



**EMC/EMI
CONSIDERATIONS FOR
CPS**

WHO ARE WE?

- Interference Testing and Consultancy Services (Pty) Ltd, trading as ITC Services is a South African privately owned EMC test laboratory, established in 1988.
- The laboratory has maintained ISO 17025 accreditation since 2003.
- ITC Services is also a certified ISO/IEC 9001 company, and has maintained this certification since 2019.
- ITC Services is a company of choice for the SKA Radio Telescope project and is actively involved in their Electromagnetic Compatibility requirements.

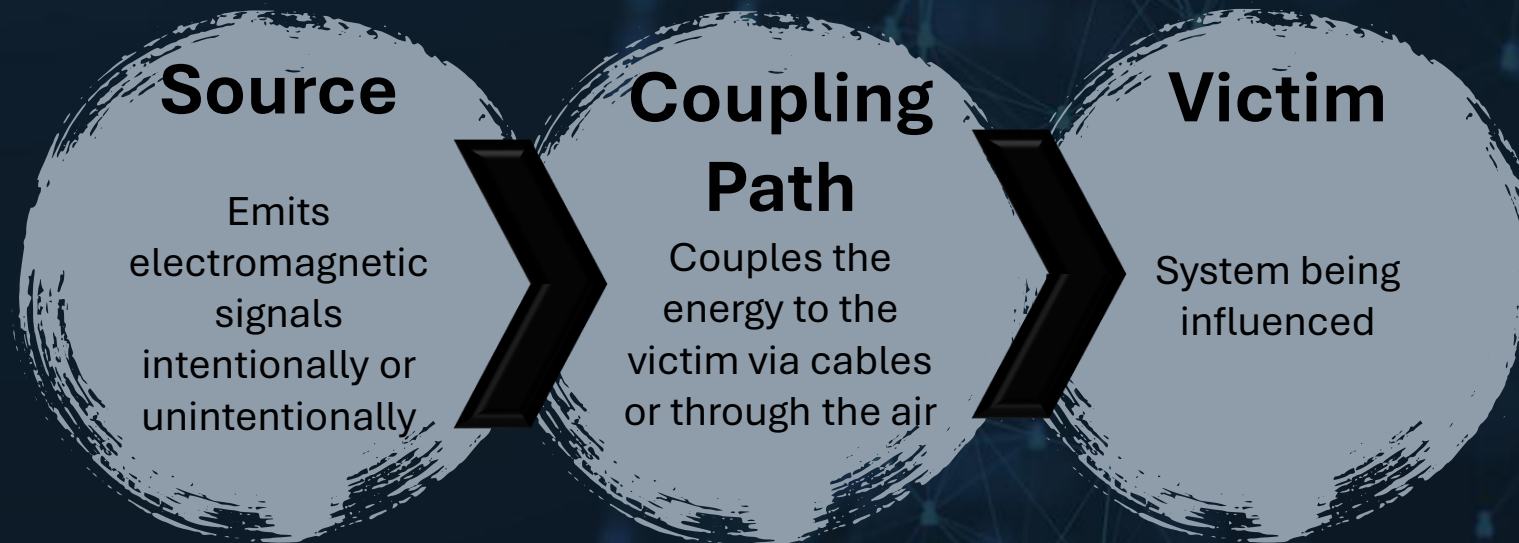


EMC INTRODUCTION

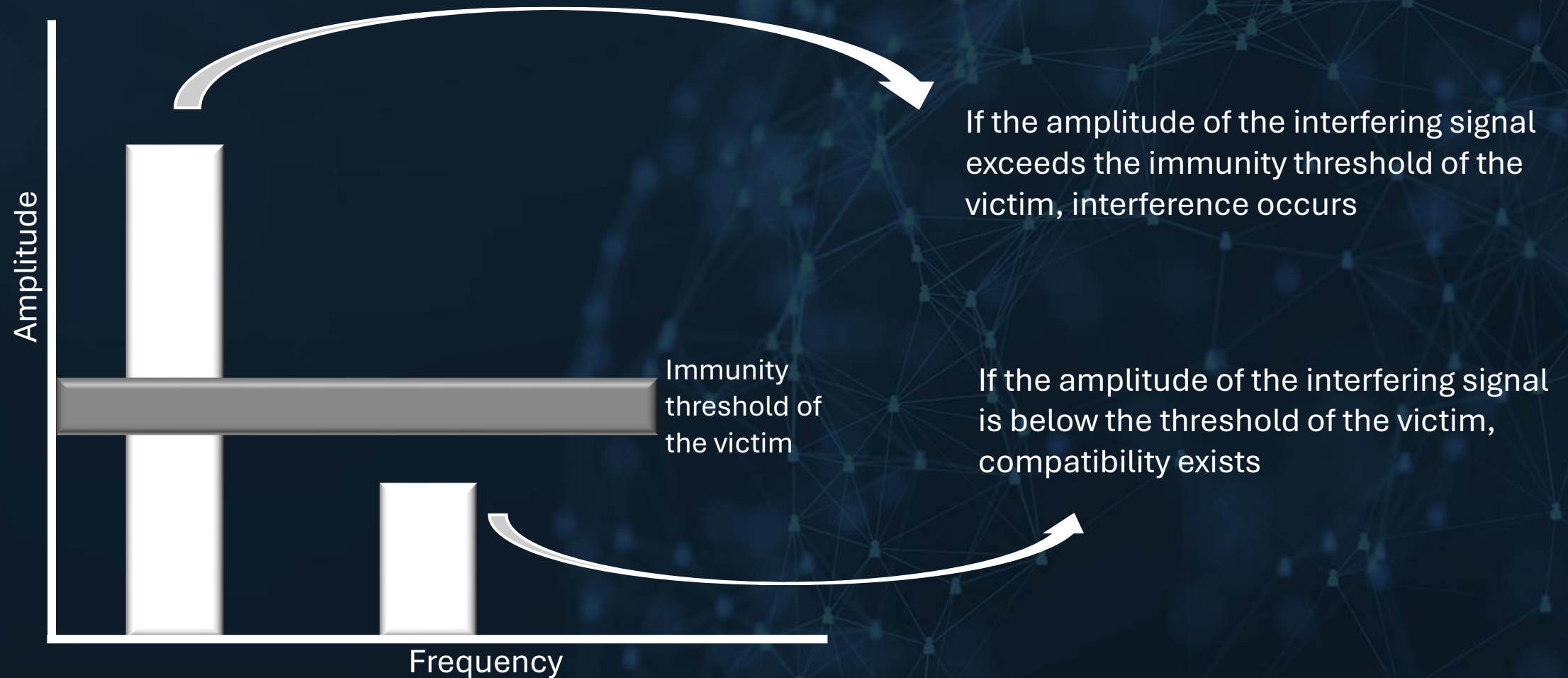
Electromagnetic compatibility is the ability of electronic devices and systems to function properly in their intended electromagnetic environment without causing or suffering from electromagnetic interference (EMI).

Electromagnetic interference is the disruption of the normal operation of an electronic device or system caused by electromagnetic radiation or signals from other electronic devices.

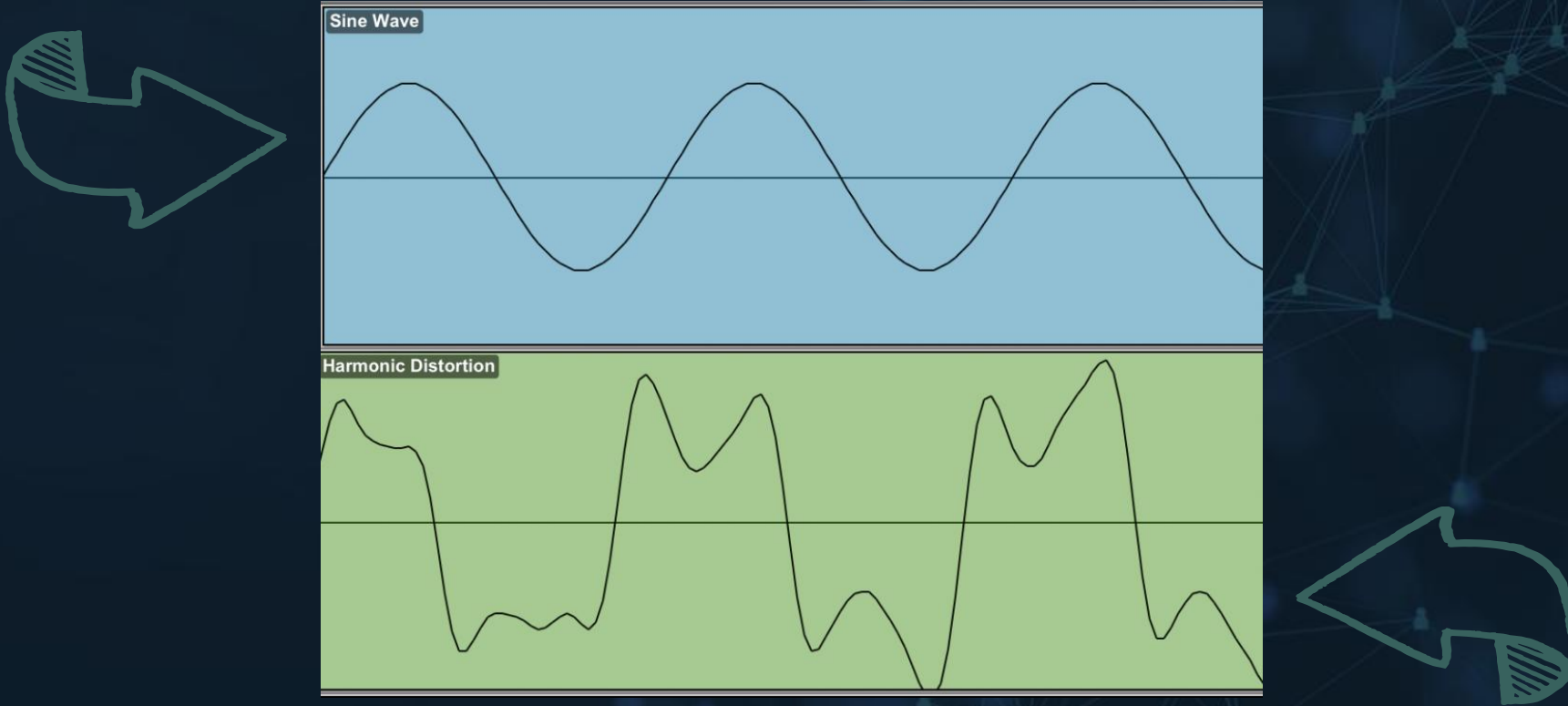
For interference to occur, 3 components must be present:



Two crucial parameters in EMC are the amplitude of the source and the immunity threshold of the victim:



For a CPS device to function properly, the signal transmitted must “fit the template” expected by the receiver. If the signal is transmitted as a sine wave (for example), the receiver would expect to receive a sine wave – much like how a key fits in a lock.



In the case where interference exists, the waveform is distorted, such that the receiver does not recognise the shape of the wave, and therefore it does not recognise the instruction that is communicated. This causes CPS to malfunction.

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INTERFERENCE EXPLAINED

BY SOUND



CPS and EMC

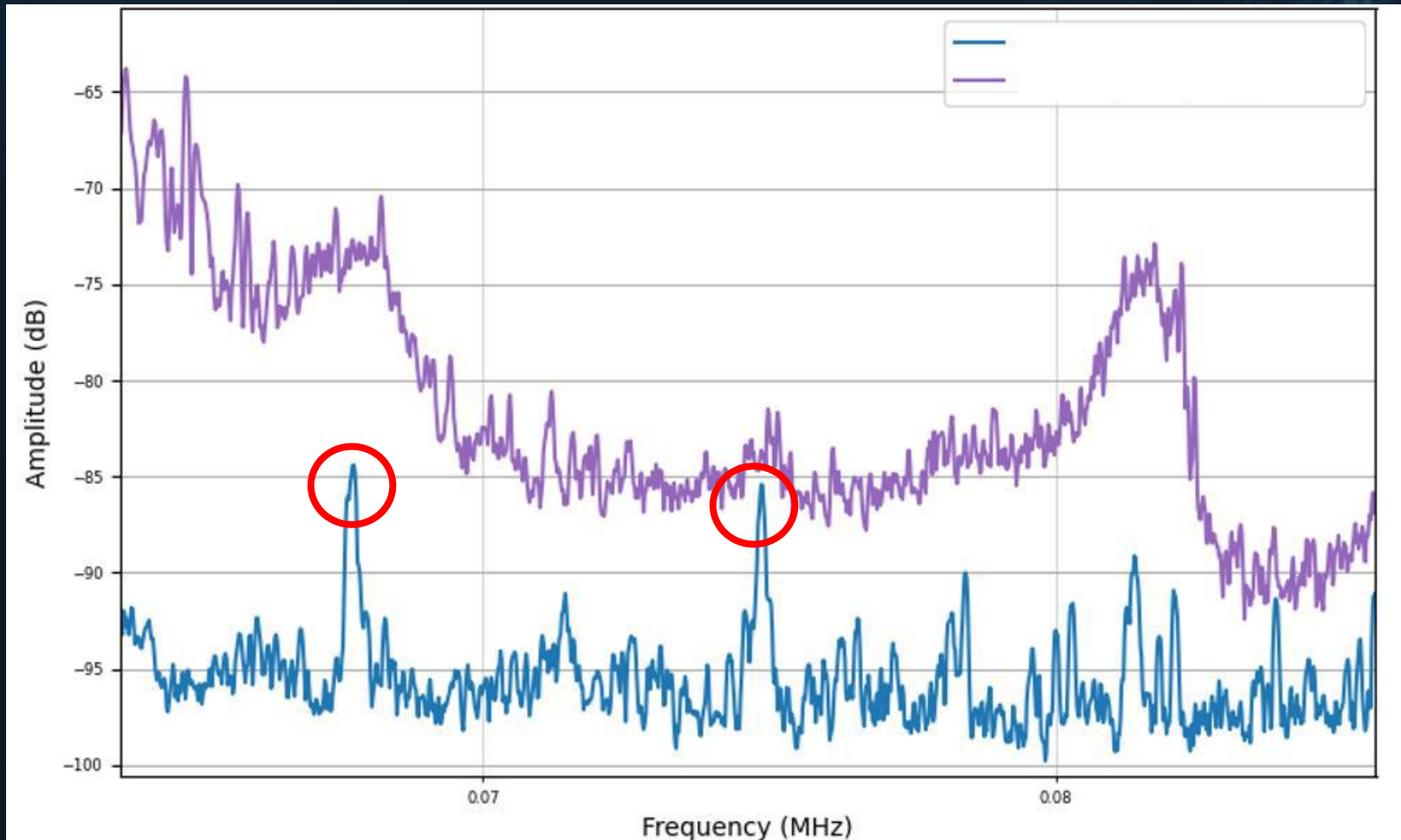
- CPS needs to be tested against particular standards to ensure optimal performance and compliance to commercial requirements in South Africa, as well as compliance with international regulations.
- South Africa's Department of Mineral Resources and Energy now require all mining operations to comply with Level 9 incident control measures – vehicles need to be able to intervene (by braking or speed reduction) when an obstacle is detected.
- EMI testing is needed to determine whether CPS is able to achieve this consistently and reliably.

Joint initiative to:

- Assess the EMI/EMC standards and requirements for testing
- Obtain a clear perspective of technical issues surrounding CPS faced by different mining operations
- Draft an EMI/EMC test strategy/methodology for CPS
- Provide SAMI with a framework to compile a radio frequency spectrum management plan

AMBIENT MEASUREMENTS AND WHY THEY MATTER

The signal to noise ratio (amplitude of the intentional signal vs amplitude of the unintentional signal) is critical for valid received-signal detection.



It is unlikely that the CPS would be able to detect the intentional signal (blue trace), and the CPS would not operate correctly in such an ambient environment.

Masked by interference
(ambient noise)

Intentional Signal

AMBIENT MEASUREMENTS – THE TESTING CAMPAIGN

- The ambient environment of a mine is dependent on the type of technology, equipment employed and installation practices at each site, which is in turn determined by commodity types and mining methods.
- ITC Services measured the ambient environment at three underground mines and four surface mines of different commodity types.
- Four to five test points at each site were identified and the results were compared to provide an average and maximum signal amplitude at a given frequency between 1kHz and 6GHz.
- Results are available for each commodity type and mine in an overall report, available from MCSA, as well as in an application format. The application and a manual for its use is available from the MCSA upon request.
- These results can be used by mining engineers and suppliers of CPS to view the possible environments that CPS need to be able to function in.



AMBIENT MEASUREMENT RESULTS – HOW TO VIEW IT

- The viewing application “Plot The Mine”, and a manual to install and use the app is available upon request from the MCSA.
- A folder with all the necessary data and installation files will be provided. Upon installation, the app will allow the user to view the data and overlay any data of your choosing.

AMBIENT MEASUREMENTS – CONCLUSIONS AND RECOMMENDATIONS

- A frequency register is an important control mechanism to implement and maintain at a mining operation.
- The electromagnetic ambient environment on a mining site is dependent on the types of machinery that the mine uses in its daily operations.
- The most prominent EMI/EMC related risk to CPS installed on a TMM seems to be the emissions of the TMM itself (its inherent systems) and third-party installations that could cause interference with the CPS antennas mounted on the TMM. Examples of possible sources of interference include emergency lights, fuel management systems, engine health systems, fire detection/extinguishing systems etc.
- Testing the RF levels that a TMM emits before CPS installation takes place is a highly recommended practice, since this data shows the frequencies that the pre-installed systems operate on and that the CPS system will have to be immune to once mounted on the TMM.
- Depending on the CPS principle of operation, the regulatory CPS immunity tests (ICASA/ DMPR requirements) which include but are not limited to SANS/ IEC 61000-4-3 and SANS/ IEC 61000-4-6, should be customised to include the electromagnetic profile of the mine.

FUTURE TESTING REGIMES – RECOMMENDATIONS ON WHEN TO TEST

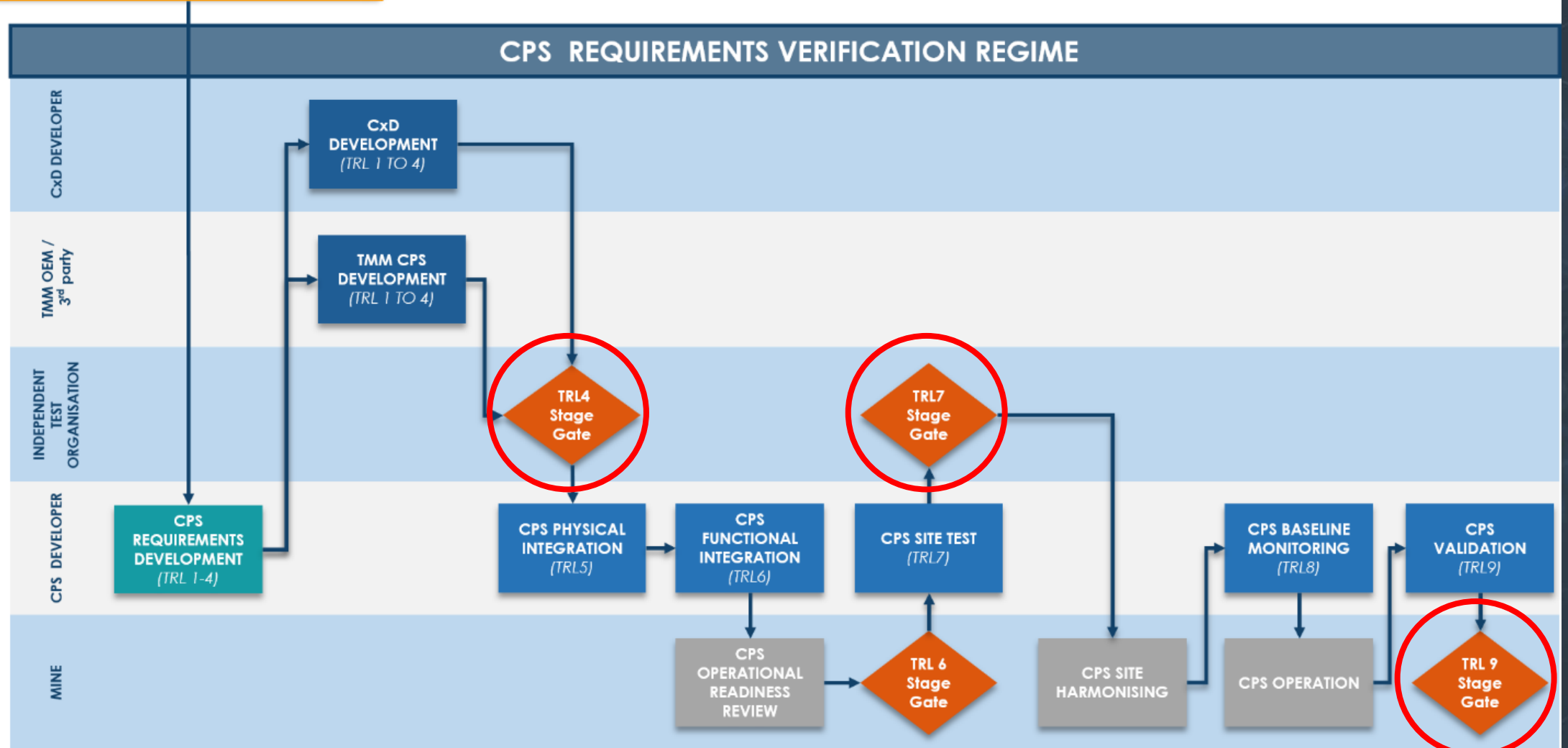
During the development and integration of CPS systems, the systems are subjected to various tests, including safety testing and functional testing. EMC testing is a vital part of this process. CPS systems should undergo EMC tests at subassembly level in a controlled environment (test laboratory) and after installation on a machine/TMM. Specific measurement methods and techniques applicable to these systems are described in the CPS EMC Test Methodology and Protocols document.

EMC testing of CPS systems is recommended at the following Technology Readiness Levels (as shown in the Integrated CPS Testing Regime document)



URS, FUNCTIONAL & TECHNICAL PERFORMANCE REQUIREMENTS

[FUNCTIONAL READINESS CRITERIA]



RESOURCES

The Collision Prevention Systems EMI/EMC Overview and Summary document provides an overview of the resources compiled by ITC Services. These resources include:

- Standards gap analysis
- Frequency spectrum management plan
- EMI/EMC Test Methodology & Procedures
- Ambient measurements and data



Q & A and CONTACT DETAILS

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