Empirical study on the impact of arc welding on 5G performance

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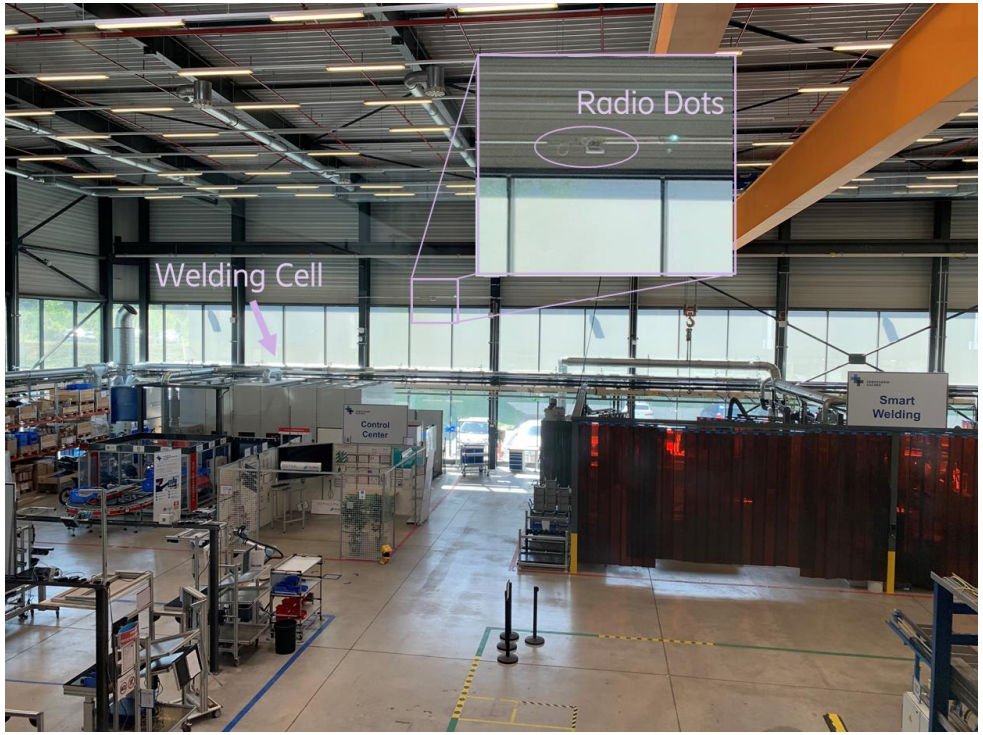
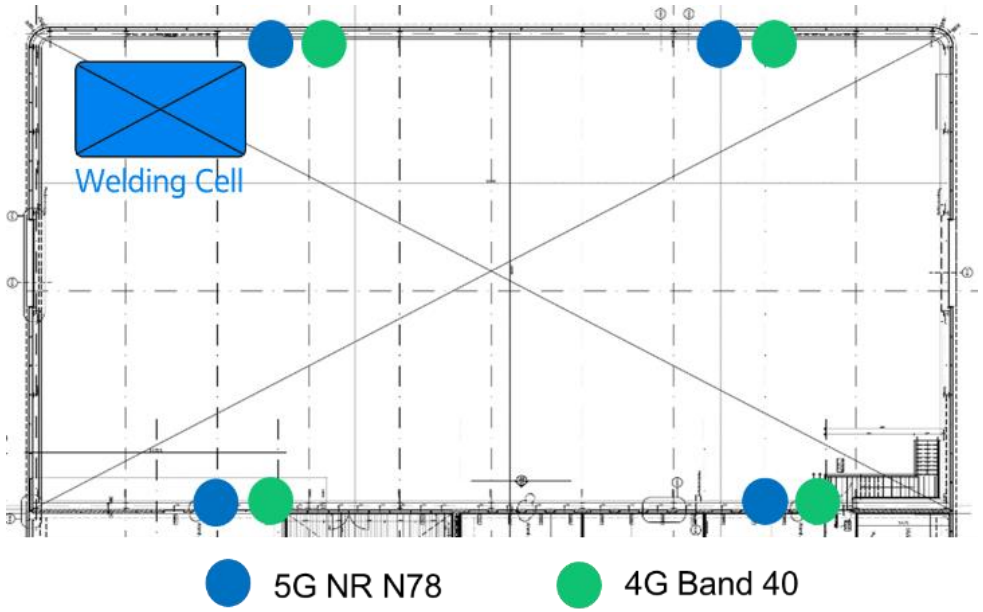
Outline

- Motivation and background
- Measurement setup and methodology
- Performance results
- Conclusions

Experimental setup



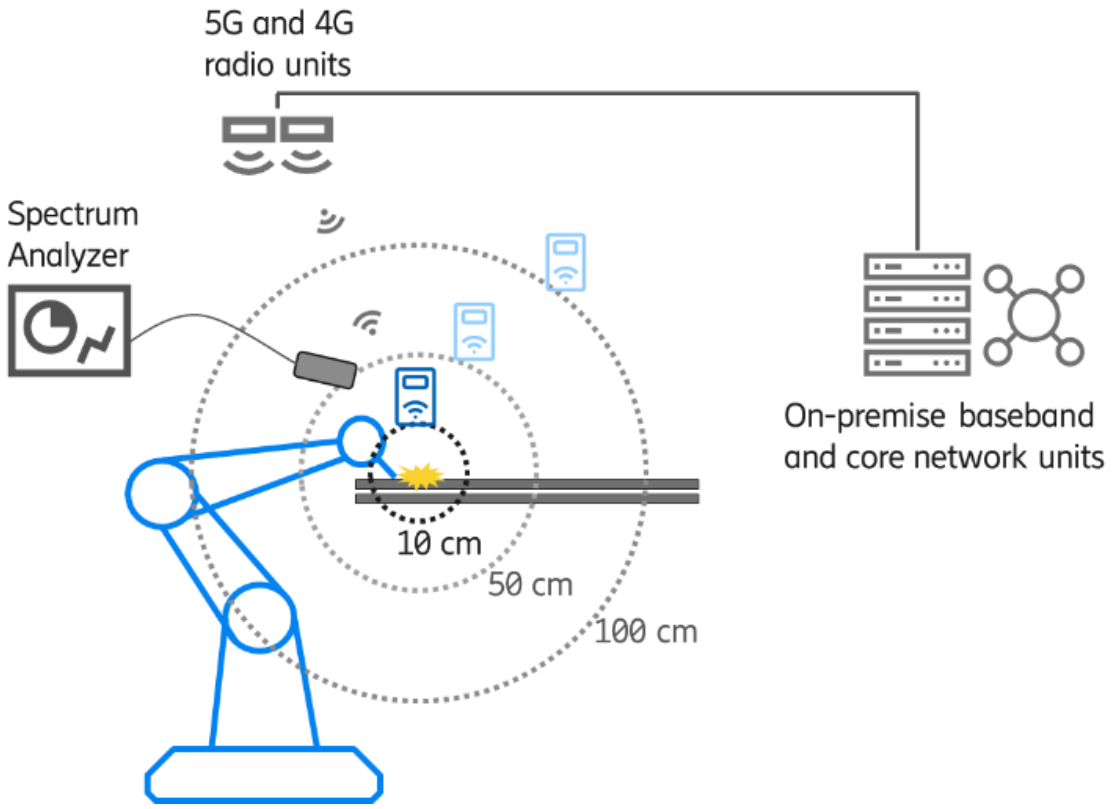
A snapshot of the production hall at Center for Connected Industries in Aachen, where 5G performance tests have been carried out in the presence of welding process.



Layout of the production hall with locations of the 4G and 5G radio units, and the welding cell in the factory hall of ca. 1500 sq. m of area.

Measurement setup

- 5G NR deployment in the mid-band frequency range of 3.7 – 3.8 GHz (Industrial licensed spectrum)
- Dedicated use of the 5G system for experiments
- Measurements of uplink and downlink performance separately: latency and throughput impact
- Monitoring of the electromagnetic spectrum using a high-end spectrum analyzer
- Commonly used welding process used in modern manufacturing
- Metal Active Gas (MAG) arc welding
- Possibility to carry out tests systematically and repeatedly



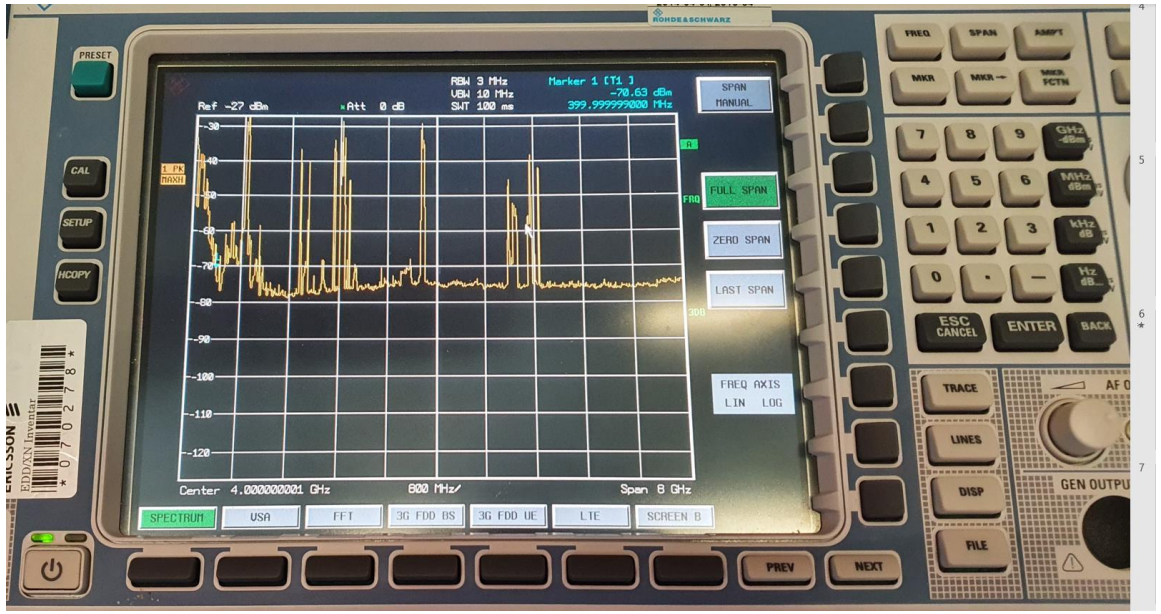
Snapshots – measurement setup

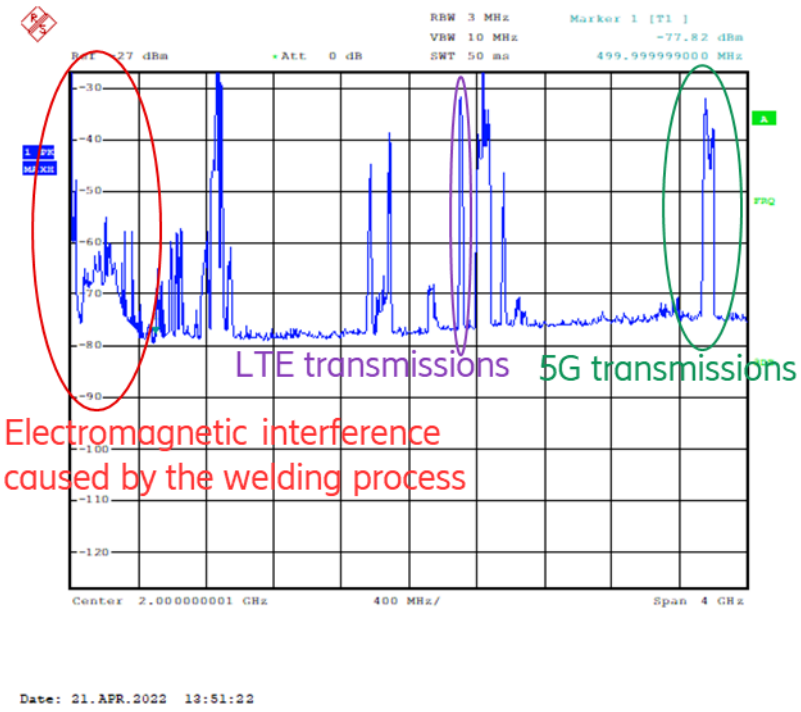
Spectrum analysis

Welding process	No	Yes	No	Yes
5G transmissions	No	No	Yes	Yes

Combination of spectrum analysis with/without welding process and with/without 5G transmissions.

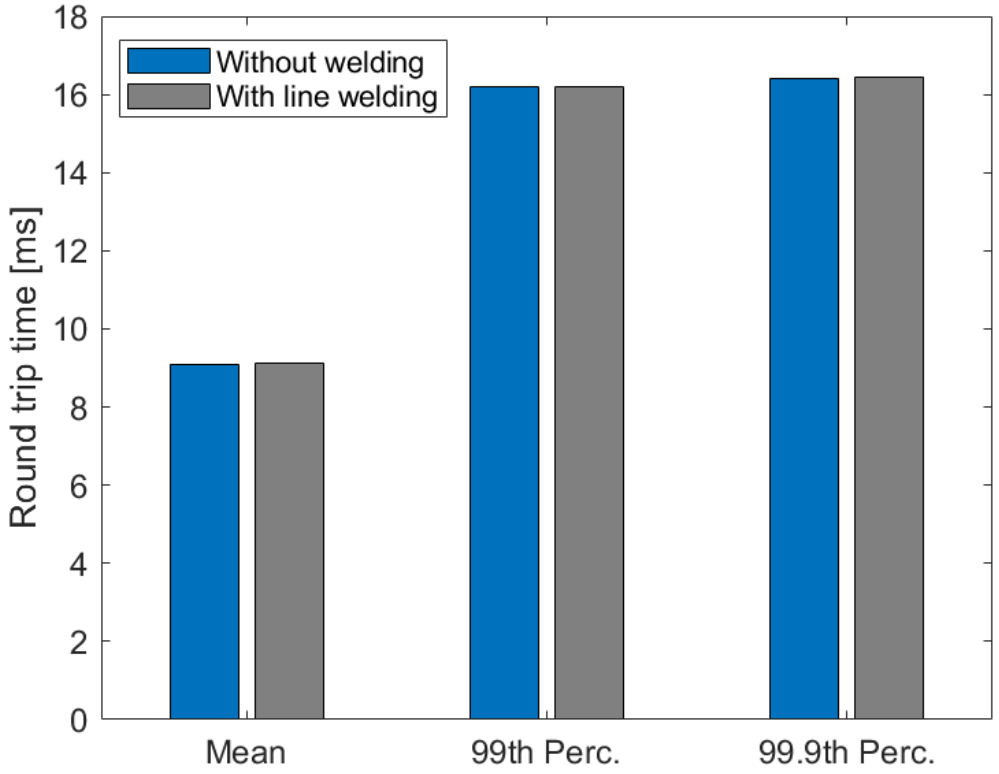
Spectrum analysis



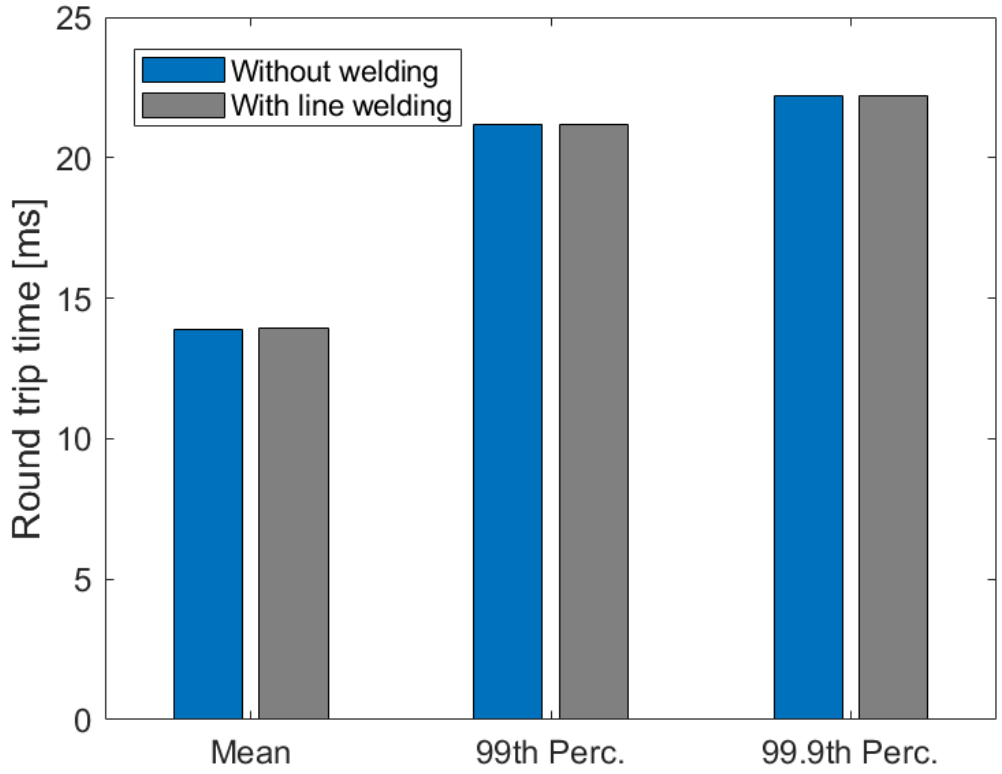


Snapshot of the analyzer with the maximum hold feature enabled indicates that the electromagnetic disturbance from the MAG arc welding process is observed up to 450 MHz. The span of the spectrum analyzer is set to 4 GHz shown on the x-axis while the y-axis limits are set from -120 dBm to -30 dBm.

Performance evaluation – latency impact

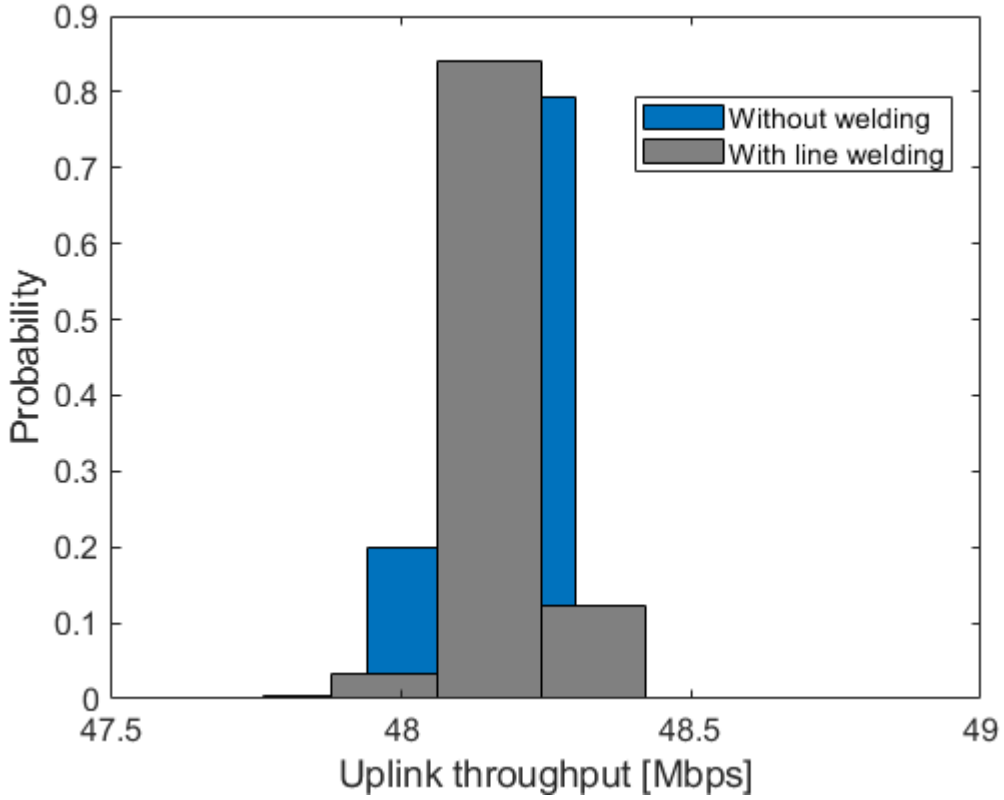


Different percentile values for the round trip time measurements for an ICMP ping packet size of 64 B transmitted at a periodicity of 16 ms.

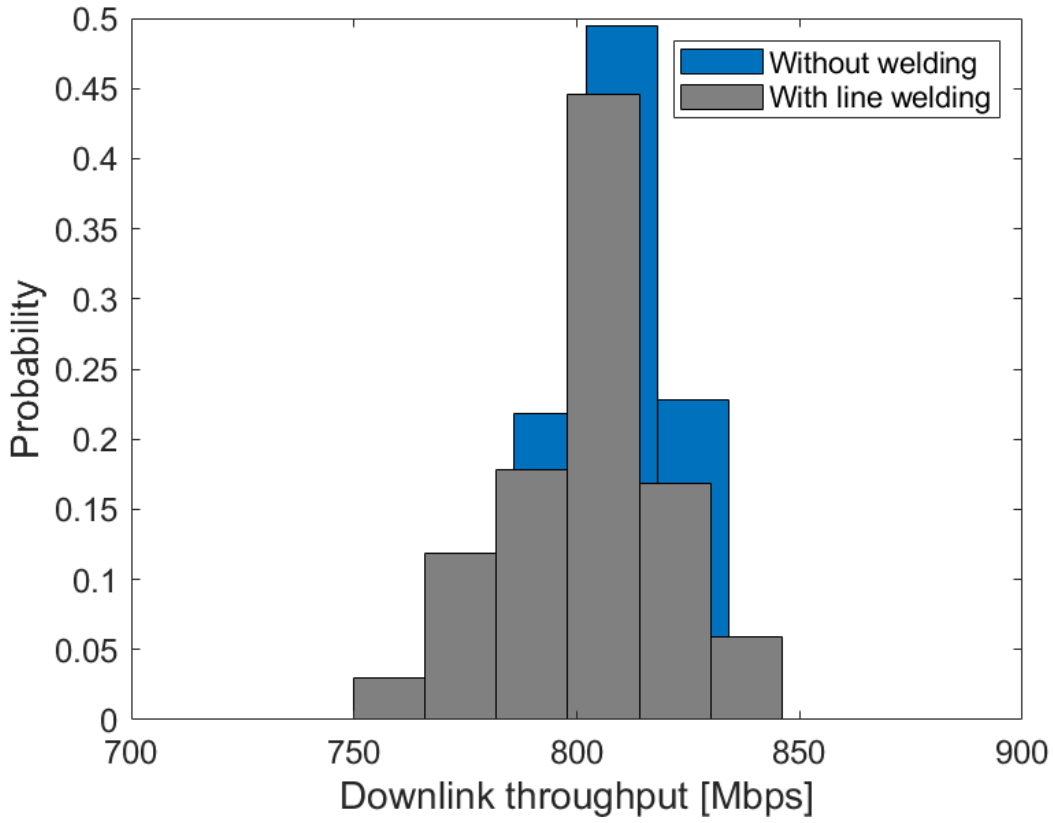


Different percentile values for the round trip time measurements for an ICMP ping packet size of 1400 B transmitted at a periodicity of 16 ms.

Performance evaluation – throughput impact



Histograms of the uplink throughput with and without the arc welding process. (50 MHz BW)



Histograms of the downlink throughput with and without the arc welding process. (50 MHz BW)

Conclusions

- Performance impact of the popular arc welding process on 5G uplink and downlink latency and throughput has been studied in a systematic manner.
- 5G mid band system operating in 3.7-3.8 GHz has no performance impact due to electromagnetic interference caused by welding process.
- The electromagnetic disturbances from spot and line welding have been observed up to 450 MHz.