# Ka-Band – the future of satellite communication?

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**We are very familiar** with the C and Ku bands. These bands are normally used for digital TV transmission. Some of our readers also know the S band. However, the frequency spectrum that can be used for satellite communication is not limited to the above mentioned ones. Before we move on to Ka-Band, let's have a look first at the whole radio frequency spectrum. It is shown in figure 1 along with the names of frequency ranges.

Formally, the radio spectrum starts with 3 Hz and ends at 300 GHz. In real world, the low-end extremes are not used for normal broadcast. "Long Waves" band in classical radio receivers starts at around 100 kHz (LF range). Lower frequency ranges may be of use for submarine communication, communication in mines or geophysics measurements.

While this topic is very interesting for radio amateurs, low frequency is of little interest for satellite industry. First of all, signals of low frequency are not suitable to convey large amount of data per second. We can think of transmitting digital (and also analog) TV starting from 100 MHz or so. Another thing we have to take into account is the property of the Earth atmosphere. Low and very high frequency signals are heavily absorbed when passing through our atmosphere. In figure 1, you can see the range of frequency that we can use for satellite communication – a green bar starting at around 20 MHz and ending at about 40 GHz. Occasionally also lower and higher frequencies may be considered but only within this range, the signal is not significantly attenuated.

The names of the ranges as shown in figure 1 are not the only ones that we use. Of course you are familiar with C Band and Ku Band terms. These bands together with the other ones are shown in figure 2. Perhaps you can be a bit surprised that "officially" Ku Band starts at 12 GHz while some of the Ku Band transponders transmit even below 11 GHz, so formally in X Band. Indeed, the downlink uses both Ku Band and X Band but the uplink uses only Ku Band. For this reason, we call them Ku Band satellites or transponders. Moreover, you should also keep in mind that we can not use the whole band (Ku, C or whatever) for the satellite downlink. A part of the band has to be reserved for the uplink, and some parts of the bands are dedicated for military or professional services (e.g. radars).

However, what can be seen very easy is that the space for TV or data channels is much greater in Ka band than in C, and Ku altogether. From 18 to 40 GHz we got 22 GHz!

No wonder that Ka band is becoming more and more interesting for the satellite service providers.

The Earth atmosphere behaves differently for various frequencies. Figure 3 shows the attenuation of our atmosphere when it is dry and wet. A dip around 22 GHz is caused by water vapor attenuation. Were this all we had to take into account, we would have no problem in using frequencies up to 50 GHz or so. Attenuation of less than 1 dB is not a big deal.

Unfortunately this is not the whole picture. Atmosphere containing water vapor is one thing, and raining is the other thing. Attenuation caused by rain dramatically increases with frequency, as you can see in figure 4.

That's why Ka Band is more popular for high speed Internet access rather than for classical satellite TV. If we speak about sending data to/from the global network, loosing a few packets is not a big problem. Our equipment will take care about asking for the missed data again and again and finally we will see the webpage as it was originally designed. The delay of a split

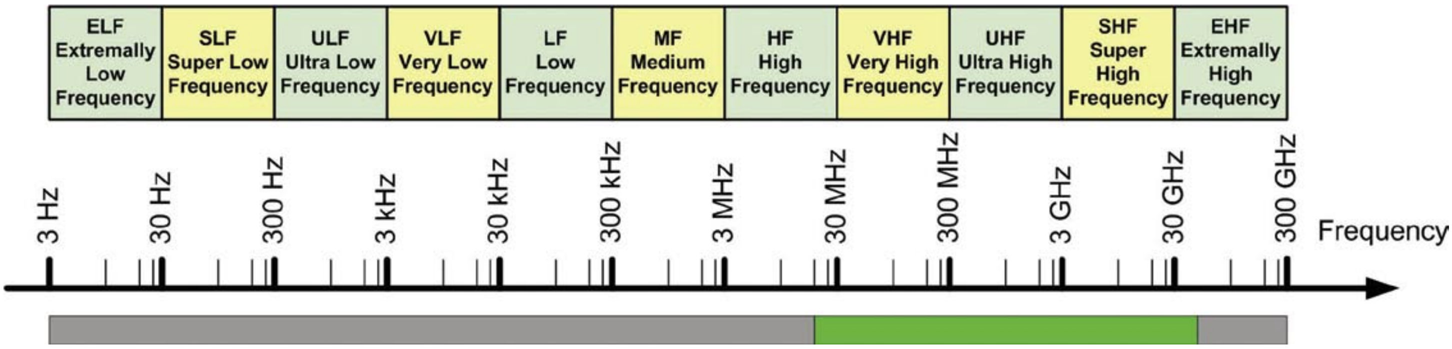


**Figure 1. Frequency spectrum.**

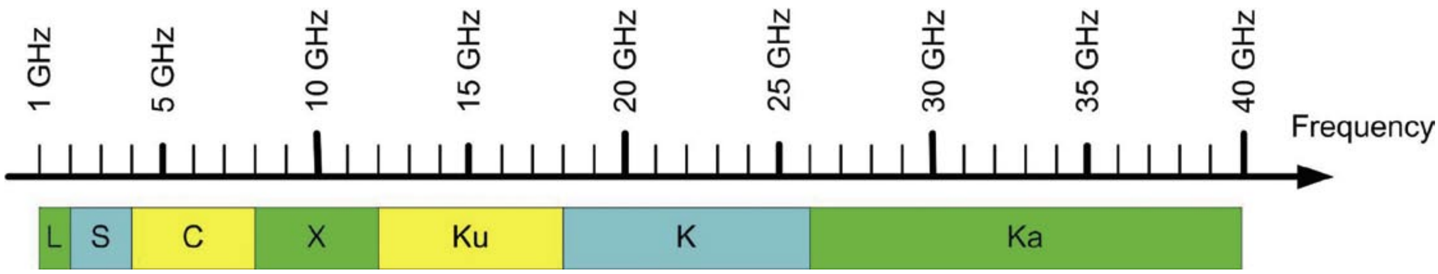


**Figure 2. Satellite bands.**

second or even longer usually does not pose a problem in the Internet based communication. Of course, we cannot say the same about digital TV reception.

## Example: WildBlue, USA

Although there are similarities between these two applications like: QPSK modulation, error correction schemes, small satellite dishes, there is one significant difference. Satellite equipment for Ka Band is built around a transceiver rather than a receiver. If we have equipment from a company like WildBlue,USA, we not only receive data from a satellite but transmit it as well. This is a 2-way communication. No telephone line or whatever is needed to complete the Internet connection. For the reception 19.7-20.2 GHz range is used. For transmission: 29.5-30.0 GHz. The IF frequencies for this setup are: 1.0-1.5 GHz and 1.8-2.3 GHz for reception and transmission respectively. Receiver of the modem can handle QPSK signal with FEC 1/2, 2/3 and 3/4 as well as 8PSK with FEC 2/3 and 5/6. When transmitting, only QPSK with FEC = 1/2 is used. The dish delivered to the end users is of Cassegrain type.

## Conclusion

So, is Ka Band the future of satellite communication? Yes and no. Yes, because we continuously need more and more wide bandwidth signals and lower bands are getting chock full. Ka Band offers us additional frequency ranges at already occupied satellite positions. No, because it is much more weather dependent than Ku and especially C Band, so moving digital TV transponders from the lower bands to Ka Band would be a very risky step unless the targeted world region is very dry.

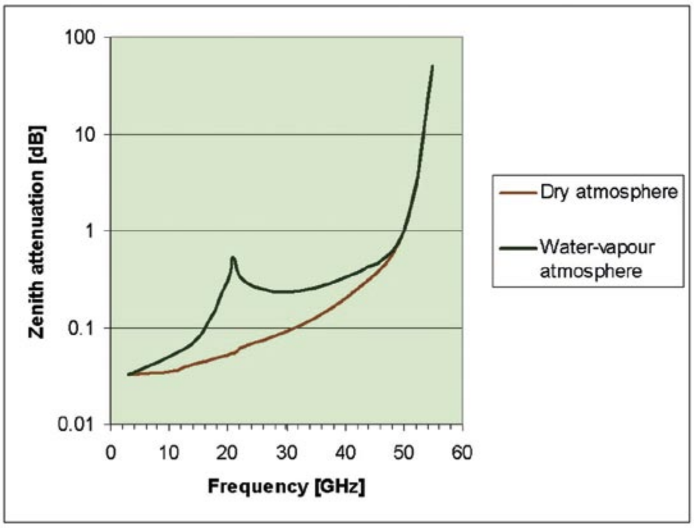


**Figure 3. The Earth atmosphere attenuation as a function of signal frequency.**

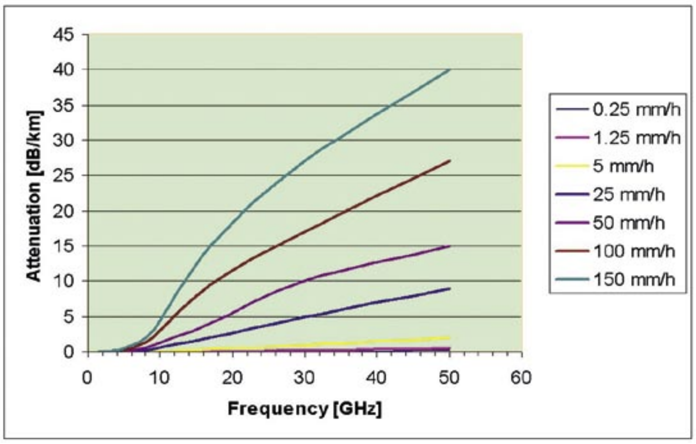


**Figure 4. Attenuation caused by rain as a function of frequency and rain intensity.**