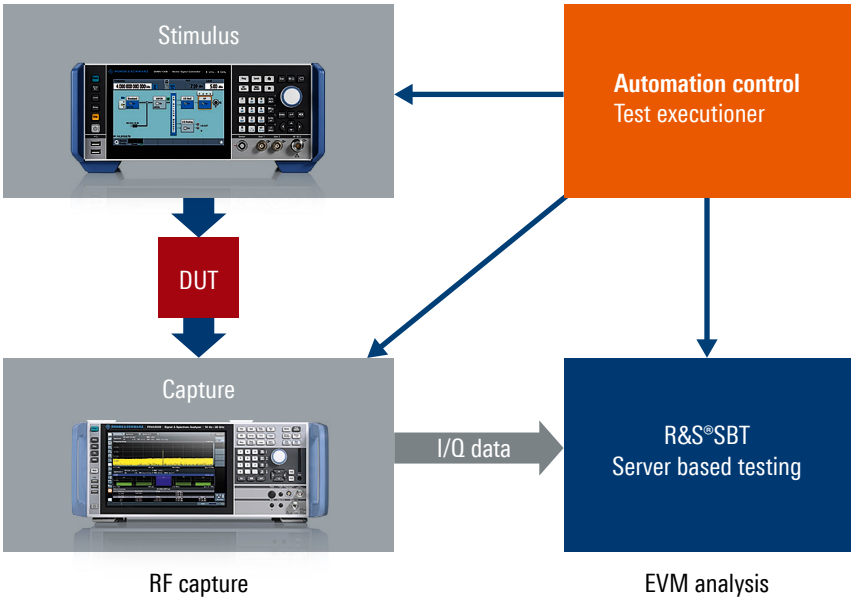
FASTER CHARACTERIZATION OF 5G RF FRONTENDS

More frequency bands and larger dynamic ranges increase the number of test points required in characterization and production of the latest RF frontends (RFFE). Actively managing test time and cost while maintaining quality is more important than ever before.



R&S®SBT test system overview

Your task

Updating infrastructures and user equipment for 5G is currently one of the hottest topics in communications technology. You are supplying the essential RF frontend enabling the wireless connection. Key aspects to be successful in a highly competitive field are time to market and design for testing to optimize production costs. You are working on how you can characterize and manufacture products more quickly under the given technical and financial conditions. The test speed is nothing new for you. Shorter product cycles require new ideas that improve test throughput in characterization.

Rohde&Schwarz solution

Parallel execution of test jobs using fast RF equipment together with multithreaded optimized signal processing based on our R&S®SBT server based testing routines is sufficient for both the speed of execution and for scalable tests to improve instrument utilization.

Let's take a step-by-step look

The traditional characterization and production routines go through each test step sequentially. After one step is completed, the next step follows. Improving test times is often accompanied by reduced test depth or accuracy, which may result in an increased failure rate in later operation.

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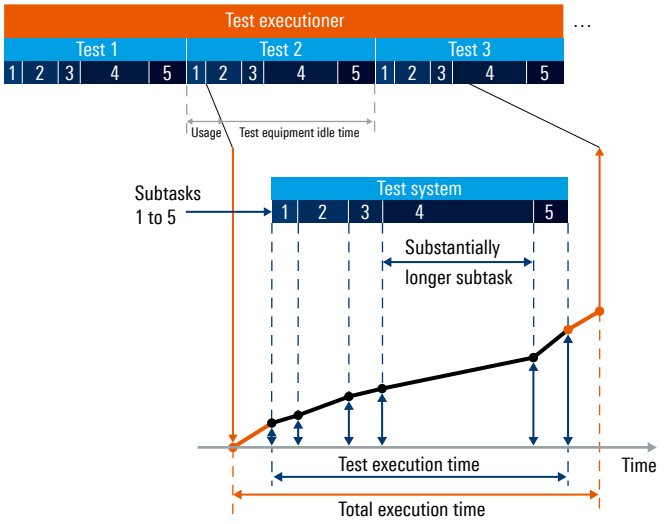
Make ideas real

Without sacrificing accuracy while still maintaining a needed quality level, every step or subtask has a minimum time tag. In RF measurements, there is typically the tradeoff between a larger dynamic range and faster sweep times, which translates directly into measurement accuracy versus test speed.

For a typical characterization over amplitude and frequency, the same test is performed at each step. It may be worth examining the duration of each subtask to find out where time is lost.

Let us look at the concrete example of creating an EVM performance map over frequency and amplitude
Various subtasks are required to get the result per amplitude and frequency point. The capture device needs to adjust its RF input for best performance and then record the signal. The recorded signal is postprocessed to calculate the EVM. In the case of 5G, this can be quite time-consuming since we are working with a complex signal structure.

Sequential process



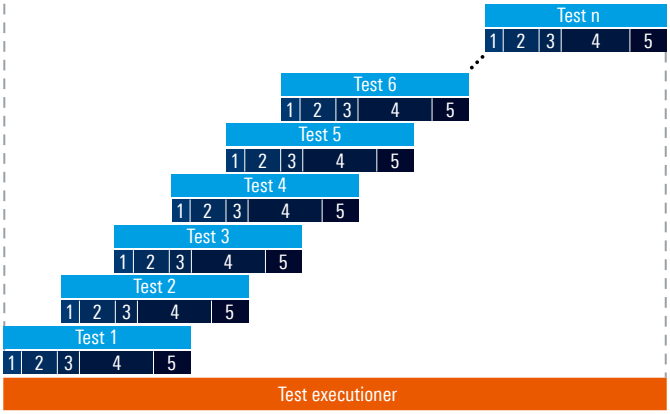
While the EVM is being derived, the RF system is typically idle.

Instead of doing each subtask sequentially, it is worth looking for parallel execution possibilities. In our example, we ideally decouple data capture by the RF instrument and the evaluation of the I/Q data to obtain the EVM.

In practice, the capture device automatically levels and samples the RF data (subtasks 1 and 2). The captured I/Q file is transferred to a server for further processing, while the instrument can go to the next step of the characterization over frequency and amplitude.

This significantly increases the utilization rate of the instrument, ensuring better use of the investment and shortening the test time.

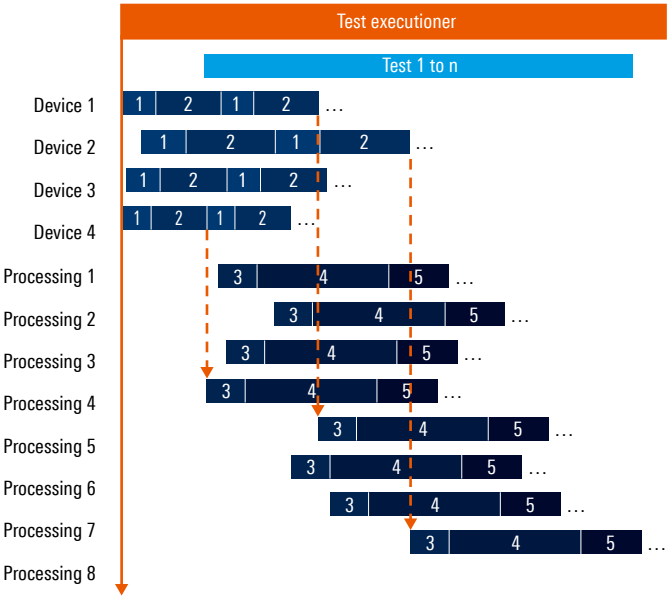
Parallelization



Assuming a powerful server with multiple cores performing the EVM calculations, not only one job but several will be executed at the same time. The handling of the data packets and the scheduling of jobs is done automatically by the R&S®SBT server based testing application.

5G frontends may include not just one but multiple RF outputs for massive MIMO and beamforming applications. Highly integrated devices address this need by offering four or more RF channels. To enhance the test speed, ideally multiple RF capture devices record data at multiple DUT ports at the same time in order to improve parallelization. Each capture device sends the captured data to the server for EVM evaluation. The R&S®SBT takes care of the rest, ensuring fastest results.

Parallelization plus multiple recording devices



Let's perform a concrete test to see results

We are looking at a 5G RFFE evaluation covering 59 amplitude points. For each point, we calculate ACLR, EVM and SEM based on a fully loaded 5G 100 MHz bandwidth frame (10 ms). We use midrange instruments – the R&S®SMBV100B vector signal generator and the R&S®FSVA3000 signal and spectrum analyzer. The traditional approach, in which all subtasks run sequentially, obviously takes the longest time. Separating RF recording and data evaluation speeds up things. Based on the capability of the PC or server, jobs that calculate the results are performed in parallel. The effect scales nicely with the performance and number of cores of the available CPU. Our measurements show improvement factors ranging from 3 to over 5, translating into a more than 5 times shorter characterization run on the device under test.

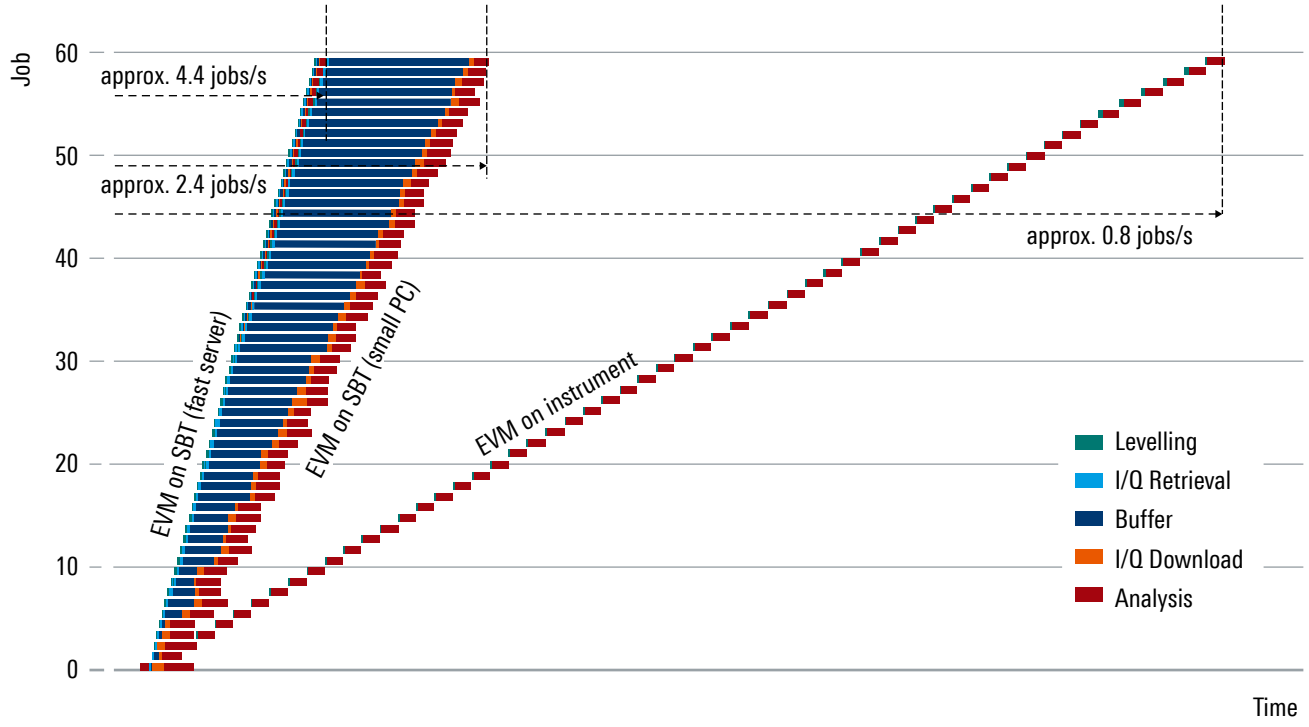
Summary

The combination of R&S®SBT server based testing and fast RF instruments allows much shorter characterization times and faster production testing without compromising sensitivity, test coverage or accuracy and repeatability, while improving equipment utilization and reducing cost. Production throughput is increased and characterization time is minimized.

See also

www.rohde-schwarz.com/serverbasedtesting

Comparison of different approaches



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PD 3608.4897.92 | Version 01.00 | May 2020 (fi)
Faster characterization of 5G RF frontends
Data without tolerance limits is not binding | Subject to change

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3608.4897.92 01.00 PDP 1 en