Aviacomm

Next Generation Smart Analog Solutions

Introduction - Wideband RF Technology

The concept of wideband RF technology and the advantages it offers – global roaming, efficient use of all available spectrum, multi protocol single radio design and the impact to consumers and service providers has long been the goal in the wireless industry. While baseband modems have progressed by leaps and bounds with incredibly flexible and powerful System on a Chip designs that can adapt channel size, modulation and in many cases protocols, the limiting factor to a truly flexible, software defined wireless device has been the RF front end.

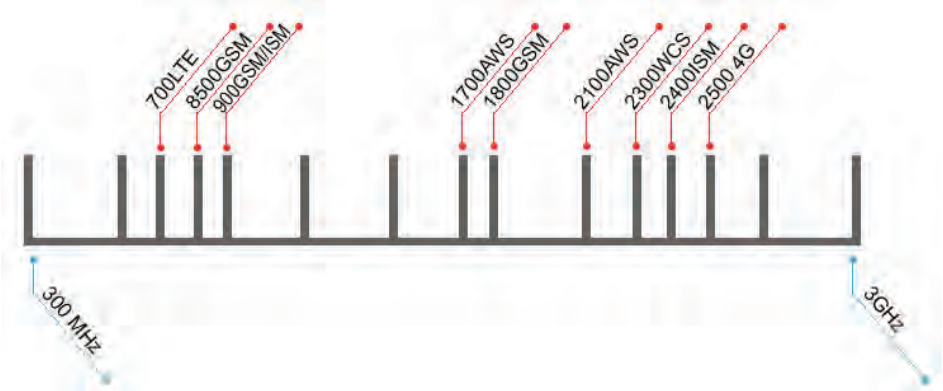
The specific challenges to the radio revolve around the wide frequency support and flexible channel sizes needed at a cost and power consumption necessary to support adoption in devices. Solutions must be able to dynamically tune to new frequencies rapidly and provide performance to meet stringent modulations schemes and regulatory requirements. Radio spectrum is a very limited resource, with the more valuable lower frequencies (sub 3GHz) providing better range and penetration due to the increased propagation. The majority of wireless applications for end devices, either consumer or machine today are using spectrum below 3GHz.

Market Driver – Applications and Roaming

Classically wireless applications occupy fixed frequencies and bandwidth as defined by regulators and industry bodies. Each of these "applications" has a distinct frequency assignment as well as spectral masks, power densities and channelizations. For example the typical mobile phone sold today supports:

- four different frequencies to achieve global roaming
- WiFi operating on two primary frequency bands (with more to follow)
- GPS running on two frequencies

This equals a total of 8 different frequencies and channelizations that must be supported today, and this will only grow as these devices add capabilities such as FM Radio, terrestrial DVT, TV White Space(TVWS) and the emerging 700MHz bands. Beyond the smart phone additional devices such as tablets and notebook computers all have similar, diverse wireless connections built in.



To support this requirement today each of wireless applications has its own RF circuitry. For a device supporting 3G and WiFi this could require up to six RFICs, PAs, and complete circuits. This drives higher cost and larger footprints in devices that are constantly being challenged to shrink size and reduce cost. A device using a single wideband RFIC, which is transparent to protocol/standard, to cover all operating frequencies and bandwidth is required going forward as applications and frequency bands multiply.

Market Driver – Limited Spectrum

Emerging applications with wireless connectivity require high data throughputs that largely depend on the availability of sufficient radio spectrum. For instance, a device may have 3G, 4G, WiFi, TVWS services available at the same time. From the end user's point of view, they do not care which service a device is going to use, they just want to have best performance in terms of data throughput. Bandwidth management and digital spectrum management techniques are being developed that allow the device to select the spectrum to use based on policy or network quality. The device will dynamically switch between bands and protocols at any given time or aggregate two or more services to achieve better performance. This requires a device to periodically monitor multiple services at multiple fixed frequencies in order to make a decision which frequency/service will be used. Some applications require even more device intelligence. In some cases the device has to listen to the current radio spectrum environment by scanning a wide range of frequency to pick a frequency and bandwidth to use on the fly. This can only be accomplished realistically with wideband RF solutions.

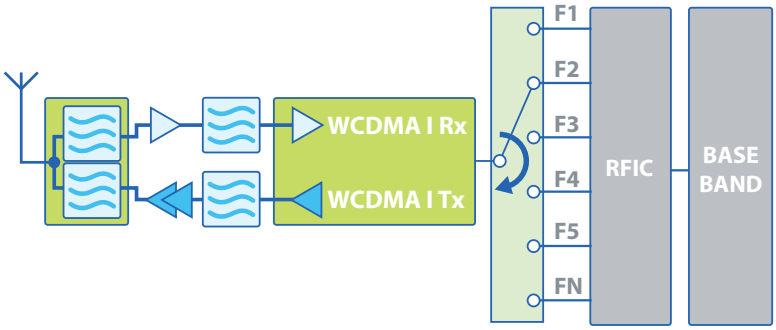
Market Solution – Aviacomm's ARF Product Line

Aviacomm is introducing a CMOS wideband RFIC, which is designed for use in virtually all wireless applications from 300MHz to 3GHz today, and up to 6GHz tomorrow, supporting channel bandwidths from 0.5MHz to 40MHz and two receiving and one transmitting channel. The ARF series of products can compete with SiGe/GaAs products in performance while providing lower cost and reduced power consumption. This single chip has the ability to support 3G, 4G, WiFi, TVWS and more in a single design meeting all protocol and regulatory demands – including the stringent TVWS spectral masks.

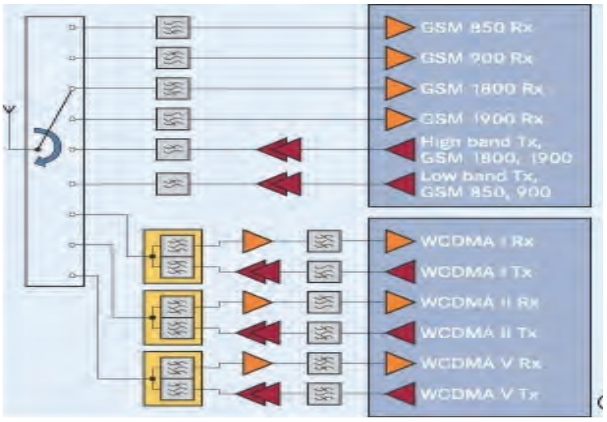
Core Technologies – Matching Networks and Programmable Band Pass Filters

When looking deeper into the design of an RF front end and how to meet the goal of a truly flexible solution there are two primary areas of focus: Matching Networks and Programmable Band Pass Filters.

An RF chain includes the RFIC, a power amplifier (PA), and an antenna. In order to deliver power efficiently from the RF to the PA and from the PA to the antenna, impedance matching between each of these components is required. However, impedance itself is function of frequency. At different operating frequencies the impedance has to be tuned to match the specific frequency. This means for each operating frequency a matching network (MN) is needed. Similarly for each operating frequency a band pass filter (BPF) is required on the receiving front end to block out unwanted signals.



ARF 1010 Approach



Current Quad Band Approach

For a wireless device with just a few fixed frequencies the problem of MN and BPF is still manageable. A quad band GSM phone for example operates at one of four fixed frequencies to provide global coverage. Four pre-tuned MN's and BPF's are built into the phone. When the operating frequency is changed, the corresponding MN and BPF circuits are used.

Aviacomm's goal is to deliver to the market a single RFIC solution that can address these issues and deliver a truly flexible RF front end. As wireless moves further toward a Software Defined Radio in support of cognitive abilities, the RF front end delivered by Aviacomm is the only product today that can deliver the performance, cost and agility necessary. Aviacomm is working on solving the matching network and band pass filter problems by developing patented "tunable" MN and BPF solutions with a self-contained tuning mechanism built into the RFIC.

Digital IQ Interface

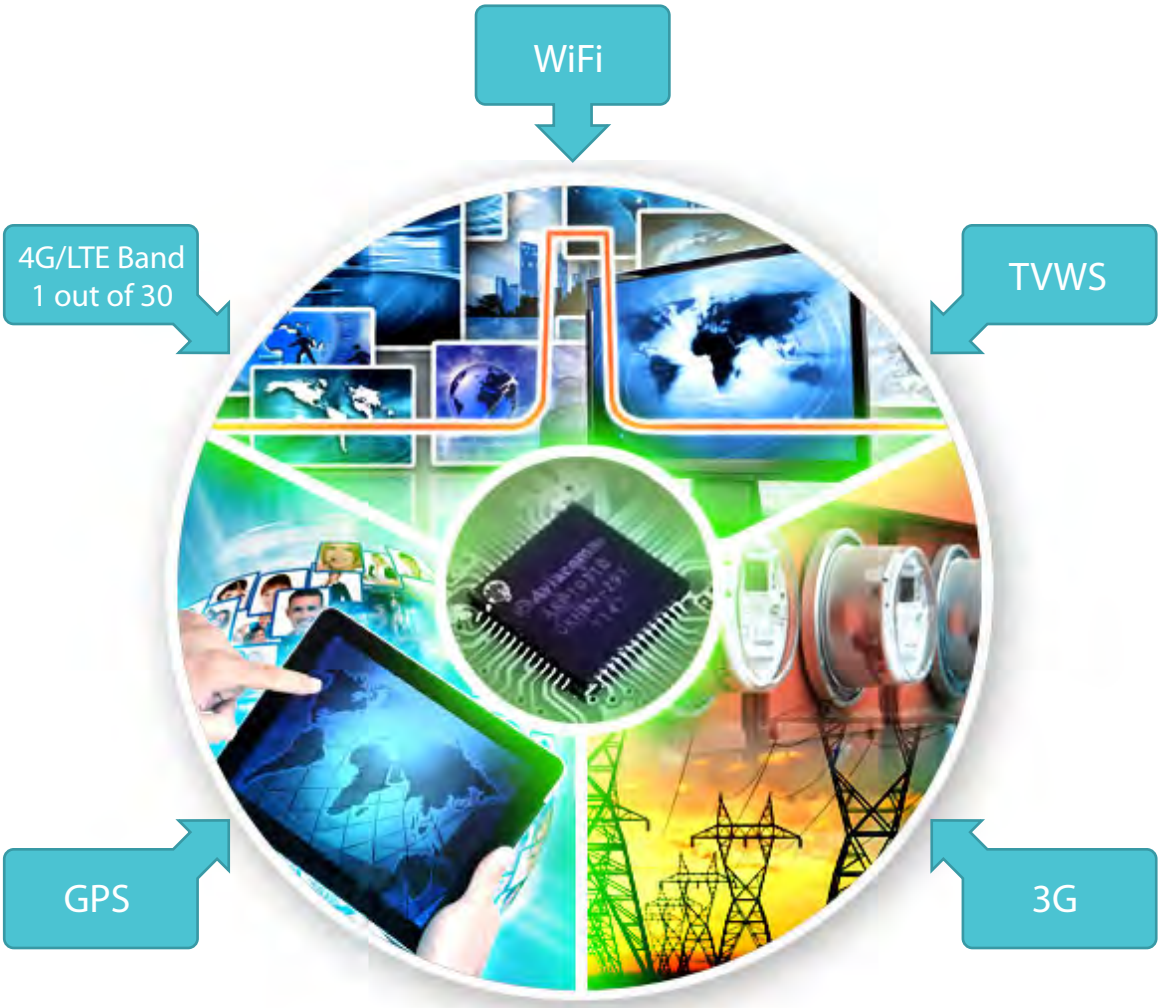
Traditionally the interface between the RFIC and baseband (BB) uses an analog IQ approach. Analog to Digital (ADC) and Digital to Analog (DAC) converters are built in to the baseband modem. Today's competitive market requires multi-function multi-protocol, low power consumption and, low cost modems. One way to achieve these goals is to shrink the die size of baseband by adopting more advanced processes, for example from 130nm to 40nm process and lower. However this approach is limited today by the mixed signal - ADC/DAC functions due to the fact that ADC/DAC implementation is process sensitive. As a result when the baseband includes the ADC/DAC in the die, there are limitations on how small the chip can be built. To solve this problem there is an industry trend to move the ADC/DAC to the RFIC. This would result in the baseband being completely digital allowing it to achieve smaller and smaller process technologies. To support this trend the interface between the RFIC and the baseband has to be completely digital. There are several efforts to define this interface with the two most popular being DigRF and JDEC.

Given that this trend is new and emerging it is not clear which if either of the two approaches above will be effective in the device market segment. There are power, cost and implementation issues with both DigRF and JDEC.

To address this issue and support the requirements for a digital IQ interface with low power consumption and low system cost, Aviacomm offers a custom, open digital interface to the ARF product line. The solution offered by Aviacomm highlighted includes an advanced 12bit ADC/DAC technology with ultralow per-channel power consumption and a high speed generic serial data interface. The resultant is a low cost, low power consumption and high performance mobile device system solution.

Summary

As wireless becomes an embedded and expected component of everyone's life style, supporting and enabling ever more amazing capabilities, the technical demands are high. The mobile market itself with 3G and now emerging 4G networks operating in as many as 30 different frequencies around the world is demanding Smart Analog Solutions supporting wideband RF technologies. For mobile applications cognitive RF solutions such as the ARF10 product line are a must.



When additional applications such as WiFi, emerging TVWS, GPS and DVT are added to the mix the current approach of individual RF circuits per frequency band is simply unworkable. The high performance, flexible approach used by Aviacomm is the only answer. As wireless expands even further into machine to machine connections such as Smart Grids or personal health monitoring the Aviacomm solution does not change – the single design supports all frequencies up to 3GHz today and 6GHz tomorrow.