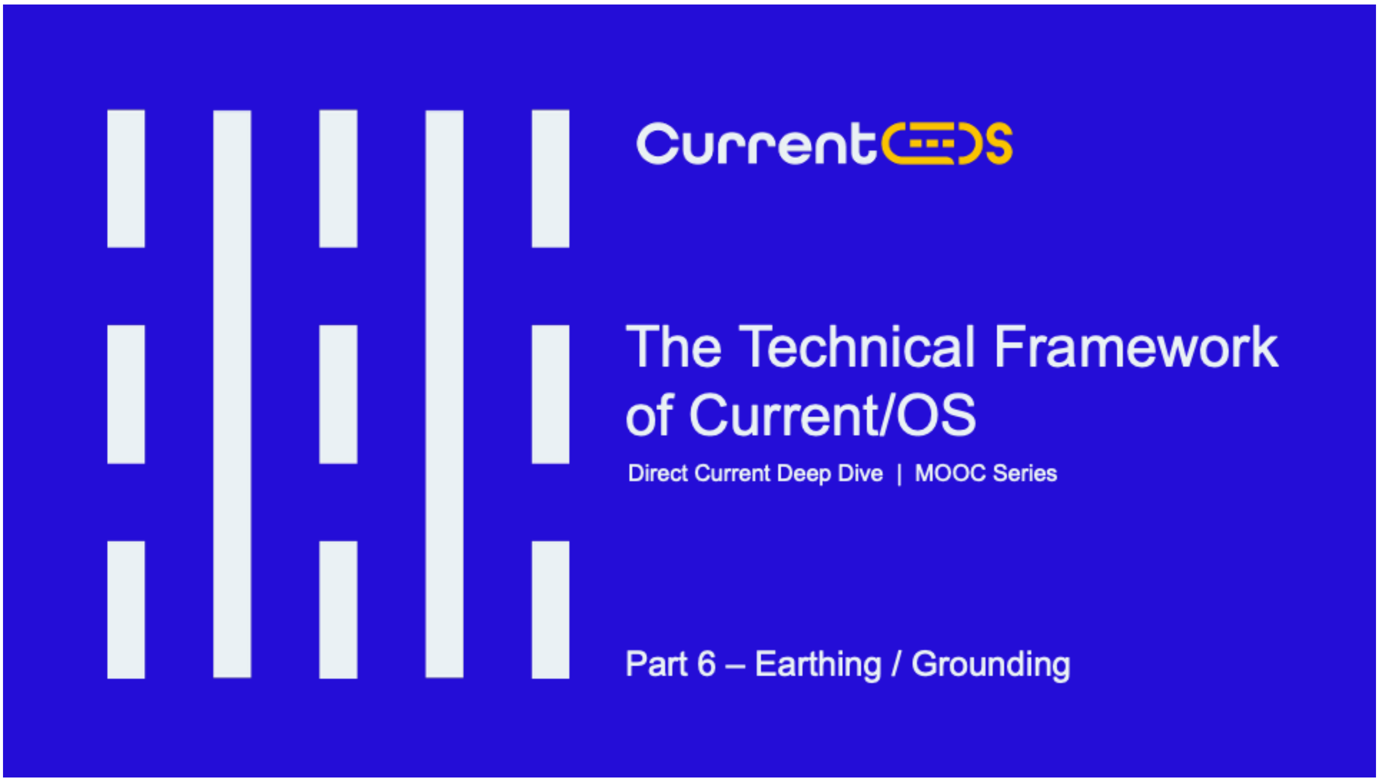


Welcome to the Direct Current Deep Dive Series: the Technical Framework of Current OS” , a MOOC designed to dive into the principles behind Current OS technical decisions and their role in defining the standard for Direct Current electrical systems, also commonly referred to as DC-coupled systems, or DC microgrids

This video is part 6 of a six-part series. Explore the remaining videos on the Current OS YouTube Channel to continue learning about the world of Direct Current.

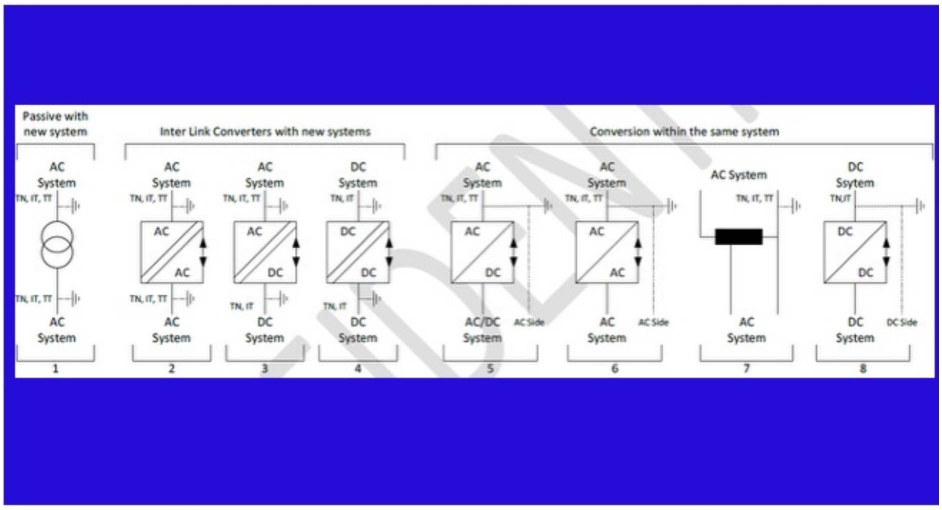
In this video, we’ll explain the underlying principles that drive Current OS's technical choices regarding

Earthing, as it is commonly referred to in British English, or Grounding in American English. For consistency, we'll use Earthing throughout this MOOC. We understand that this might sound unfamiliar to our American audience and appreciate your understanding.

The aim is to isolate the DC installation from the AC grid for stability. Current OS solution makes DC applications safer, simpler to design and more immune to external issues. By eliminating the need for continuous specialized maintenance, it is particularly well-suited for commercial and industrial applications.

Earthing Rationales

- IEC rules impose isolation between AC and DC in *installations*
- Only 2 exceptions : PV *applications* and battery storage *applications*
- Failures causing DC value added to the AC side can saturate transformers
- Failures causing AC common mode to the DC side can have dangerous effects



Earthing in a DC system is a critical topic, and Current OS has established a key rule that the IEC is in the process of formalizing: a DC system can only have its own independent earthing network if it is galvanically isolated from the AC system.

The core principle of Current OS is therefore to isolate the DC installation from the AC grid, preventing disturbances and faults from propagating between the two systems.

Without isolation, the DC system effectively extends the AC earthing scheme.

This would be posing significant risks.

For example, if there are DC current leaks into the AC network, they can saturate transformers. Even just a few hundred milliamps can saturate a medium-voltage low-voltage (MV LV) transformer, creating a highly dangerous situation.

In the opposite direction, if AC current leaks into the DC network, it can generate voltage transients that may damage electronic systems and converters.

Failing to isolate DC from AC requires additional precautions and protections on both sides, which are complex to implement. For this reason, Current OS does not recommend this approach.

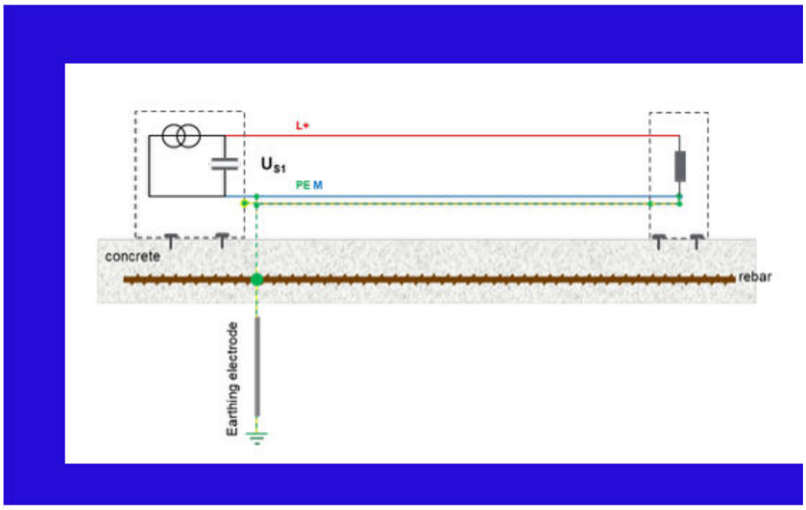
Corrosion mitigation is also an important element, and Current OS addresses this issue.

So Current OS mandates galvanic isolation between AC and DC systems.

Additionally, Current OS recommends a TN-S configuration or single point grounding for the DC side, earthing the midpoint of the DC voltage band.

Warning : avoid TT, TNC, TNCS in DC

- Stray current can not be controlled nor mitigated
  - With TT, current leaks go through the building structure
  - With TNC, TNCS, potential differences on the PE forces current leaks in the building structure.
- Large consensus among the DC community (Current/OS, DC-Industrie, EMerge Alliance, etc.)



It’s also essential to implement corrosion mitigation measures. This is why Current OS prohibits the use of TT earthing for DC installations.

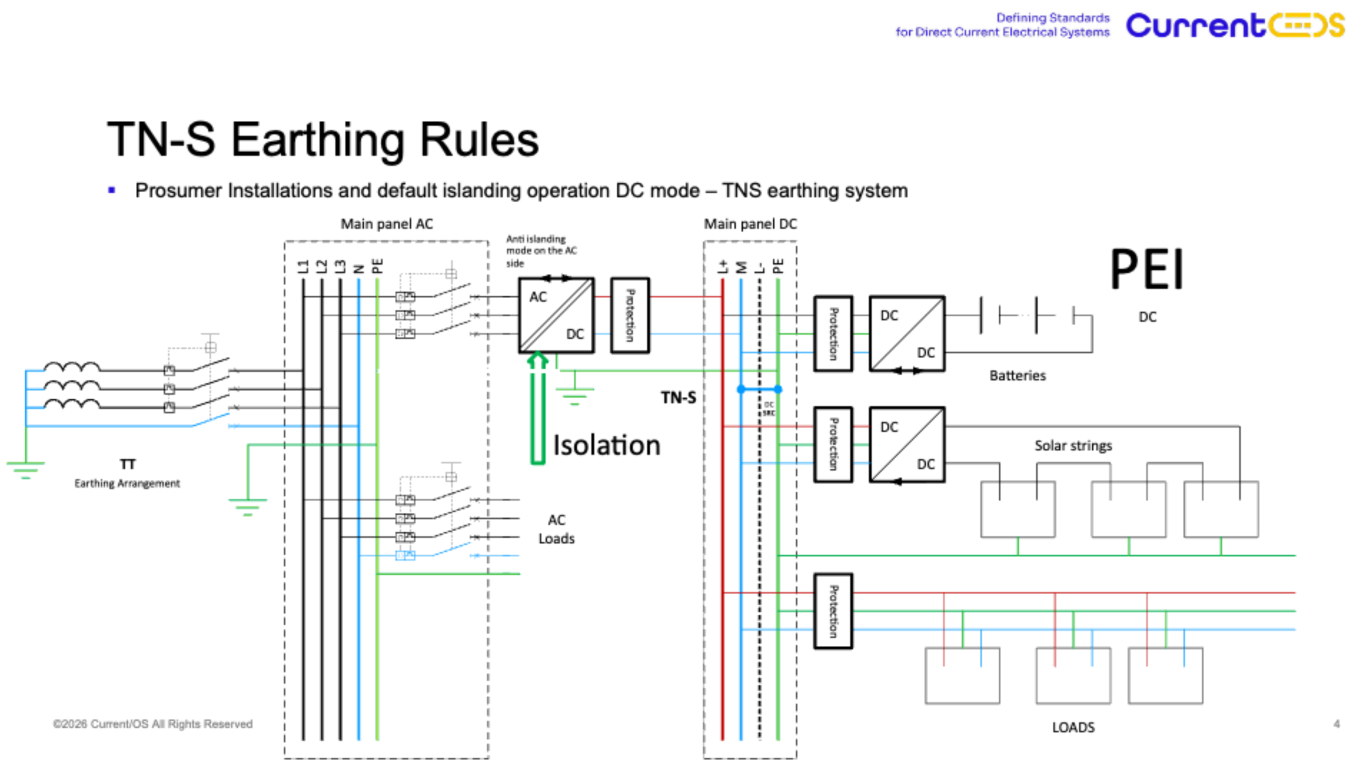
While TNC and TNCS systems can technically be implemented, they require significant precautions, making them less favorable.

IT earthing or isolated grounding is also an option but has not been documented by Current OS. It has been explored by ODCA and CABEE. However, the IEC does not recommend IT earthing for commercial buildings. In the event of a DC earth leakage to ground, it’s generally better to cut the power and allow a maintenance team to address the issue.

In industrial settings or hospitals, where uninterrupted energy availability is critical, and a dedicated maintenance team is present 24 7, IT earthing may be suitable.

However, in commercial buildings, where on-site electricians are not available around the clock or may lack the required expertise, TNS is the simplest and most effective choice.

That is why Current OS recommend the TNS configuration for its DC installations.



Here is the recommended approach from Current OS for connecting to an AC system:

The setup typically involves an AC system connected via an isolated converter or a transformer followed by an AC DC converter. This configuration is common practice: using a transformer to provide isolation and then converting AC to DC. The term "converter" is used instead of "rectifier" because energy flows are bidirectional, allowing power to move both ways when needed.

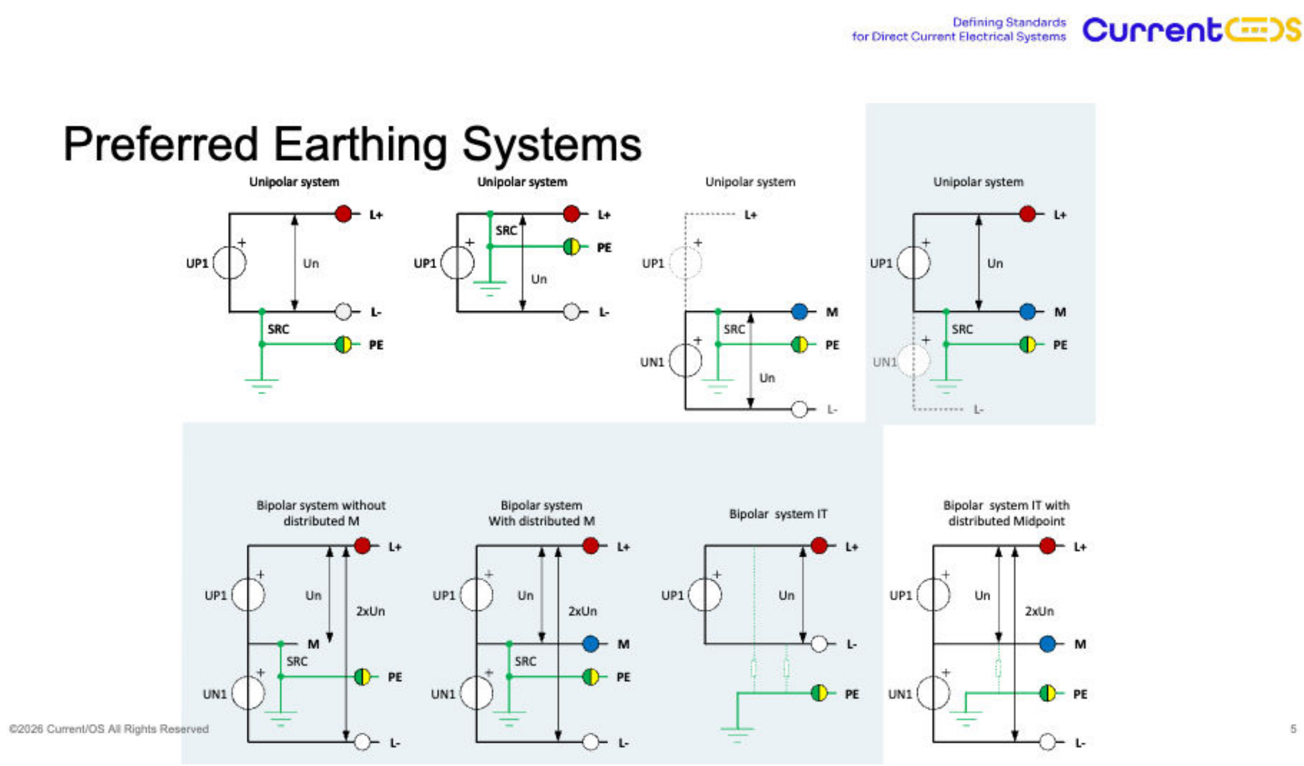
Next in the configuration are the fast-acting electronic protections.

The system connects the M point to the PE (Protective Earth). Whether it’s called a midpoint with a positive and negative pole or simply M without a negative pole, the principle remains the same.

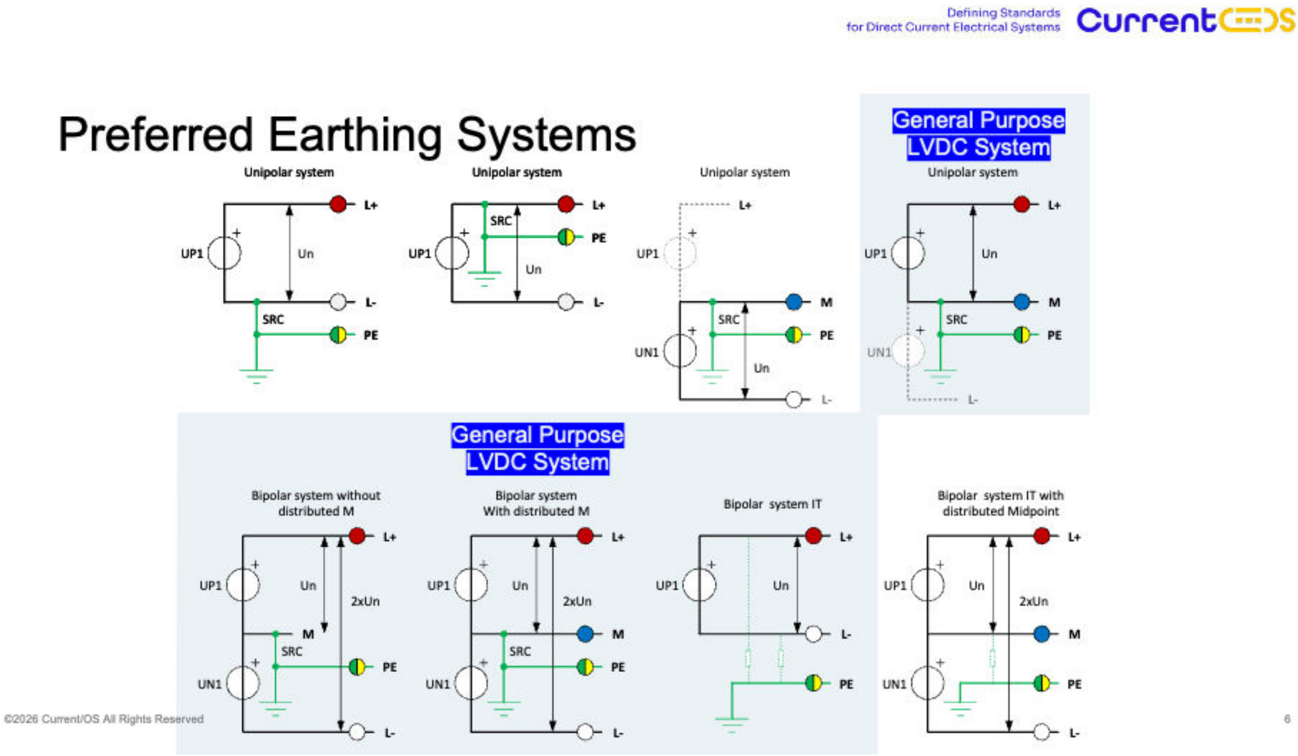
One key advantage of this setup is that electronic protections only need to interrupt a single conductor. This is twice as cost-effective compared to IT systems, where both conductors must be interrupted. It also results in lower energy losses and reduced heat generation.

Finally, power is supplied to the DC converters.

With this arrangement, issues related to DC earth leakage currents are resolved, ensuring the installation is both safe and sustainable.



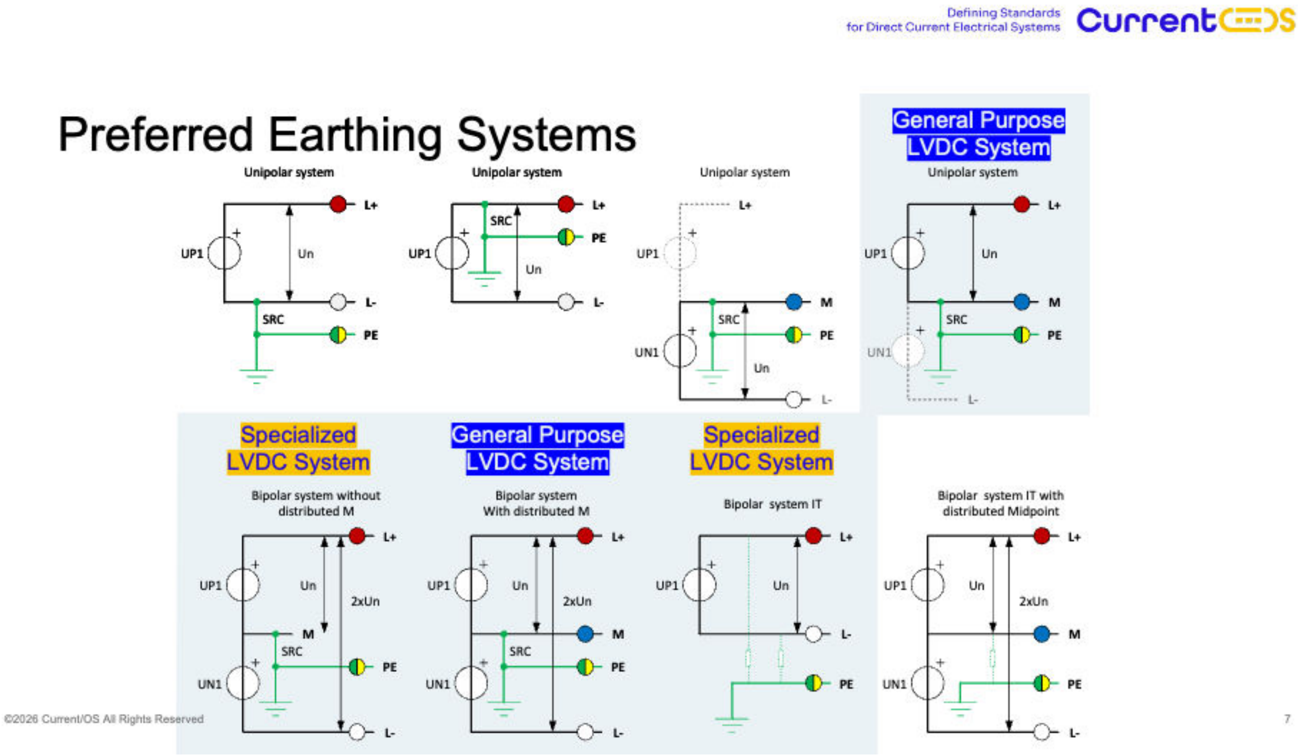
To summarize, these are the preferred earthing systems defined by Current/OS.



For General Purpose LVDC Systems, the unipolar distribution system with TN-S earthing is extensively documented in the Current/OS reference documents and installation rules.

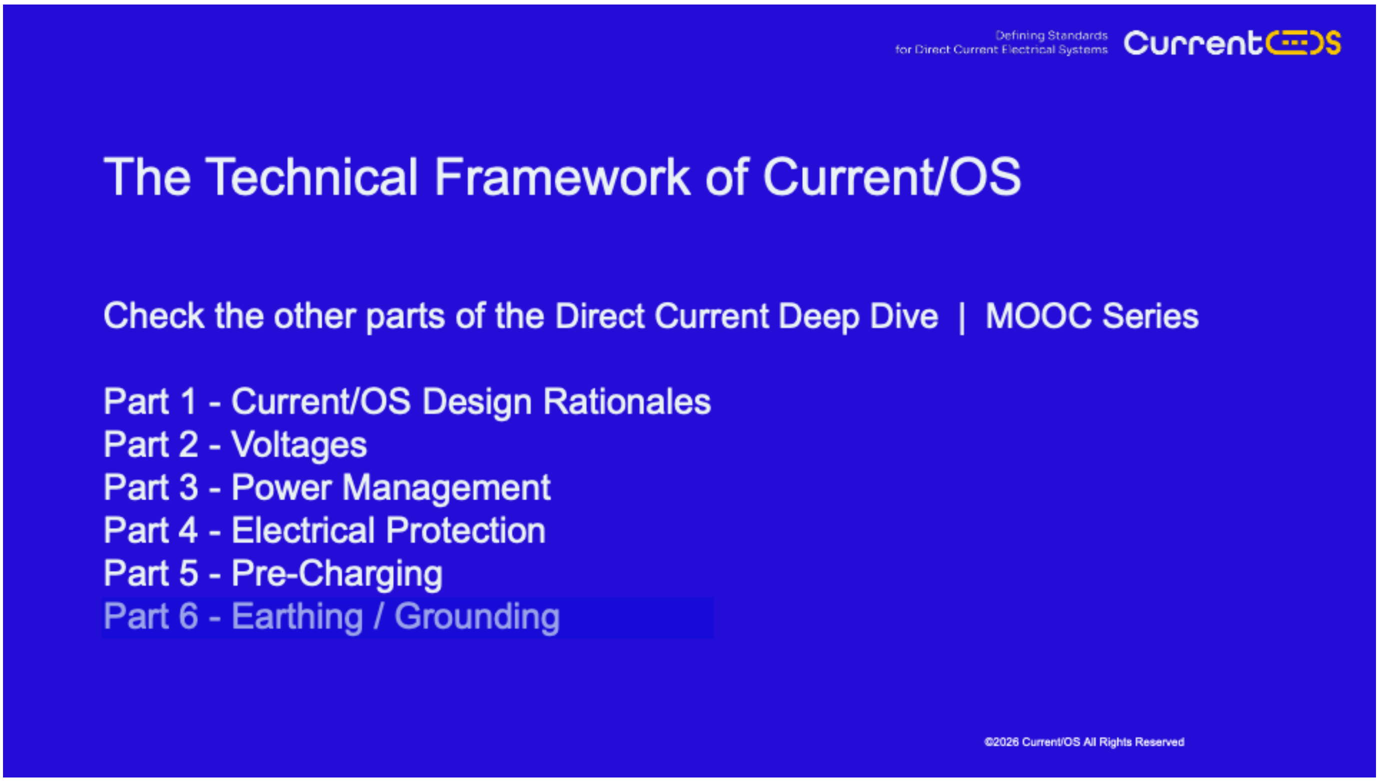
Its applications include buildings, where it can power devices such as LED drivers, computers, and telecom infrastructure. For example, it might distribute 350 volts.

Current/OS also proposes a bipolar system for General Purpose applications. This architecture is particularly suited to powering higher-demand equipment. In this case, 2 × 350 volts can be distributed to applications such as heat pumps or elevators. This system should be implemented with a distributed midpoint (M).



However, other applications require additional flexibility in the choice of earthing architecture and may justify alternative earthing approaches.

For these cases, for example data centers or specific industrial processes, Current/OS provides the Specialized LVDC Systems solutions, developed on a case-by-case basis. They should be implemented with appropriate technical support for system designers.



This concludes the introduction of Current OS.

Want to learn more? Check out the other five Current OS MOOC videos covering an introduction to Current OS, voltages, power management, electrical protection and earthing or grounding

Thank you for watching, see you in the next video!

Defining Standards
for Direct Current Electrical Systems

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