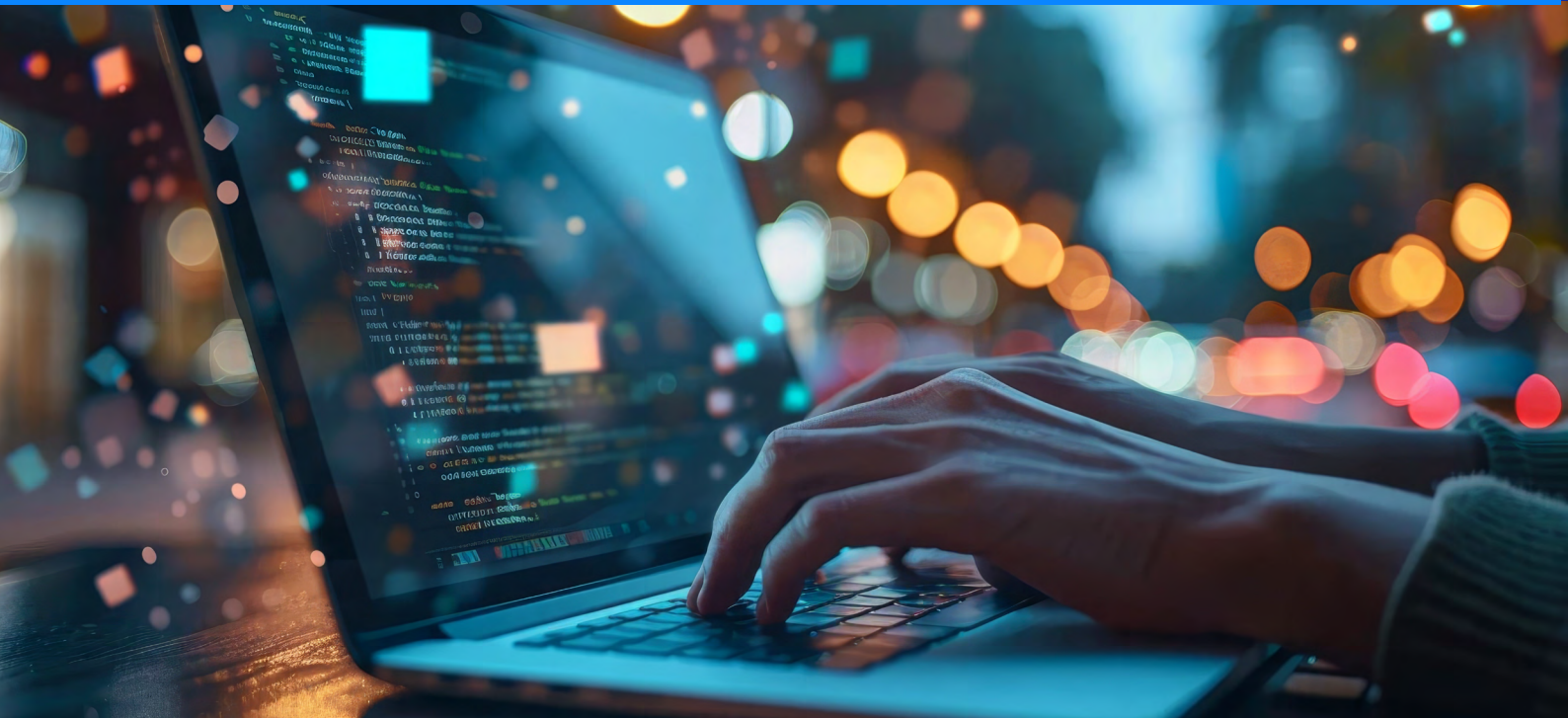


CASE STUDY

Comarch Test Tool Development for Avnu Alliance



Background and initiation

Over the years, Comarch's visibility on the certification market has increased, thanks to the quality of the products delivered by our teams. In 2020, Avnu Alliance established cooperation with Comarch with the objective to create a certification device for the Milan standard. Milan is an industry-specific profile for audio-video bridging (AVB) and time-sensitive networking (TSN) protocols. Developed by the Avnu Alliance, Milan is designed specifically for professional audio and video applications, ensuring reliable and deterministic delivery of multimedia content over ethernet networks.

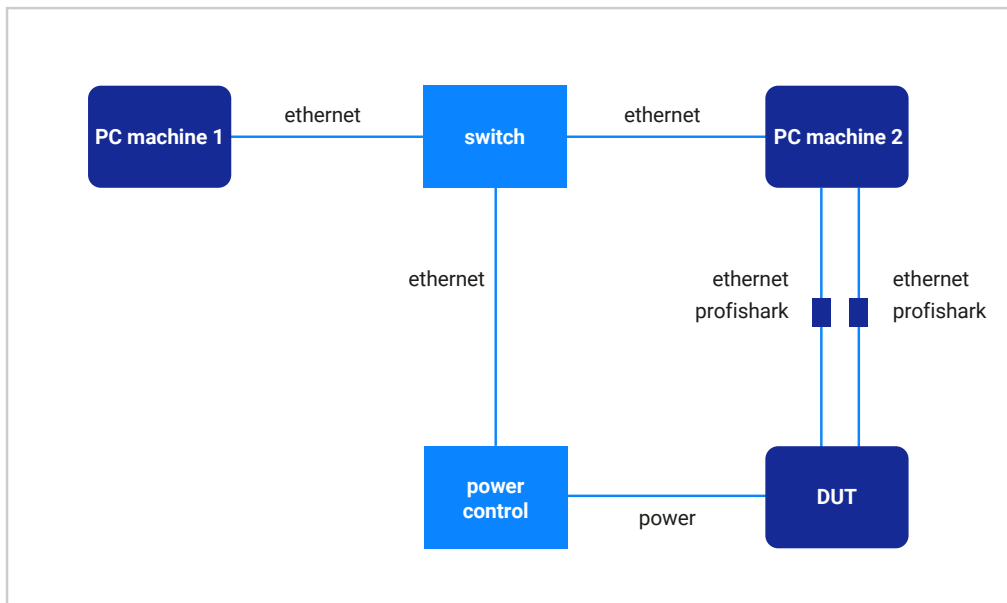
Expansion and CATF creation

To meet Avnu's requirements, streamline efforts and maximize efficiency, Comarch used its own **CATF product - Comarch Automated Test Framework**. It is a specialized compliance testing framework dedicated to certification alliances. It has been designed to shorten development time as well as ensure high stability and efficiency.

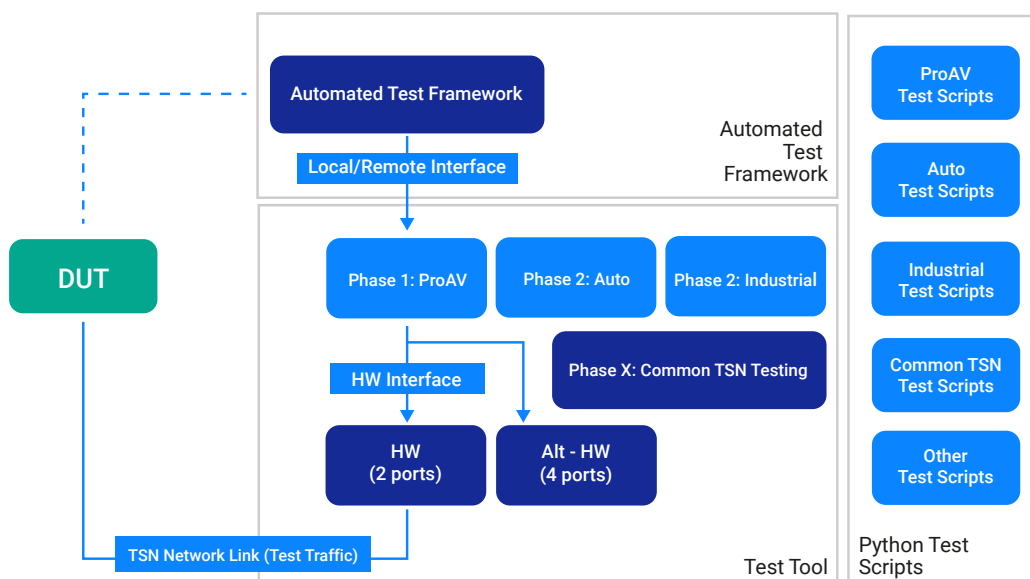
Here you can find more information about CATF: [Case study](#)

Architecture and implementation

One of the key requirements was to divide the test tool into multiple components, all culminating into the Avnu Express Test Suite (AETS), which includes: the Avnu Express Test Control Software, Avnu Express Test Engine Software, (also known as: AETS, AETCS, AETES). The control software, running on Windows, is used to select tests, execute them, and log results. The engine software, based on real-time Linux, implements the AVB (audio video bridging) stack and communicates with the DUT (device under test).



For the tests, we used Python 3, which speeds up scripting and implementing modifications by both developers and users. For certification purposes, each test tool release has script signatures which ensures that certification is performed on unmodified files.



Challenges and solutions

The major challenge in the development of the test tool was to implement the AVB stack. By using open-source libraries adapted to our needs, we implemented protocols such as **gPTP**, **MAAP**, **SRP**, **AVDECC**, and **Emulated Milan Entity**. These protocols are accessible via a Python API using rpyc protocol (remote Python calls). Communication between the test tool and the DUT is logged using two Profisharks with synchronized time, allowing precise network traffic tracking down to 40 nanoseconds.

- **Generic precision time protocol (gPTP)** supports the protocol and procedures as defined in the IEEE 802.1AS-2011 standard. It's used for time synchronization between devices in the network.
- **Stream reservation protocol (SRP)** is an enhancement to Ethernet that implements admission control. In September 2010 SRP was standardized as IEEE 802.1Q at which has subsequently been incorporated into IEEE 802.1Q-2011. Stream Reservation Protocol defines the concept of streams at layer 2 of the OSI model.
- **MAC Address Acquisition Protocol (MAAP) specifies protocols**, procedures, and management objects for locally unique assignment of 48-bit and 64-bit addresses to ports in IEEE 802 networks.
- **Device discovery, connection management, and control protocol (AVDECC IEEE1722.1)** for devices based on IEEE 1722™.
- **Emulated Milan Entity** – a simulator of the AVDECC device which implements the Milan stack. Used for test procedure purposes.

For running tests during the implementation process, Comarch used physical devices, which gave us real-time feedback and validation. Weekly meetings with Avnu subject matter experts and device manufacturers helped identify and correct errors early in the implementation and the test plan. This iterative process led to numerous improvements in the test plan.

Regular engineering test case releases allowed Avnu Member companies involved in the process to run tests on-site on multiple devices, which was crucial for the project's success.

A full test run of all 94 complex test cases for one device takes approximately 18 hours. To ensure the reliability of the results, Comarch runs tests every night during the development process.

Plugfests hosted by Comarch

Comarch regularly hosts plugfests at its headquarters in Kraków. These events provide an invaluable opportunity to test the certification tools on physical devices, allowing direct feedback and validation. By hosting and welcoming industry experts and device manufacturers, Comarch ensures comprehensive testing and continuous improvement of the test tools. The hands-on experience and collaborative environment during these plugfests significantly enhance the quality and reliability of the certification process.

More information about most recent Avnu event at Comarch: [Avnu Alliance Event](#)



Further cooperation

1. Bridge device tests

Comarch developed 11 test cases for bridge devices. A bridge device is a network component that connect different segments of a TSN-enabled network, crucial for managing the precise timing, reliability, and efficient data transmission. The implementation required close cooperation with equipment manufacturers and subject matter experts.

2. Tests with gPTP (IEEE802.1AS-2020)

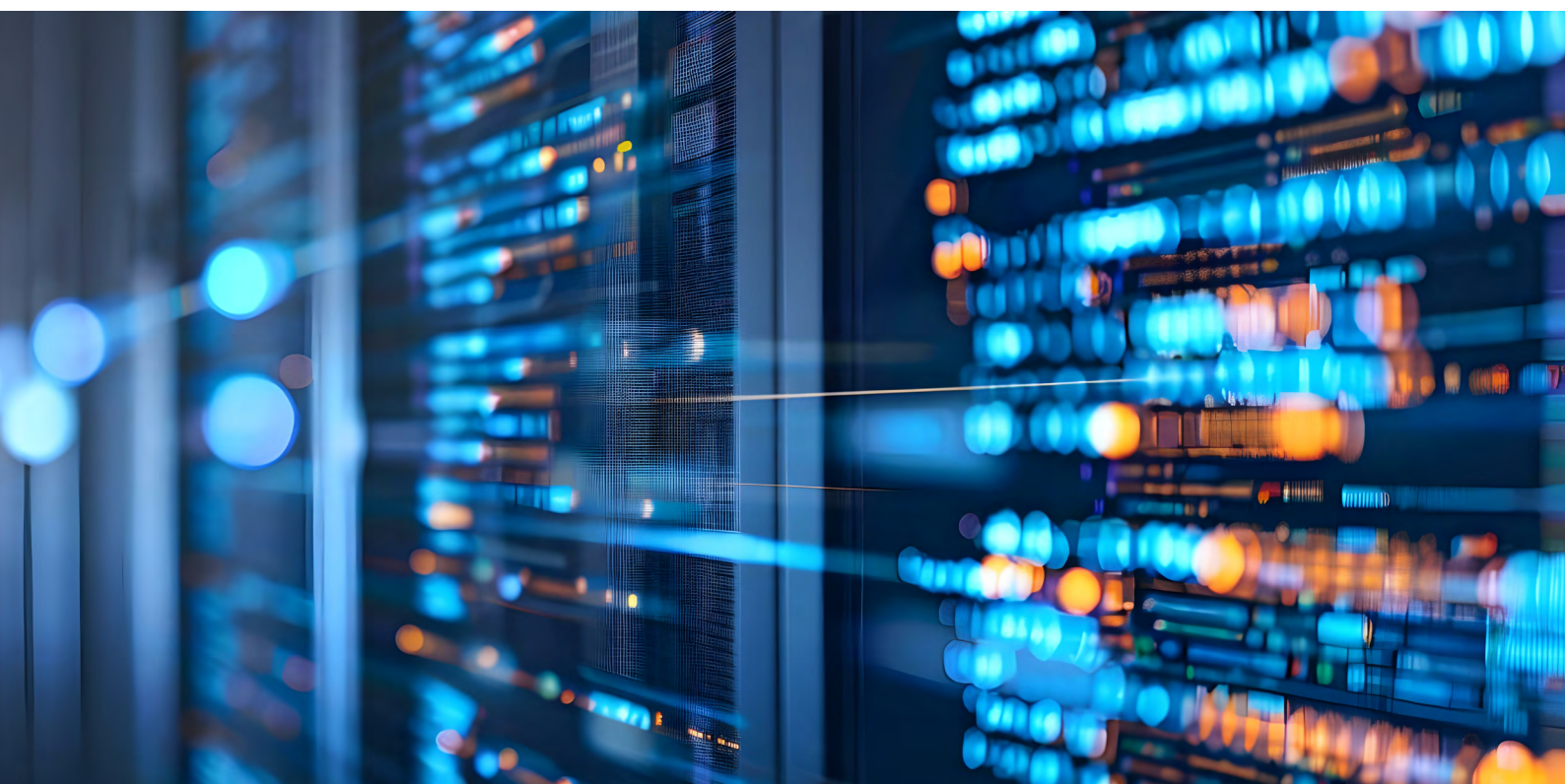
Comarch implemented 70 tests with various variants, adapting the existing gPTP stack implementation to the new 2020 standard. Cooperation between test plan authors, test implementers, and equipment suppliers was also key in this part of the project. This approach addressed the problem that, during the initial phase of creating the test plan, there was no actual device yet implementing the 10 standards. Engineers at Comarch successfully tackled this challenge, demonstrating their ability to work effectively even in such scenarios. There were over 60 corrections to the test plan alone.

3. AVB switch tests

Part of the project involved implementing the API on the test engine side for AVB switch tests. AVB switches are network devices used to route audio and video data streams with precise timing and minimal latency. The script creation was handled by organization members. Initial training sessions were provided by Comarch, followed by collaborative test case implementation and ongoing support through code reviews and Q&A sessions. Approximately 250 tests were to be implemented.

User feedback and support

Avnu Members report bugs through a dedicated Bugzilla platform, and weekly or bi-weekly meetings are held to address important issues and solve problems collaboratively.



Conclusion

The long-term collaboration with Avnu has resulted in the continuous development of the AETS that has evolved over time. This partnership, along with the creation of CATF, underscores Comarch's ability to build flexible, efficient, and reusable testing frameworks. By leveraging a unified approach and a close collaboration with industry experts and hardware manufacturers, Comarch has successfully delivered robust certification tools that meet the needs of certification organization.

As Avnu continues to grow, it provides us with new opportunities for development. The implementation of CATF enabled us to expand and enhance our capabilities. Avnu members, who are audio device manufacturers, appreciate using CATF, and the organization values this achievement.

In creating the Avnu Express Test Suite, we have gained in-depth knowledge of TSN standards. Through multifaceted collaboration with Avnu and its members, we have earned a reputation as recognized experts in this field. We are delighted to share our expertise, supporting audio manufacturers in implementing their solutions.

To date, Comarch has implemented a total of 175 tests cases for Avnu Alliance:

94

tests cases for
device certification

11

tests cases for
bridge devices

70

tests cases for gPTP
(IEEE802.1AS-2020)
with various variants

The Milan standard continues to be actively developed and supported by numerous companies:
[Avnu Alliance Members](#)

Comarch remains committed to working with Avnu Alliance and Avnu members in the ongoing process of creating and refining specifications, test plans, test scripts, debugging and validation/verification of the test tools.



COMARCH

For more information about our advanced solutions or to request a customized proposal tailored to your unique needs, please feel free to contact Comarch at technologies@comarch.com. To find out more about our services visit our website: technologies.comarch.com.

For more information about Avnu or if you are interested in purchasing our TSN AETS [click here](#).