

Network Isolation

Highly secure systems such as energy, military, and infrastructure controls often leverage air gapping to protect themselves from external attacks. By disconnecting themselves from all public and insecure networks, critical systems are better shielded against external threats. But this, unfortunately, also makes data exchanges a lot more complicated.

Traditional Approaches

Exchanging secure data with air-gapped systems usually involves the use of removable storage such as USB drives. First, the source data is extracted from the air-gapped system, packaged, possibly encrypted, and stored on the removable drive. The drive is then connected to the receiving system, where the data is decrypted, unpacked,

and possibly merged with other data. If there are multiple data sets to exchange, each will require similar handling. If the amount of data to be exchanged is high, for example, if it is also used to perform backups, this can easily exceed the capacity of a single removal medium, requiring more complex solutions.

Air gapping is a powerful security measure but makes exchanging information between systems significantly more tedious and complex.

COSNIM Technology

COSNIM stores and encrypts everything in capsules, which themselves hold all the data, metadata, and control information needed to operate a fully functional filesystem. Since capsules form a self-sustaining mesh, without any external data, server, or support database, a COSNIM Continuum and its filesystem(s) can be held entirely and shared with an air-gapped system solely using capsules, with all features available. As capsules are already sealed and 100% encrypted, they can also be exchanged directly with other systems across air gaps without any additional processing. Moreover, in the same way that COSNIM can freely distribute capsules on any type and number of cloud storage services, air-gapped systems can distribute and replicate capsules on any type and number of storage media, irrespective of the storage technology or format. The following explains more about how this is accomplished.

Exporting Data Using Capsules

Since COSNIM capsules contain everything to hold a filesystem, any amount of data and files can easily be exported out of an air-gapped system simply by sending out the capsules. This is much easier than extracting, packaging, encrypting, decrypting, unpackaging, and possibly merging data as would normally be required. The receiving system simply mounts the COSNIM Continuum filesystem from

those capsules and instantly has access to all of the data as if it's a local filesystem, without any additional handling or processing.

COSNIM's fully encapsulated filesystem is ideal to securely exchange highly sensitive data between air-gapped systems, with the simplicity of a fully integrated filesystem.

When data is updated in the air-gapped system, COSNIM internally produces additional capsules that contain the newer data plus embedded mesh update information to identify where this data now fits in the Continuum; these newer capsules can simply be sent to the receiving system to fully expose those updates, without having to resend all capsules. On the receiving end, COSNIM simply leverages these new capsules alongside other previous capsules to instantly represent the updated air-gapped filesystem's contents, without any reconstruction or additional processing.

Importing Data Through Capsules

Importing data into an air-gapped system is the same process as exporting, just in the reverse direction. Here, an external filesystem and its updates, including Time-Travel, can be quickly imported into an air-gapped system simply by importing capsules, without any additional processing. The air-gapped system will have immediate and full access to the external data as if it were a shared filesystem, without the security risks of networks.

Large Data Sets

With traditional approaches, if very large data sets to be exchanged with an air-gapped system exceed the size of a removable storage medium, the data must first be split into smaller pieces, stored on multiple devices, and then reassembled on the receiving system, a tedious process. Since COSNIM is de facto a filesystem, it already fragments data into smaller capsules in the same way a regular filesystem might store data blocks and stripes. Capsules can therefore easily be transported over smaller removable storage media without additional processing.

Moreover, the same way COSNIM can distribute capsules to any number and type of hybrid and multi-cloud storage service, air-gapped systems can also store and distribute capsules on any type and number of storage media, easily spreading data over multiple devices without disassembly and reassembly. Contrary to traditional RAID, sharding, and replication technologies, the COSNIM storage media that make up a Continuum don't need to be the same size, format, or even technology; an air-gapped Continuum can be freely composed of any combination of spinning disks, flash memory, and storage formats without any loss of functionality, reliability, or security. A Continuum may also be configured to

guide newer update capsules to specific media, making their exchange extremely easy with other systems, even if the filesystem itself is spread across many different devices.

Air-Gapped Backups & Time-Travel

Since COSNIM Time-Travel is fully integrated and combines live storage, snapshots, backups, and versioning services, an air-gapped Continuum can be quickly backed up to external storage simply by copying capsules elsewhere, the same way a Continuum would be exchanged with another system. That backup can then be kept up to date simply by regularly copying the newest capsules produced on the air-gapped system. Contrarily to traditional backups, these capsules are entirely self-sustaining and carry absolutely everything about the air-gapped filesystem, including metadata, control information, Time-Travel history, and audits. There is no need to use separate backup servers, maintain a database of backups, or even track versions. Everything is held in 100% encrypted capsules, without additional processing. By extension, capsules that are backed up externally also form a fully functional storage Continuum and filesystem; the data they contain can be freely examined by any other system directly as a filesystem, with all services available, including Time-Travel, without the use of any server, data reconstruction, or additional processing.

Time-Travel brings full continuous data protection to air-gapped systems, without servers, databases or external coordination.

Bi-Directional Data Sharing

Because updates are recorded entirely as capsules, air-gapped systems can also exchange data back and forth between themselves through capsules. For example, an air-gapped system (A) can update a filesystem and then send those updates to another system (B) simply by sending the newer capsules. The receiving system (B) will immediately see those updates in its filesystem through these new capsules and can further modify this data. This will produce additional capsules that can be sent back from the system (B) back to the air-gapped system (A) to bring that filesystem up to speed. Updates can be exchanged back and forth this way simply by exchanging newer capsules produced on each end. This gives air-gapped systems the convenience of a shared filesystem with all COSNIM features enabled, without the risks of network connections.

Note that in the current version of COSNIM, only one system is allowed to perform updates on a filesystem at a time; when one side is updated, newer capsules need to be sent to the other system before updates can be applied on that system and returned. Future versions of COSNIM will support full, concurrent bi-directional filesystem sharing between air-gapped systems with no such limitation.

Self-Hosted Replication

Air-gapped systems have full access to all COSNIM advanced features, including hybrid and multi-cloud replication and outage resiliency, simply by leveraging existing non-cloud infrastructure.

In the cloud, COSNIM's asymmetric replication allows data to be scattered and copied to any number and type of cloud storage service, irrespective of their technology, to better shield data against outages and data loss. The same technology can be used in air-gapped systems and external systems simply by leveraging local storage instead of the cloud. All the same capabilities of asymmetric cloud replication are available to air-gapped systems, including the ability to freely intermix different storage sizes and types, seamlessly survive the loss of an entire storage

medium, and immediately reintegrate long-time disconnected storage media without resynchronization or delay. This gives air-gapped systems very high resiliency, without the usual complexity and limitations of hardware and RAID setups.

Immutable Storage

Just as in the cloud, capsules can also be stored on any type of immutable storage for immediate data authentication and ransomware protection. On air-gapped systems, these can be as simple as WORM disks or optical media. Contrary to traditional technologies, COSNIM can directly use immutable storage for all live storage purposes, without intermediary processing or servers. This means that data on the air-gapped system can be immediately protected against ransomware and undesirable alterations, while also being updated and exchanged with other external systems. Since all updates are fully protected by Time-Travel, wherever the changes are made, immutable storage also automatically guarantees the authenticity of all current and past data without having to take extra copies, maintain journals, or require the use of hashes or digital signatures.

Exchanging data with air-gapped systems is often a tedious task requiring multiple interventions, data transformations, and synchronizations. COSNIM makes sharing data between air-gapped systems as simple as sharing a filesystem, with full access to all security, reliability, and Time-Travel features.