Ultra ELECTRONICS | FORENSIC TECHNOLOGY

SEEKING INTEROPERABILITY OF **BALLISTIC IDENTIFICATION SYSTEMS**

The goal of making all BIS (Ballistic Identification Systems) and standalone ballistic image capture equipment interoperable was always hindered by the intrinsic incompatibility of 2D (reflectance) images from different systems. The relatively new variety of technologies to acquire good quality 3D topographic data revives this long-sought objective. Is a file exchange format, like X3P for 3D topographic images, really the only missing piece of the interoperability puzzle?

WHAT IS **X3P?**

X3P is now defined by ISO 25178-72, published in 2017. It is a file format for the storage and exchange of topography and profile data (the 3D representation of a surface area or profile). This format has been used outside the firearms field since 2012.

An X3P file for a 3D topography is like a JPEG file for a 2D image. It contains a single 3D topography and includes some extra properties of the device that captured it.

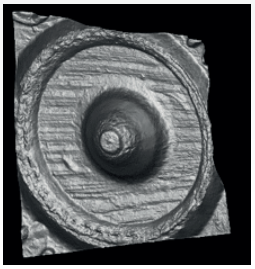
Importantly, the X3P file format does not include any metadata (case, exhibit, and firearm data), which is needed to facilitate a ballistic correlation (whether between systems from the same vendor or between systems from different vendors). The OpenFMC extension does provide some metadata to describe the exhibit and firearm, but still lacks the associated context or criminal case information needed to properly manage even a small-scale comparison search.

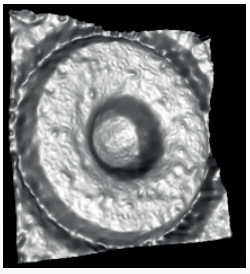
THE LIMITATIONS OF X3P IN THE CONTEXT **OF SHARING BALLISTICS DATA**

1

The X3P standard **does not** define the **quality and resolution of 3D data that** should be included. As such, an X3P file's topography of a surface area could have any lateral resolution for any field of view, using any number of pixels with whatever precision or sensitivity (elevation resolution). A 3D topography, like a 2D image, must not only have sufficient quality to be displayed, it must also have sufficient quality for automated comparison (correlation). If lateral or axial/depth resolution is inadequate, comparison performance quickly fails.

Example: Two topographic captures of the same cartridge case, performed with different techniques, both show similar precision for gross marks as both firing pin depths agree within 10%. However, their depth resolution and sensitivity are quite different making the right-hand side version unusable for a correlation search or for a one-to-one examination. They nevertheless both fit in a perfectly valid X3P file!





2

Even with the OpenFMC extension, X3P **does not** define how to delimit **regions of interest.** IBIS acquires three regions of interest (breech face, firing pin and ejector mark, and uses them for independent correlation and visualization). Other systems may split the breech face area into two distinct regions of interest if aperture shear marks are present. Where to position the firing pin delimiter will differ greatly from vendor to vendor. These differences in area definition create issues for the implementation of automatic correlation, and with one-to-one examination to some extent, that a standard file format will not resolve by itself.

3

X3P **does not** include any standardized **metadata** for the descriptive information fields associated with the case, exhibit, or firearm. Without standard values, systems cannot be automated and operator-independent, and the absence of context information makes it difficult to generate valuable intelligence.

So, exchanging X3P files is only useful for visualizing 3D data from another source. It does not offer a solution for significant data sharing or automated correlation, which are essential for an effective automated ballistic identification system.

THE LIMITATIONS OF X3P IN OFFERING **A SCALABLE, SECURE, NETWORKED SOLUTION**

Any image capture application, including IBIS, can export images to file. Being able to export IBIS images to PNG and/or JPEG2000 has never been considered as an adequate way to share ballistics data over a network, let alone between different vendor systems. X3P offers nothing more than what has been possible in the past, except for the standardization of a limited set of metadata fields.

The encoding of an X3P file requires much more storage space than the same data in a JPEG2000 file format. Consequently, they are not an effective way of sharing large sets of data across a network. Manually sharing X3P files is more applicable to occasional one-to-one image comparisons.

Multi-system sharing requires adequate infrastructure to deal with: image capture standards for quality and content definitions, standardized metadata values, automated data exchange automated correlation requests, security constraints of multiple agencies, sensitive data sanitization mechanisms, network security infrastructure to control external access to secure networks, to name a few key challenges. Having the X3P standard solves none of these complex issues.

SUMMARY

X3P is simply a standardized **container** for the storage and exchange of 3D topography data. Since there are no standard **content** specifications (such as for resolution, regions of interest, or metadata), X3P can simply be used for visualization but not correlation. Lastly, an effective network of interoperable ballistic identification systems must be able to move data seamlessly, while complying with necessary security protocols – X3P does nothing to address these needs.

For more information, contact James Hopper at James.Hopper@ultra-ft.com or +44 752 547 7327