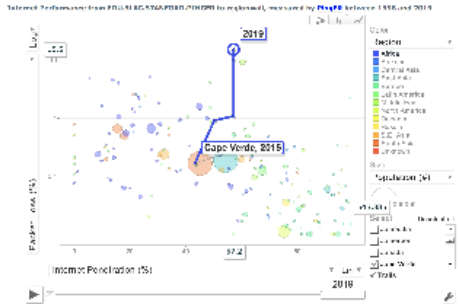
PingER Anomalous throughputs

There are often anomalously high or low values or dramatic changes in throughput as one moves from year to year. This can typically be observed by looking at the motion metrics normalized throughput. There can be several causes:

- A possibility is that the country has moved from using Geo Stationary Satellite (GEOS) to terrestrial links. This will dramatically reduce the minimum RTT from over 450ms to typically well under 350ms, and hence increase the throughput since it goes as 1/RTT. For example: see the change in Cuba between the year 2012 and the following years. This is due to the change from using a GEOS to a terrestrial link via Venezuela.
- If we have very few (e.g. 1) target hosts in a country then maybe the target behaves strangely. For example, see Cape Verde from 2015 to 2019. it is seen the throughput drops from 5,531 Kbps to 395 Kbps. The main cause is the dramatic increase in loss from 0.2% to 15.5%. Note the throughput goes as 1/sqrt(loss). To see whether the cause is the anomalous behavior of a single target (in the case of Cape Verde the only target was www.cmsf.cv) if possible we add more targets in the country (e.g. in July 2019 we added more targets in Cape Verde).



- Another example is Iran where the loss rose from < 1% in 2015-2017 to over 7% in 2018 and 2019.
- If we have multiple hosts then we can look at whether some targets are behaving anomalously (usually large RTTs, high losses) some of the time (e.g. as seen monthly) and if so filter them out of the summations.
    - It may also be that the target has a low RTT or loss. The cause of the low RTT may be that the target is no longer physically located in the country but is a proxy closer by (e.g. in the US). In this case, we replace the target. A low loss of 0.0000% may be since all the pings sent have been returned with no loss. For a 365 day year we monitor each target with 10 (or up to 30 if there are losses) every 30 minutes, i.e. ~175K pings (or if 1 ping is lost a 0.0006% loss). If we monitor for a month then the loss of a single packet gives a loss of ~0.007%.
    - If there are big differences between targets in a country then we may need to add multiple hosts to get a quorum. For example, for Iran in 2019 there were huge differences in losses for the two targets monitored there (irissf.ir with losses of 0.1% - 0.8% and www.iut.ac.ir wit h losses of 7% -22%).