Taqua’s Virtual Mobile Core solution set provides operators and carriers a variety of internetworking solutions, such as Small Cell, Wi-Fi Calling, Circuit Switched Fallback (CSFB), Service Centralization and Continuity (SCC), Voice Call Continuity (VCC) and Voice over LTE (VoLTE). The software-based system is field proven and highly scalable, with millions of existing subscribers across Taqua’s customer networks.

**VoLTE MMTEL**

VoLTE MMTEL is one of the applications available with the Taqua Virtual Mobile Core. In this configuration, it is used as a 3GPP GSMA IR.92 and IR.94 compliant MMTEL for the delivery of voice and video services to VoLTE subscribers that have full feature parity with UMTS 3G and CDMA 1x networks. VoLTE MMTEL also interworks with the circuit-switched core, Home Location Register (HLR), Service Control Points (SCP) for prepaid, VPN, Ring Back Tone, Location Services, or enhanced routing applications. Taqua’s Virtual Mobile Core supports OIP, OIR, TIP, TIR, CDIV, HOLD, CB, MWI, CONFI, ECT, AOC, CUG, 3PTY, FA, CW, CCBS/CCNR, CAT, CRS, and MCID supplementary services for voice. It also handles video calling (mono, bidirectional, early media, multi-party) and dial out.

**CSFB - Circuit Switched Fall-back**

The introduction of single radio (SR) 4G LTE phones poses a challenge to operators who have not launched VoLTE. These new SR phones are always ‘locked’ onto the LTE network and require the network to signal to them that an inbound voice call is in process. The SR phone and the network must work together to ‘fall back’ to the 2/3G network in order to receive the voice call, which is known as Circuit Switched Fall-back (CSFB).

CSFB requires an upgrade to the operator’s legacy MSCs to support the interworking with the Mobility Management Entity to page the mobile device that a call is pending and the phone needs to switch to the 3G mode. This added interworking capability and interface often comes at a great expense and must be done across all MSCs in the network.

Taqua’s Virtual Mobile Core’s CSFB IWS solution set provides a centralized Interworking Server (IWS) function for CSFB that eliminates the need for costly upgrades to the legacy circuit-switched core. This Virtual Mobile Core solution supports the SGs/S102 interface to various MMEs of the leading 4G/LTE RAN suppliers, and supports interfaces toward the legacy MSC environment. In addition, supplementary Virtual Mobile Core applications such as SCC-AS, Wi-Fi Calling, and VoLTE can be easily added to the Taqua CSFB IWS solution.

For GSM/UMTS applications, Taqua’s patent-pending technology eliminates all delays associated with subscriber registration and the serving MSC, and provides equivalent performance as the native IWS on the serving MSCs. The Virtual Mobile Core’s CSFB IWS solution provides operators with a very simple way to quickly and inexpensively launch new SR phones without disruption to legacy 2/3G MSC and 4G/LTE systems.

**VCC - Voice Call Continuity**

The explosion of mobile data traffic is forcing operators to deploy 4G/LTE radio equipment more aggressively, while simultaneously resorting to other unlicensed radio access technologies, such as Wi-Fi, for traffic offload. It will take many years for complete and universal LTE coverage, and during this transition operators must be capable of supporting different radio access technologies.

As operators consider launching a voice service, either over LTE or Wi-Fi, their network must be capable of ensuring that subscriber voice calls can travel uninterrupted to and from 4G/LTE, Wi-Fi and 2/3G coverage to ensure a positive
user experience. This capability is possible through the Virtual Mobile Core’s Voice Call Continuity (VCC) application, a standards-based solution in which voice calls can seamlessly flow from VoIP/IMS to 2G/3G network coverage.

The VCC solution can support both Dual Radio VCC (DR-VCC) and Single Radio VCC (SR-VCC). The SR-VCC and DR-VCC functionality allows for a cost effective and standards-based solution to ensure call continuity and support (CAMEL/WIN triggers) between new IMS-based all IP networks and the legacy circuit-switched domains. Voice calls that are originated on the VoLTE/Wi-Fi Calling IMS core are seamlessly handed off via the VCC from the IMS core network to the 3G circuit-switched network.

**SCC-AS**

Taqua’s Virtual Mobile Core’s Service Centralization and Continuity Application Server (SCC-AS) bridges the circuit-switched and packet-switched environments to enable smooth communication across disparate networks and endpoints, regardless of the subscriber location. It is a standards-based IMS application server that provides VCC and multimedia session continuity for dual radio and single radio phones for both GSM/UMTS and CDMA networks, to 4G/LTE for convergence applications. The SCC-AS allows for mobility across the packet-switched to circuit-switched domains, as well as call control and session control signaling with high scalability and geo-redundancy.

The Virtual Mobile Core’s SCC-AS operates as the signaling gateway between circuit-switched networks and the IMS, supporting call and session control signaling from IMS application servers. It acts as a Service Control Point toward the circuit-switched Mobile Switching Center, and an application server toward the IMS, which provides domain notification and selection, call routing and anchoring, respectively. The SCC-AS can also perform multiple roles in the network by providing domain selection, call anchoring, and handover to enable device independent, access agnostic, and seamless communication.

**SCC-AS Key Features**

**Domain Selection Features**
- Network domain selection
- Terminating domain selection for LTE
- Domain notification using SMS via SMPP or SMDPP Interface

**Call Anchoring**
- IMS centralized services
- GSM/UMTS/CDMA originating and terminating call anchoring (CAMEL/WIN)
- Handover features
- Domain transfer via VCC from the IMS to circuit-switched domain
- SR-VCC and DR-VCC
- Last active session transfer

**Interfaces**
- SIP/ISC to S-CSCF/IMS core
- SGs and S102 to MME
- Diameter (Rf) for charging
- GSM MAP/CAMEL
- CDMA ANSI-41/WIN
- Global Title (GT) and Alias Point Code Routing on SS7
- SMPP and SMDPP for test message delivery
- SNMP for alarms and provisioning

**Configuration**
- Geo-redundant
- Linux Operating System
- Kontron and Dell servers or HP and IBM BladeCenters
- AC/DC power options
- 2M BHCA per two-server configuration
The Demand for VoWiFi

Operators are increasingly evaluating and implementing mobile traffic offload alternatives due to the rapid growth of data hungry devices, the increase in large multimedia content, the difficulty in providing indoor coverage, and the cost and lack of new spectrum. One such alternative is Wi-Fi offload, which has been widely deployed by operators to offload mobile data.

Today’s smartphones increasingly provide a great user experience for internet connections. Conversely, the alternatives available for over-the-top (OTT) Voice Over WiFi (VoWiFi) fall far short of providing a seamless user voice and messaging experience.

Taqua’s Integrated Wi-Fi Calling Solution

Taqua’s Wi-Fi Calling solution provides service parity with the features offered by the legacy mobile phone network. The solution easily integrates into the operator’s network by leveraging Taqua’s Virtual Mobile Core. The VMC supports 3GPP MMTEL, GSM MAP/CAMEL, and ANSI-41/WIN services, which include critical regulatory services like emergency calling, lawful intercept, and location-based services as well as full suite of supplementary services to provide a cellular experience over Wi-Fi.

The Wi-Fi Calling client comes either embedded in the actual phone or downloadable from the cloud, requiring no outside or OTT applications to install the service. The Wi-Fi Calling client uses the phone’s same dialer and interface to send and receive calls, and operates through the user’s same phone number. Thus, all calls are made and received with the user’s regular phone number, as opposed to OTT VoWiFi applications that use an email address or alias phone number.

For the downloadable client, to initiate Wi-Fi Calling service, the user simply enables the Wi-Fi Calling capability whenever the phone enters a trusted WiFi network (same process as remembering/saving a WiFi SSID). When Wi-Fi Calling is enabled in a WiFi network, the phone will keep both the cellular and WiFi channel active. With the “Cellular First” feature, voice calls are made on WiFi, only if the cellular/macro network signal quality is poor and below a configurable parameter set by the mobile operator. With “Wi-Fi First” feature, the smartphone always tries Wi-Fi calling first before resorting to the cellular channel.

There are two ways to tell that Wi-Fi Calling is active on a phone: 1) in the upper-left corner of the phone the Wi-Fi Calling symbol will appear (see accompanying image), and 2) in the phone dialer/call log interface, the press-to-call button will have the same Wi-Fi Calling symbol as in the upper-left corner.

Taqua’s Wi-Fi Calling solution provides the operator with a simple and cost effective means to deploy a seamless user voice experience over any standard Wi-Fi connection. A seamless user Wi-Fi Calling experience is maintained by utilizing subscriber profiles from a single database (HSS or the legacy HLR) and legacy CAMEL/WIN based service nodes. This allows for continuous mobility across Wi-Fi, LTE and 2G/3G for all voice and messaging services.
Small Cell Core

Today’s mobile operators are increasingly looking to evolve their Fixed Mobile Convergence capabilities to provide service differentiation. At the same time, data-intensive mobile device users in the consumer and enterprise markets continue to pose network capacity challenges for operators by requiring more data at higher speeds. To combat this issue, the mobile industry is looking to small cell deployments as a principal solution for addressing network capacity challenges, data off-load requirements and in-building coverage issues.

Taqua’s Small Cell Core enables mobile operators to efficiently deploy new small cells to extend and improve mobile service to the home and enterprise over broadband access. These small cell services help operators increase customer satisfaction, improve coverage, reduce subscriber churn, and introduce new high-margin revenue streams. Taqua’s Small Cell Core solution can be deployed in pre-IMS and IMS networks.

In pre-IMS networks, Taqua’s Small Cell Core acts an application server operating as a SIP-MSC/IWF, while in IMS networks, it operates as a SIP Multimedia Telephony Application Server (MMTEL) coupled with a IP-SM-GW for messaging.

Taqua’s Small Cell Core solution delivers macro network feature parity and the service-layer interworking that is essential for a seamless subscriber experience, while also meeting the carrier’s strict reliability and quality standards. It leverages existing mobile core systems and practices so that operators can deploy new small cell offerings with minimal financial or operational impact. The Small Cell Core also provides operators to deliver new IP-based applications, and to expand mobile network capacity without re-engineering the circuit-based mobile core. Additionally, Taqua’s Small Cell Core enables a graceful migration to next-generation VoIP and IMS architectures, while leveraging existing network infrastructure.