[We observe that the text in section 4.3 R09 is a mix of discussions on demanded bandwidth and offered bandwidth (and the discussion about demanded bandwidth is not consistent with the new section 4.2.2.) Here is a proposed replacement for this section that follows the methodology of contribution on Offered bandwidth forecasting to the San Antonio meeting.]

4.3 Forecasting offered bandwidth– residential access

In contrast to the previous section on forecasted bandwidth consumption, this section addresses forecasting of bandwidths offered to residential subscribers, which is in principle independent of actual bandwidth demands.

The most well-known method for forecasting offered bandwidth over residential access systems comes from extrapolating "Nielsens' Law of Internet Bandwidth" [Nielsen], which claims that a high-end user's connection speed grows by 50% per year. This assertion is based (in recent years) on premium service levels offered over DOCSIS HFC networks to J. Nielsen in the U.S. It is problematic to apply this "Law" to FTTH networks, as it has already failed, by an order of magnitude, to account for the recent proliferation of Gigabit offerings. Further, it only applies to the offered speed of Internet connections, excluding the connectivity for managed linear pay-TV, which represents a much larger component of a user's traffic on all-IP video networks. Accordingly, an alternative method for forecasting maximum service level offerings is presented here.

We suggest that operators will never offer speeds that can't be realized and speed-tested by subscriber end terminals in the home network. The maximum that can be speed-tested in the home today is approximately 1 Gb/s, using a Gigabit Ethernet home network and Gigabit Ethernet end terminals. We note that current Gigabit service offerings are the first time that offered bandwidth equals the capability of subscriber end terminals in the home network.

We next suggest that more than Gigabit service will not be offered until there is something faster than Gigabit Ethernet in the home, because again those higher service offerings couldn't be tested in a speed test.

Therefore, we posit: once offered bandwidths reach the maximum capability of subscriber end terminals in the home network (which has already happened for FTTH networks), the maximum offered bandwidth will be governed by the maximum bandwidth capability of subscriber end terminals in the home network. The latter is examined next.

The adoption of IEEE 802.3 Ethernet LAN over UTP bandwidths in the home is approximated by the solid red line in Figure 13. Extrapolating this adoption trend predicts 10G Ethernet over UTP in the home within the next 10 years. Alternatively, intermediate Ethernet speeds over cat-5 UTP are under consideration in IEEE: 2.5G and 5G. Finally, it's possible that none of these

higher speed technologies gain significant traction in the home, maybe because of the proliferation of wireless devices at the expense of wired devices. These four possibilities are represented by the dashed red lines in Figure 13.

In parallel, the approximate real world peak speeds of IEEE 802.11b, .g, .n, and early .ac wireless LANs (for a single end user device) in the home are indicated by the solid blue curve. A linear extrapolation (on a semi-log scale) is shown by the dashed blue line, and predicts a 3 Gb/s peak speed in 10 years. However, this is speculative, as there is no plan in 802.11 to achieve this peak speed in the home; it is not clear if even 1 Gb/s will be practical.

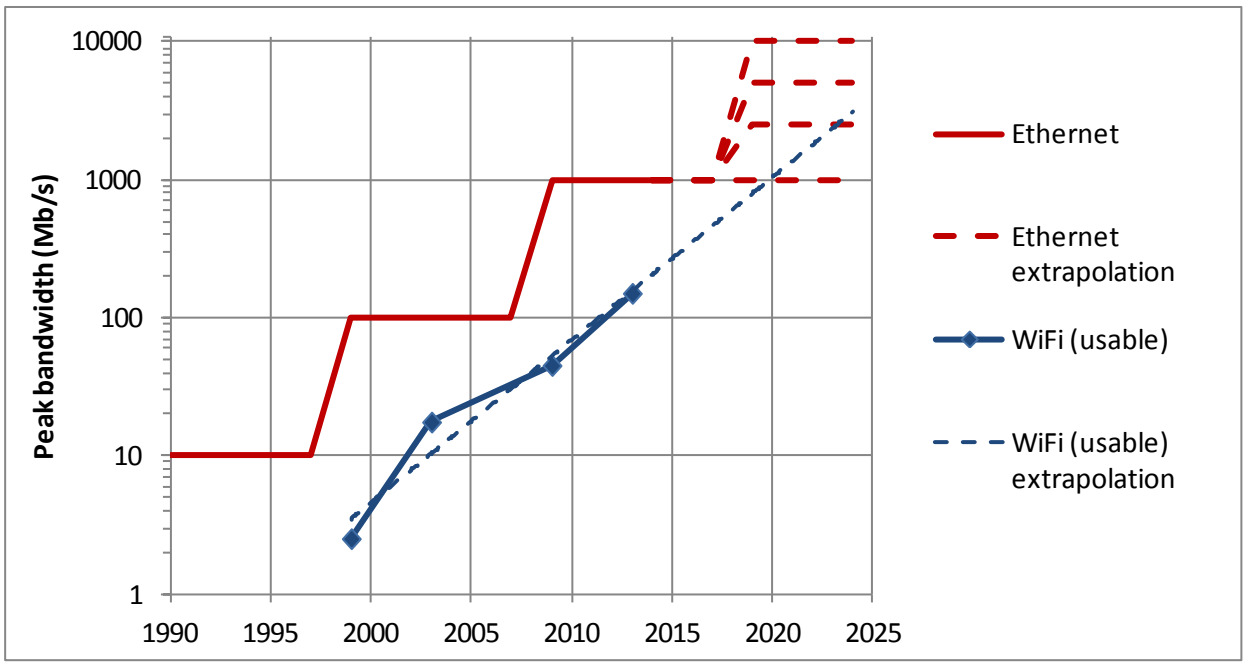

Figure 1~~13~~: Evolution of residential home network bandwidth

Accordingly, in 10 years maximum peak residential home network bandwidth will probably be limited to somewhere between 1 and 10 Gb/s. Following the logic above, that operators won't offer speeds that can't be realized and speed-tested in the home, the maximum offered bandwidth will also be somewhere between (today's) 1 Gb/s and 10 Gb/s. In the context of defining NG-EPON, it makes sense to plan for the high end of that range, i.e. 10 Gb/s offered peak bandwidth. Although there is a good chance that this is overly aggressive in light of a preference for wireless connectivity in the home.

References

[Nielsen] J. Nielsen, "Nielsen's Law of Internet Bandwidth", http://www.nngroup.com/articles/law-of-bandwidth/, updated 2014.