video, and more.

A range of enhancements can be offered such as WiFi only calling for teens and student or business features. A business example might include 2G handover when leaving the WiFi domain for business people in large office buildings or campuses that are experiencing poor 2G/3G reception indoors.

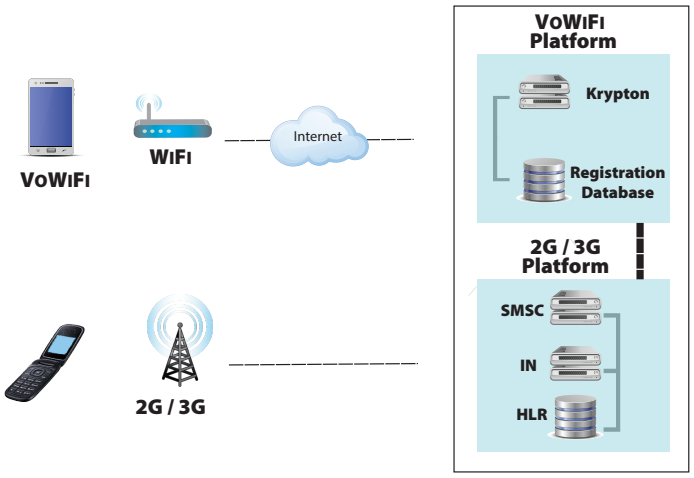
For IOS devices, subscribers will use a downloaded dialer to place and receive calls independent of whether the call is made over WiFi or over the mobile network. The downloaded app will arbitrate the decision of prioritizing WiFi when available, or cellular as a fallback. A primary benefit for Android and IOS is automated WiFi or cellular selection without any requirement for action by the user.

The non-native solution is also more flexible in terms of features that the operator might like to introduce with the service. For example, the service can be integrated with visual voice mail, or the service can be extended with voice handover towards 3G or towards 2G using DRVCC functionality when available in the network. The app can easily be tailored for the intended user group to extend capabilities and appeal to the intended user group as much as possible.

Platform for Non-IMS

The required elements to serve the non-native VoWiFi back-end solution in the mobile network is also less arduous to implement than a native VoWiFi solution based on the presence of an IMS core. NewNet's Krypton IP-Communications platform is built on the foundations of the GSMA RCS 5.2 standards for best effort voice described in the IR.92 specifications.

A critical Krypton element is inclusion of a Registrar function to accommodate for client SIP registrations, initial authentication and the inclusion of CSCF (Call Session Control Function) and SBC (Session Border Controller) services as implemented within an IMS core. Krypton integrates with the existing mobile network (IN) on the IP-Communications platform to ensure voice and messaging is seamlessly interchanged between WiFi and circuit switched networks.



As a result, a Krypton empowered VoWiFi service can run without an IMS-core network. This IP Communications platform can also fully integrate with an IMS network as a RCS Application Service providing the full suite of RCS 5.2 services once an operator does have an IMS network deployed. This also ensures that the investments made by the operator to deploy VoWiFi services on a non-native basis is never relegated as a legacy solution.

CONCLUSION

VoWiFi service is a win-win for subscribers and Communication Service Providers Key takeaways include:

1) ***Subscribers want VoWiFi*** – Rapidly growing WiFi availability in virtually all parts of the world is establishing a ready communication foundation for VoWiFi. It's also fueling user expectations for quality, convenience and cost savings that they expect will be available from their Communication Service Provider.

2) ***Do not Delay*** – Competition is building ranging from OTT alternatives to emerging presence from significant entrants such as Google Fi and others. Holding off to see how the market shakes out or prioritizing other systems updates will likely result in subscriber loyalty degradation and an inability to compete on a level ground for new subscribers against competitors offering VoWiFi.

3 **Get started without an IMS** – A commonly held belief that spending to deploy IMS first is simply not the case. There is an alternative that allows Communication Service Providers to deploy before an IMS core is in place with NewNet's Krypton solution. There is also a cloud version of Krypton available, meaning capital expense is negligible while deploying VoWiFi to enhance loyalty and increase overall efficiency.

ABOUT NEWNET MOBILE COMMUNICATIONS

NewNet Mobile Communications enables IP Messaging, Video & Voice Calling, WebRTC, VoWiFi, and more for MNO's, MVNO's, Inter-Carriers, and Telecommunication Providers around the world.

More than 1 billion subscribers in over 90 countries currently access NewNet Mobile Communication solutions.

Find out more at www.NewNetMobility.com

Footnotes

1 - Tefficient Blog, How Carriers are Using Wi-Fi Around the World, Fredrick Jungerman, 11/20/2015

2- www.ipass.com/wifi-growth-map/

3- Strategy Analytics Press Release, US Wi-Fi Households to Own Average of 11 Wi-Fi Devices in 2017 says Strategy Analytics, 2/27/2014

4- Maravedis-Rethink, Wireless Broadband Alliance, Towards 2020: Emerging Opportunities for Wi-Fi Services, Caroline Gabriel, 5/2015

5- Dell'Oro Group Blog, Voice Over WIFI - Sending a Strong Signal to Service Providers, Chris DePuy, 2/24/2015

6 - Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2015–2020 White Paper, 2/3/2016