GETTING PHYSICAL: UxS PAYLOAD FORM FACTORS

Unmanned systems (UxS) come in many shapes and sizes, whether airborne, in the water, or land-based. Most count as SWaP-constrained systems, with care needed in design to properly budget for power, weight and available payload volumes. Other notes in this series have discussed the challenges of power budgeting for SDRs, and RF architectures that optimize SWaP. We often have less choice in the form factors we need to fit into, as these are usually set by the larger system, and the customer question will be "I have this form factor, what can you do in it?".

The US Department of Defense continues to push for more open-standard, modular embedded systems. Many are based around OpenVPX[1], which originated the well known 6U and 3U VPX form factors. Cards based on, for example, 3U VPX, fit easily in some of the larger payload sizes such as AgilePod and are illustrated in ***Figure 1***. The larger platforms have plenty of room for power systems, heat management and the required card cages, and for these Epiq supplies 3U VPX cards that are SOSA-aligned[2] as well as cards based around FMC (VITA 57.1).

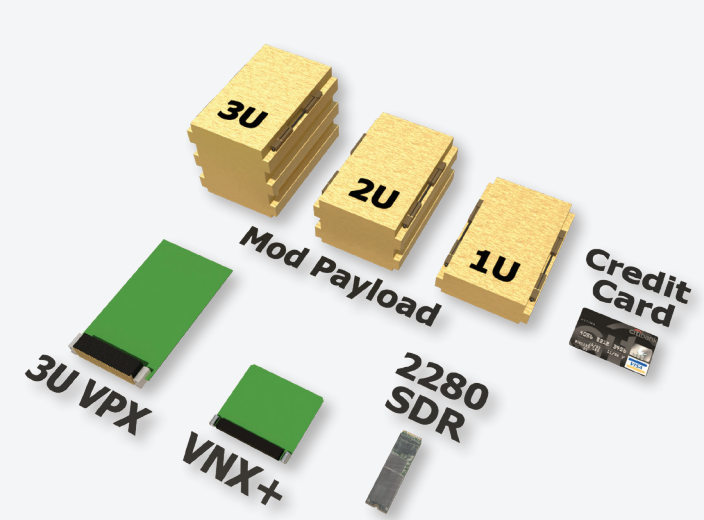

Figure 1: Common open architectures compared to show relative sizes.

It gets more interesting as the payload decreases in size. ***Figure 2*** is based on work by others[3] and shows how as the effective diameter of the parent housing decreases, 3U VPX starts to become impractical. This is one of the drivers for efforts to define and gain acceptance for VNX+, a smaller standardized form factor. ***Figure 3*** illustrates how even at 5" effective diameter, 3U VPX cards may be squeezed in length-ways, scalability is limited. For the same size tube, VNX+[4,5] (specified in VITA 90) allows cards to be mounted perpendicularly to the longest dimension and added scalably.

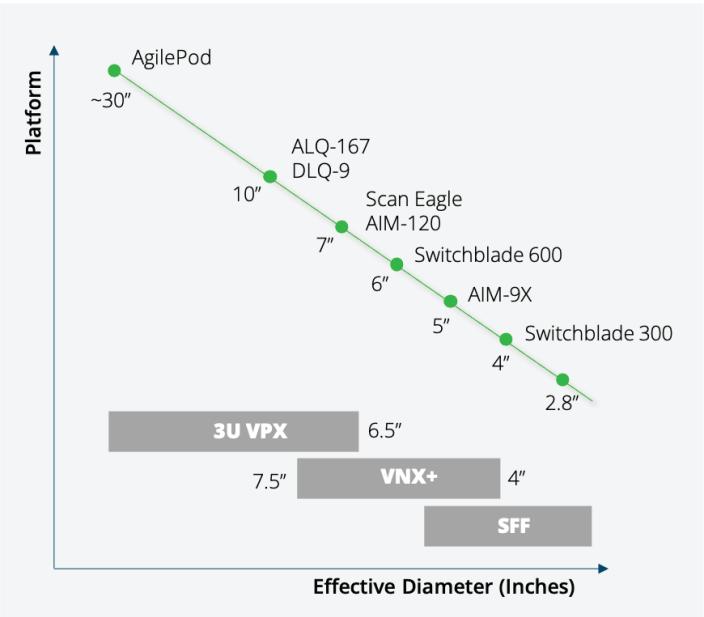

Figure 2: Example enclosure diameters with example platforms compared with some standard form factors.

There is interest from many of our customers in effective diameters smaller than 4", where standardized form factors become less relevant. An example is shown in the lower portion of ***Figure 3***. The Small Form Factor (SFF) requirement is for a 2.8" tube into which is packed an SDR with coverage from 1 MHz to 18 GHz, 2 receiver channels and one transmit channel, up to 450 MHz instantaneous bandwidth (IBW) per channel, an FPGA and a CPU/GPU for on-board AL/ML processing. The latest advances in technology enable such extremes of SWaP-C. A photograph of such a unit is shown in ***Figure 4***.

Below these sizes we frequently adhere to laptop standard form factors such as those used for Solid State

Drives (SSDs) like M.2[6], as illustrated with the 2280 SDR in ***Figure 1***. We unify our SFF products with a common software library (Libsidekiq) to ensure customer code developed for one will work with all.

This shallow discussion hasn't addressed the wide variety of RF, high speed serial bus, digital control and other interface standards, or issues of cooling or the myriad other factors that play into system design. **Contact us** for a spirited discussion of the lessons learned in supplying some of the smallest and lowest SWaP SDRs in the industry, or visit **our website**.

REFERENCES

1 A nice summary article here: https://militaryembedded.com/avionics/computers/vpx-and-openvpx
2 SOSA explained here: https://www.everythingrf.com/community/what-is-sosa
3 Adapted from Samtec VNX+ introduction material.
4 Nice VNX+ overview here: https://www.military-aerospace.com/computers/article/14290276/embedded-computing-sosa-smallformfactor
5 Image inspired by work from Collins Aerospace in Figures 5 and 6 here: https://militaryembedded.com/unmanned/rugged-computing/introducing-vita-90-the-latest-rugged-small-form-factor-module-standard
6 An overview of SSD formfactors is given here: https://www.cdw.com/content/cdw/en/articles/hardware/ssd-types-m2-sata-nvme-u2.html

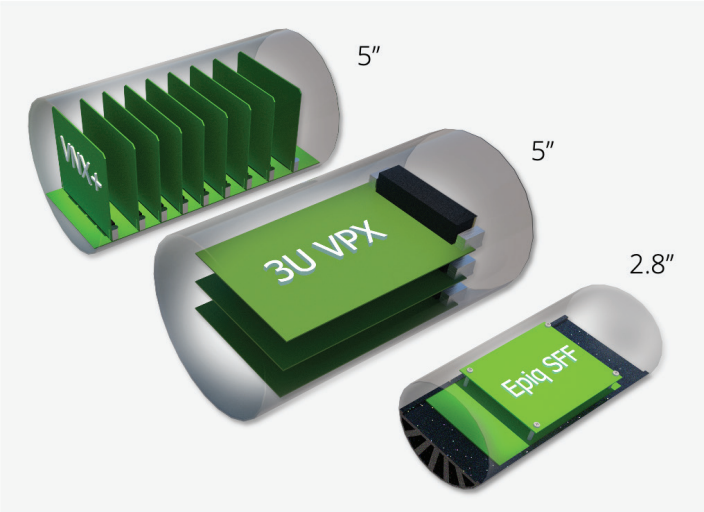

Figure 3: Comparing orientation of SFF cards in different effective diameters

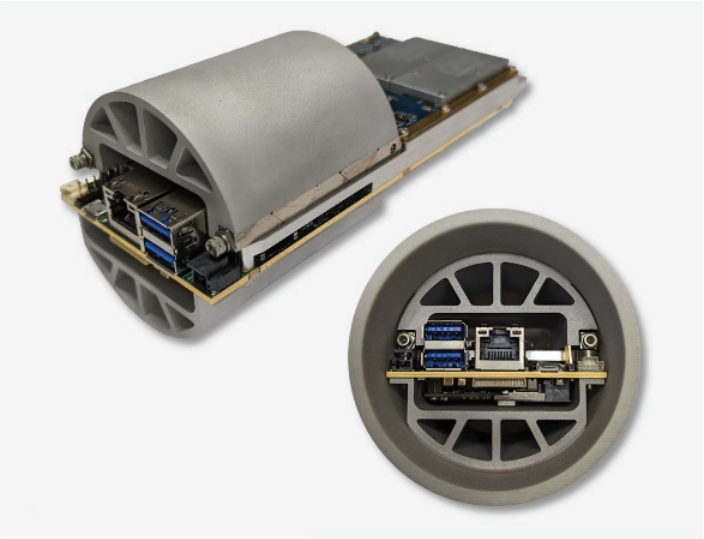

Figure 4: Example 2.8″ diameter SDR

ABOUT EPIQ

Epiq Solutions develops cutting edge tools for engineering teams and government-focused organizations requiring situational awareness and detailed insight into their RF environments in order to identify and act against wireless threats.

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