RTT TECHNOLOGY TOPIC
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Multi band multi mode multi media mobiles

In this month's HOT TOPIC we look at how the design brief for cellular handsets has expanded and the consequence in terms of component count, component cost and complexity.

3G Handset Partitioning

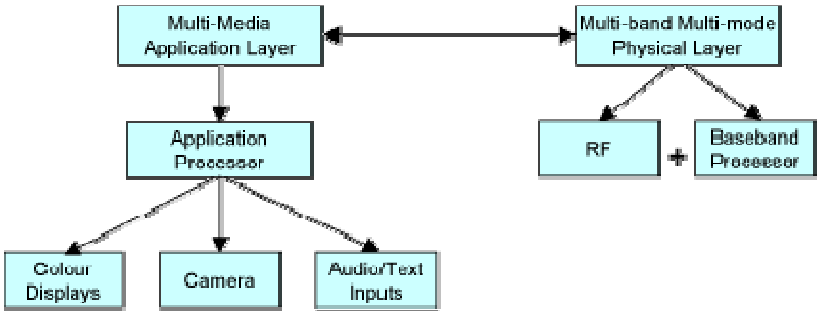

Figure 1

The most obvious additions in a multi-media phone are a colour display and a camera. A camera (lens, sensor, image processor) adds about 10 dollars to the component cost of the handset, a colour display adds rather more (depending on how many colours, resolution, type of LCD, backlight or reflective, etc etc). However it's not just the cost of the components themselves but the add on effect they have on the rest of the phone. For example, most multi-media phones now have two rather than one microprocessor - an application processor and a baseband processor. They might be packaged together but they are still two separate components. Typically today, a baseband chipset will be an ARM 7 microcontroller running at 52Mhz, an application processor will typically be an ARM 9 microcontroller running at 140 Mhz or more. As a result, the application layer is now competing very actively for the power budget available in the phone. Apart from the microcontroller, several hundred milliWatts disappear in the display and display driver and a camera and MP4 encoder can eat through 80 to 90 milliWatts (and a great deal more if you are trying to process CIF, QVGA or VGA images at 15 fps (frames per second).

In parallel the demands made on the physical layer are considerably increased. The market brief very easily expands to include GSM 850, GSM 900, GSM 1800, GSM 1900 (quad based GSM) plus the IMT bands adding substantial complexity to the RF stages in the phone. The need to support multiple modulation formats means more linearity is needed for the RF power amplifier and/or output power has to be reduced. Either way, power efficiency goes down.

Consider the imaging bandwidth produced by a 300,000 pixel CMOS image processor (VGA), at 12 bits per pixel at 15 frames per second. Now compress like mad to get something small enough to either store or send - the compression takes power, the storage takes power, the sending takes power.

In addition, there are subtle but significant trade offs to consider.

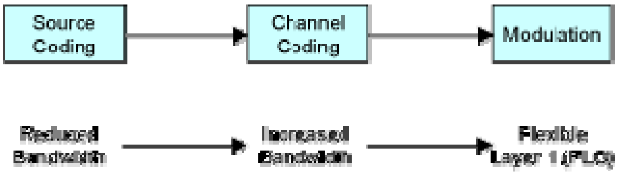

Figure 2

Let's consider the bandwidth savings that can be achieved in the source coder (power and time permitting).

A picture taken in fine camera mode with a Q of 90 produces, let's say, a file of 172,820 bytes, on a 33.6 kbps uncoded channel this would take 41.15 seconds to send.

We could increase the compression and greatly reduce the size of the file, for example to 12,095 bytes but the 'Q' would have reduced to 5 - the quality of the source coded material will have been significantly degraded. If the picture is being sent to a device with a poor quality display, a 'Q' of 5 probably doesn't matter very much, but if the picture is being sent to a device connected to a computer router, it will be unacceptable..

Note also, our example is an uncoded channel. Generally, in any 2G, 2.5G or 3G radio channel we will be adding in significant amounts of channel coding.

As we increase the compression ratio in the source coder we can decrease the source coder bit rate which means we can increase the channel coder overhead.

The net result may or may not be an improvement in transmission quality (this would be dependent on the radio channel conditions **and** the efficiency of the source coder compressor) and of course also depends on the perceived degradation of image quality.

The source coded and channel coded information stream then has to be modulated on to the radio bearer which in itself is adaptive. Note that one of the good things about the 3G radio layer is that as data rates increase, bandwidth occupancy rather than power increases. A 960 kbps user will be using 25% of a 5 MHz channel, a 15 kbps user will be using less than half of one percent of a 5 MHz channel.

This layer one flexibility promises to deliver substantial RF power budget gains, which is just as well considering the power needed in other parts of the handset.

So 3G handset design is a balancing act between power hungry devices competing for limited battery bandwidth, and a balancing act between RF and baseband and application layer hardware and software design. It highlights the need for a multi-disciplined approach to multi-media handset design, in particular, a need to integrate

RF, DSP and system engineering design skills.

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