DIGITAL
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Frontline Digital Mobility National Guidelines

Laptop Shells

March 2020

FRONTLINE
DIGITAL
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[Sussex Police and Crime Commissioner of Sackville House, Brooks Close, Lewes, East Sussex BN7 2FZ is the contracting party acting on behalf of the DPP.]

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1. Context

The processing power and storage of today's premium smartphones is immense. Yet despite this mobile capability, frontline officers and staff are not currently able to be entirely mobile and complete all their duties supported by just their radio and smartphone. In particular, the relatively small screen size and touchscreen keyboard of a smartphone means that frontline officers and staff often return to police stations to complete activities on a desktop computer, particularly those tasks which are screen and/or keyboard intensive, such as completing reports and statements.

Low cost peripheral keyboards (see *FDM's Peripheral Keyboards guideline*) help officers and staff complete some further tasks remotely, but do not entirely remove the need to return to police stations. Secondary devices, such as laptops and tablets, can enable police officers and staff to remain mobile. Yet issuing frontline officers and staff with a second device, like a laptop, is very costly, even more so if fitted with a SIM. There are also security considerations related to these devices, since they store and access police data and yet are often left unattended in vehicles while officers and staff attend to a scene.

Laptop shells, attractively priced at less than £295, offer a potential "mobile-only" solution. A laptop shell, very much an emerging technology, is a peripheral that, like a laptop has a screen, keyboard, trackpad, speakers and battery. Yet unlike a laptop, it is not capable of storing any data. Once a premium smartphone with DisplayPort and the appropriate "desktop mode" software is attached to a laptop shell, a fully connected mobile desktop experience is created.

A number of forces are exploring the frontline use case for laptop shells, with some forces even having completed pilots and beginning roll out. The public have responded well in pilot areas, reporting that they welcome this innovation, particularly with respect to statements. Using a laptop shell, an MG11 can be completed entirely in one visit to a victim or witness's home. Once an officer or member of staff has completed the statement using a laptop shell, the smartphone is then disconnected from the laptop shell and the victim or witness can electronically sign the statement on the smartphone screen allowing the MG11 to be submitted immediately from the victim or witness's home.

There are currently only two laptop shell manufacturers in the market. They both have a new model in the final stages of production but these are only currently available for pre-order (although both manufacturers have released early examples which forces have been able to obtain for trials). Forces that have trialed these laptop shells have generally found their experiences positive, yet workarounds are necessary to make them fit for frontline policing. These forces are working to influence the design and functionality of future laptop shell products by engaging with manufacturers. It is expected that this technology will continue to mature over the next 12 months and beyond and that further mainstream suppliers will enter the market place.

This guideline looks at the variances in terms of specification, features and price between the laptop shells currently available for pre-order. It explores the capabilities that a connected premium smartphone must have, such as DisplayPort and an appropriate "desktop mode". Finally recommendations are made for forces who wish to be early adopters of this still immature technology (see section *4. Recommendations,* page 4).

This guideline has been developed to reflect existing technology and related capabilities available in the market place to forces today. Consequently, this guideline does not currently reflect any future capabilities that may be delivered, for example, by other national programmes such as ESN or NLEDS. This guideline should be considered alongside force mobility strategies and future plans for ESN (for more information contact your regional ESN coordination manager).

2. An Introduction to the technology

2.1 Laptop shells

A laptop shell, also known as a passive terminal or a lapdock, is like a laptop in that it has a similar sized screen, keyboard, trackpad, speakers, a battery and input and output ports. Yet in contrast to a laptop it is entirely driven by a connected premium smartphone, since it has no Central Processing Unit (CPU), memory, hard-drive, or Operating System (OS) of its own. Once a smartphone with DisplayPort and appropriate "desktop mode" software is attached to a laptop shell (via a USB-C cable), a mobile desktop experience is created. Laptop shells use the connected smartphone's data, Wi-Fi and Bluetooth. Applications on the smartphone become resized into a desktop view and the interface is presented in a windows-like environment. When connected, the battery within a laptop shell also charges the smartphone.
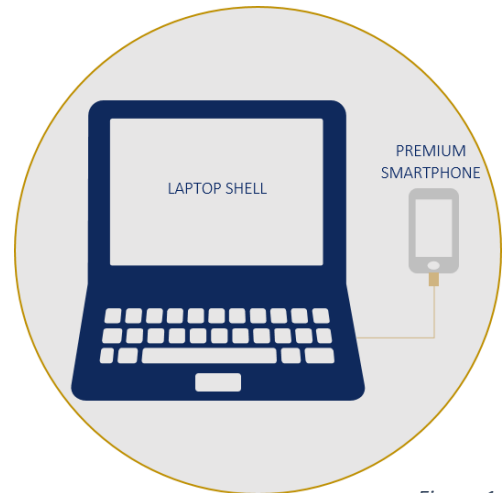

Figure 1

3. Benefits

Laptop shells offer a range of strategic and tactical benefits. These are detailed below.

3.1 Strategic benefits

BENEFIT 01

IT RATIONALISATION

Supporting an often duplicative IT estate of desktop PCs, laptops, tablets and smartphones places strain on a force's IT budget and resource. Laptop shells offer the potential to move to a single mobile-only device strategy, which could enable savings and rationalisation of hardware.

BENEFIT 02

ESTATE RATIONALISATION

Laptop shells have the potential to place an office in an officer and staff's pocket. A reduced requirement for desktop computers means greater potential for a force to further rationalise its estate.

BENEFIT 03

GREATER INTERNAL IT INNOVATION

Maintaining legacy technology presents many challenges for force IT departments. A single device mobile-only strategy would help by streamlining device management, enabling more time to be focussed towards innovation.

BENEFIT 04

KEEPING PACE WITH MARKET INNOVATION

Software and service providers are focusing investment on mobile platforms. They have embraced mobile apps and are reducing their focus on supporting legacy technology. Forces that are slow to improve their focus on mobile risk having to manage a legacy estate with less support.

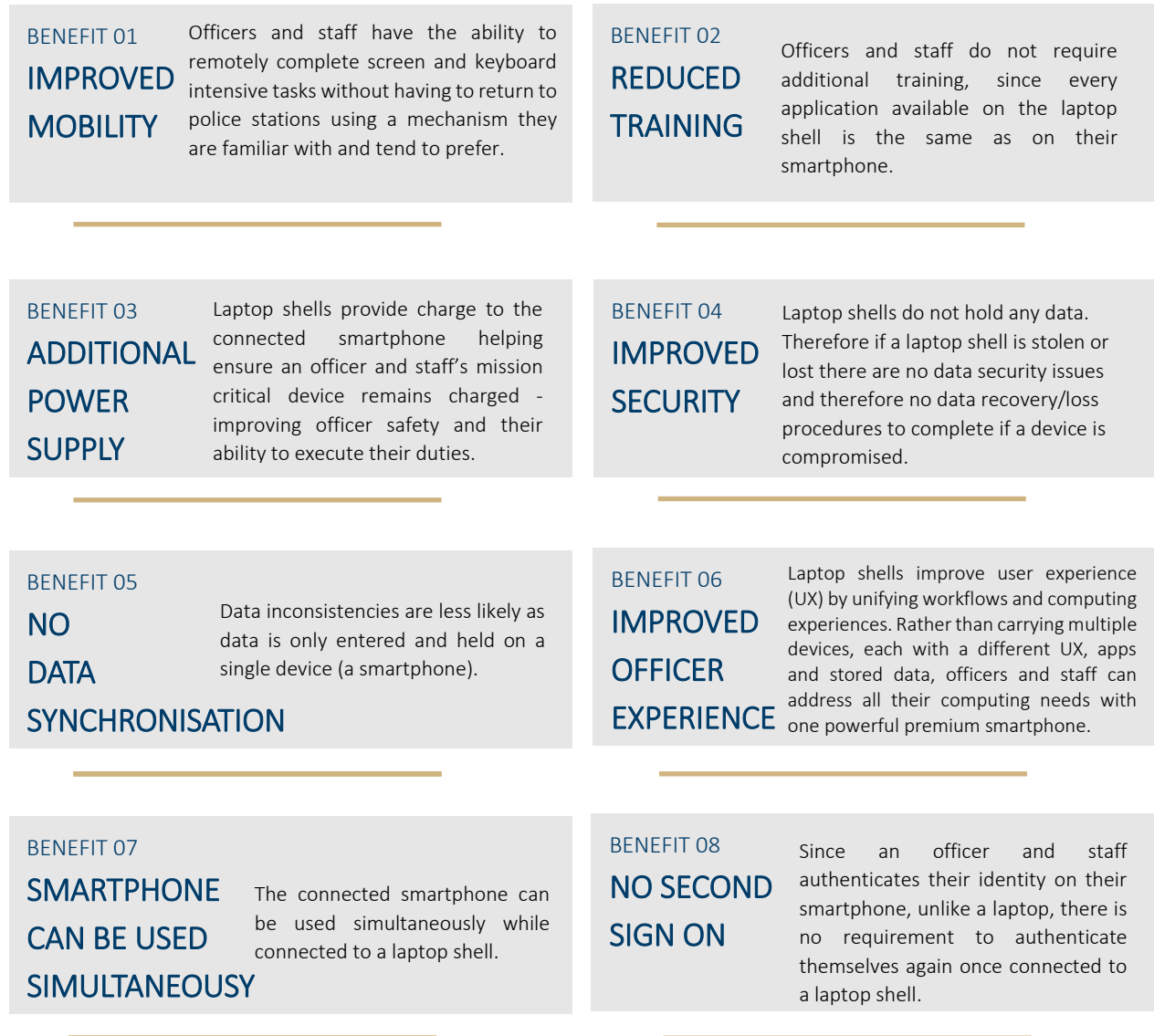*Figure 2*

3.2   Tactical benefits

BENEFIT 01

IMPROVED MOBILITY

Officers and staff have the ability to remotely complete screen and keyboard intensive tasks without having to return to police stations using a mechanism they are familiar with and tend to prefer.

BENEFIT 02

REDUCED TRAINING

Officers and staff do not require additional training, since every application available on the laptop shell is the same as on their smartphone.

BENEFIT 03

ADDITIONAL POWER SUPPLY

Laptop shells provide charge to the connected smartphone helping ensure an officer and staff's mission critical device remains charged - improving officer safety and their ability to execute their duties.

BENEFIT 04

IMPROVED SECURITY

Laptop shells do not hold any data. Therefore if a laptop shell is stolen or lost there are no data security issues and therefore no data recovery/loss procedures to complete if a device is compromised.

BENEFIT 05

NO DATA SYNCHRONISATION

Data inconsistencies are less likely as data is only entered and held on a single device (a smartphone).

BENEFIT 06

IMPROVED OFFICER EXPERIENCE

Laptop shells improve user experience (UX) by unifying workflows and computing experiences. Rather than carrying multiple devices, each with a different UX, apps and stored data, officers and staff can address all their computing needs with one powerful premium smartphone.

BENEFIT 07

SMARTPHONE CAN BE USED SIMULTANEOUSY

The connected smartphone can be used simultaneously while connected to a laptop shell.

BENEFIT 08

NO SECOND SIGN ON

Since an officer and staff authenticates their identity on their smartphone, unlike a laptop, there is no requirement to authenticate themselves again once connected to a laptop shell.

Figure 3

4. Recommendations

A defined list of guidelines have been established and detailed below.

Guideline ID	Recommendations	Section Reference	Guideline Theme
GL-LS-01	Both laptop shell manufacturers report that their final model is in the last stages of configuration (both having released early examples) and therefore is only currently available for pre-order. Forces are recommended to validate product availability as well as any potential minimum order quantities with manufacturers.	6.10 Price	Availability
GL-LS-02	It is recommended that forces carry out a comprehensive application inventory in order to ensure that the tools officers and staff need will be available and usable from the start. A comprehensive application inventory for each user group will identify business-critical mobile and web-based apps, as well as Windows-native applications. Forces should also consider their strategy for new applications to ensure that these are portable between devices and operating systems.	8. What to expect from apps using Samsung DeX	Compatibility
GL-LS-03	The pre-order laptop shells available are priced at a suitable level for frontline use. Shipping and Excise Duty will add cost to the per unit price. It is recommended that forces consider identifying a UK reseller for continuity of supply and support.	6.10 Price	Cost
GL-LS-04	Forces who are keen to be early adopters should conduct rigorous pilots of laptop shells to be sure adoption is right for them. It is further recommended that they work with other forces with a similar ambition and engage with the manufacturers to influence the shaping of the next generation laptop shells.	10. Considerations for early adopters	Early Adoption
GL-LS-05	Forces are recommended to put in place in-car charging capabilities to ensure that laptop shells remain charged, thereby preventing the need to return to police stations for mains electricity charging.	6.5 Battery	Performance

GL-LS-06	It is recommended that forces purchase protective cases to protect laptop shells from damage. The laptop shell manufacturers produce their own protective cases, yet the dimensions of the laptop shells are such that many third party protective cases will be fit for purpose also.	6.8 Ruggedisation and Environmental proofing	Ruggedisation and Environmental proofing
GL-LS-07	If forces feel that a protective case does not offer sufficient protection from damage they should consider engaging with laptop shell manufacturers to encourage the production of a ruggedised/environmentally proofed laptop shell.	6.8 Ruggedisation and Environmental proofing	
GL-LS-08	As laptop shells are often used around the public and they do not currently have a built in privacy screen setting, it is recommended that separate privacy screen filters are purchased and used with laptop shells to protect police data from the public.	6.2 Screen	Safety/Security
GL-LS-09	Since no reported policing metrics are currently available with respect to drop out rates between smartphones and the currently available pre-order laptop shells, it is recommended that forces conduct rigorous pilots to ensure that disconnection rates are below locally decided acceptance levels.	7.2 Desktop mode	Usability
GL-LS-10	The USB-C cables of the pre-order laptop shells available are not considered to be optimal for frontline use. Forces are recommended to engage with suppliers to encourage the supply of longer cables, (taking into consideration the risk that longer cables could be a trip hazard and could be used as a strangulation ligature) and / or to purchase secondary cables to extend the length to allow officers and staff to place their smartphones in their pocket while connected. A maximum cable length of 1 metre is recommended.	6.7 Cables	
GL-LS-11	It is recommended that sufficient instruction is provided to users to ensure the correct port is used for the intended purpose (crucially to ensure that the correct USB-C port is used for charging).	6.6 Input and output ports	
GL-LS-12	The pre-order laptop shells available with United States QWERTY keyboard design are not considered as optimal for frontline use. Forces are recommended to engage with manufacturers to encourage the production of a United Kingdom QWERTY keyboard design. This message should be reinforced by Police ICT Company on behalf of forces.	6.4 Keyboard	

Table 1

5. Market place

5.1 Technology maturity

The concept of converting a smartphone into a desktop experience is not new. In 2011 Motorola released a lapdock for their Atrix 4G Android smartphone. The lapdock itself looked like a small notebook computer complete with large screen, full keyboard and trackpad. Docking an Atrix 4G into a slot behind the screen opened a WebTop application with full desktop Firefox web browser. While the concept was thought to be compelling, there were issues with app support and slow browsing. Priced at £500 the Atrix lapdock was discontinued after two years and Motorola have not offered a similar solution since.

In 2017, HP released their HP Elite x3 lapdock, allowing their HP Elite x3 smartphone to be used to create a full desktop experience via Microsoft Continuum. While the hardware itself was largely praised, limitations of Windows 10 Mobile and Microsoft Continuum led to both the smartphone and the lapdock being discontinued. At around the same time, Sentio began a crowdfunding campaign for its "Superbook". While the order page appears to still be live, the company have since announced that due to financial constraints they will not be able to fulfil orders. It is therefore unclear whether this product will actually be released into the market.

Miraxess and its Mirabook and Nex Computer's Nexdock2 are the only two laptop shell products available for pre-order. As the name suggests, the Nexdock2 is the second generation of the Nexdock, (the first of which was released in 2016).

It is expected that this technology will continue to mature over the next 12 months and beyond and that more mainstream suppliers will enter the market place.

5.2 Key manufacturers in the market

As explained above, there are currently only two manufacturers in the market place, these are detailed below.

Supplier	Supplier Summary
Nex Computer	This supplier is a Californian startup founded in 2016 through a crowdfunding campaign. In their first year they launched the first generation of their laptop shell called the "NexDock".
Miraxess	This supplier is a French startup company founded in 2015 through a crowdfunding campaign. Their current first generation product is called the "Mirabook".

Table 2

6. Technology specification and features

6.1 Laptop shell hardware

Laptop shells provide a screen, a keyboard with a track pad, speakers, a battery, and input and output ports.

6.1.1 Casing

The two laptop shells available to pre-order both have robust aluminium casings. Some previous models were made from plastic.

The pre-order laptop shells available with aluminium cases are considered suitable for frontline use.

6.2 Screen

Laptop shells available to pre-order come in one size, 13'3 inches. The screens are full HD with a resolution of 1920 x 1080 pixels. There are no touch-screen options currently available, which consultation with forces suggest would be beneficial.
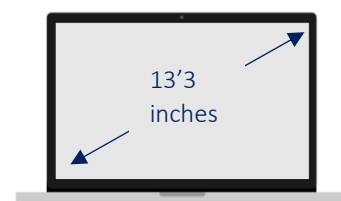

13'3 inches

Figure 4

The pre-order laptop shells available with 13.3 inches, 1920 x 1080 pixels screens are considered suitable for frontline use.

> As laptop shells are often used around the public and they do not currently have a built in privacy screen setting, it is recommended that separate privacy screen filters are purchased and used with laptop shells to protect police data from the public.

6.3 Trackpad

Like a laptop, laptop shells have a trackpad. A trackpad, also known as a glide pad, is an input device that allows the user to move the cursor with their finger. An external mouse may also be plugged in to the device. On both laptop shells currently available to pre-order the trackpad is large and very useable.

The trackpads of the pre-order laptop shells available are considered suitable for frontline use.

6.4 Keyboard

Both laptop shells currently available to pre-order have back-lit keyboards, which are vital to allow working in dim lit environments (such as in vehicles during the hours of darkness). The only keyboard type currently available is a full sized United States QWERTY keyboard design. There are a number of differences between a United States and a United Kingdom keyboard which forces must take into consideration. These are listed below:

- The pound (£) sign on a UK keyboard is replaced by a hash (#) symbol on the US keyboard
- The 'Alt' key immediately to the right of the space bar on a US keyboard is replaced with a 'AltGr' on the UK keyboard
- The tilde (~) key is moved with the hash (#) key and is replaced by an optional hyphen (¬) symbol on the back quote (`) key on the UK keyboard

Forces rolling out laptop shells have worked around this issue by reassigning the affected keys and placing stickers over the keys in order to re-label them.

The pre-order laptop shells available with United States QWERTY keyboard design are not considered as optimal for frontline use. Forces are recommended to engage with manufacturers to encourage the production of a United Kingdom QWERTY keyboard design. This message should be reinforced by Police ICT Company on behalf of forces.

6.5 Battery

There is a lithium-ion battery inside both the laptop shells currently available for pre-order. This is used to power the screen display, speakers, keyboard back-light and also provides charge to the connected smartphone. These laptop shells have 47 – 51 WHr batteries which equates to an average of eight hours battery life when in use. The greater the WHr the longer the battery will last between recharges. When not connected to a smartphone, laptop shells go into idle/sleep mode to conserve the battery life.

The laptop shells are supplied with 60W USB-C PD chargers. Plug heads for the UK are available. There are function keys on the keyboard which once pressed indicate the battery status on the display screen.

One force, which is rolling out one pooled laptop shell per response vehicle, has fitted a lock box in the boots of their response vehicles, which essentially provides both a protective case for a laptop shell and an in-vehicle charger.

The lithium-ion batteries of the pre-order laptop shells available are considered suitable for frontline use.

Forces are recommended to put in place in-car charging capabilities to ensure that laptop shells remain charged, thereby preventing the need to return to police stations for mains electricity charging.

6.6 Input and output ports

Both laptop shells currently available for pre-order have a number of input and output ports. Input ports are used to either charge the laptop shell or to connect the input device (i.e. a smartphone). The output ports are used for multiple purposes such as for audio or connecting additional peripherals. A list of some of the key input and output ports and their use is detailed below.

Port Type	Port Name	Port Purpose
Input	USB-C PD	This port is used to provide charge to the laptop shell. It only works with PD chargers.
	USB-C DisplayPort	This port is used to project connecting devices onto the laptop shell. The most commonly connected device is a smartphone. However, it is possible to connect and project laptops and tablets also (but while connected these cannot be controlled via the laptop shell, only from the device itself).
	HDMI	This port is also used to project connecting devices, i.e. using the laptop shell as a monitor (but while connected these cannot be controlled via the laptop shell, only from the device itself).

Output	USB-A	This port is used to connect additional peripherals to the laptop shell, such as a mouse or a peripheral speaker.
	Micro SDXC Reader	This port is used to write data from the mobile device to SD media.
	USB-C	This port is used to provide power for a Raspberry Pi (a small single board computer).

Table 3

The input and output ports of the pre-order laptop shells available are considered suitable for frontline use.

> It is recommended that sufficient instruction is provided to users to ensure the correct port is used for the intended purpose (crucially to ensure that the correct USB-C port is used for charging).

6.7 Cables

Cables are required to connect the ports between the laptop shell and a mains power supply and a laptop shell and a connecting device. On both laptop shells currently available to pre-order, the USB-C cables provided to connect the laptop shell to the premium smartphone are short (15 cm or less), and really only lend themselves to using the laptop shell on a desk, where the smartphone can be placed next to it. However officers and staff who have participated in pilots have reported that they find these cables too short. They would prefer longer cables so they can use the laptop shell on their lap and then tuck their smartphone in their pocket. One force which is rolling out laptop shells has purchased a secondary cable to extend the length of the one supplied. When considering longer cables forces should bear in mind the risk of long cables being used as a strangulation ligature as well as them being a trip hazard. Cables should have a maximum length of 1 metre to prevent tripping. Engaged forces report that the optimal future laptop shell would be able to wirelessly connect to a premium smartphone, therefore eliminating the need for a cable.

> The USB-C cables of the pre-order laptop shells available are not considered to be optimal for frontline use. Forces are recommended to engage with suppliers to encourage the supply of longer cables, (taking into consideration the risk that longer cables could be a trip hazard and could be used as a strangulation ligature) and / or to purchase secondary cables to extend the length to allow officers and staff to place their smartphones in their pocket while connected. A maximum cable length of 1 metre is recommended.

6.8 Ruggedisation and Environmental proofing

"Ruggedisation" protects against bangs and drops. Ruggedised devices tend to have a thicker and stronger housing with the aim of withstanding shock and vibration. Devices can also have an environmental proofing rating, known as an Ingress Protection (IP) rating, which is used to define levels of sealing effectiveness of electrical enclosures against intrusion from foreign bodies (dust etc.) and moisture. The laptop shells currently available to pre-order are not ruggedised and nor do they have any environmental proofing. While the aluminium cases have a premium feel, they do not protect from drops or water.

The currently available for pre-order non-ruggedised or environmentally proofed laptop shells are considered suitable for frontline use.

> It is recommended that forces purchase protective cases to protect laptop shells from damage. The laptop shell manufacturers produce their own protective cases, yet the dimensions of the laptop shells are such that many third party protective cases will also be fit for purpose.

> If forces feel that a protective case does not offer sufficient protection from damage they should consider engaging with laptop shell manufacturers to encourage the production of a ruggedised/environmentally proofed laptop shell.

6.9   Size and weight

Figure 5

Laptop shell manufacturers list three physical dimensions for the size of the device: width, depth and height (or thickness).

The laptop shells currently available to pre-order have dimensions of approximately 317 x 215 x 15.9mm and range from 1.3kg to 1.4kg in weight.

Laptop shells are typically slightly smaller and lighter than a laptop. For example, the Lenovo ThinkPad Yoga Business series (used by many forces) range from 323 x 218 x 15.5mm to 322 x 224 x 18.8mm in size and 1.35kg to 1.56kg in weight.

Laptop shells are considerably larger and heavier than tablets. For example, the Samsung Tab A series (again used by many forces) range from 210 x 124 x 8mm to 260 x 161 x 8mm in size and 0.35g to 0.53g in weight. However frontline officers and staff often use peripheral keyboards when using tablets and so it is important to factor in the additional weight and bulk associated with this.

The pre-order laptop shells available are considered to be of a size and weight which is suitable for frontline use.

6.10 Price

The current laptop shells available for pre-order range in price from £200 to £295. It is important to make clear that the price of the current laptop shells available for pre-order does not include shipping or Excise Duty (both laptop shells available are produced and shipped from outside the UK) – this will add cost to the per unit price. Additionally, there may be a minimum order quantity for laptop shell orders so it is recommended that forces check this with the manufacturer.

Current laptop shells available for pre-order are considerably cheaper than most laptops, for example the Lenovo ThinkPad Yoga Business series have a price typically around the £1,500 mark. While tablets are typically slightly cheaper than laptop shells, for example the Samsung Tab A range are around £140, it should be remembered that frontline officers and staff often use peripheral keyboards when using tablets and so there is the additional cost of this to consider.

Both laptop shell manufacturers report that their final model is in the last stages of configuration (both having released early examples) and therefore is only currently available for pre-order. Forces are recommended to validate product availability as well as any potential minimum order quantities with manufacturers.

The pre-order laptop shells available are priced at a suitable level for frontline use. Shipping and Excise Duty will add cost to the per unit price. It is recommended that forces consider identifying a UK reseller for continuity of supply and support.

7. Requirements of the connected smartphone

The laptop shells available for pre-order require that the connected premium smartphone is both DisplayPort compatible and is running a mobile operating system with the appropriate "desktop mode".

7.1 DisplayPort

USB-C

To connect to the laptop shells available DisplayPort is a required feature of the connected smartphone.

DisplayPort is a digital display interface that can transmit both audio and visual signals from a video source to a display device. The technology is overseen by VESA, the Video Electronics Standards Association. Now available over USB-C, DisplayPort is increasingly available on a wide range of smartphones, tablets and laptops as a display input.

DisplayPort delivers monitor resolutions of 4K (and beyond), and super-speed USB (USB 3.1) data.

Connected smartphones will have to support DisplayPort over USB-C to be compatible with the pre-order laptop shells available.

Figure 6

7.2 Desktop mode

To connect to the current laptop shells a mobile operating system with the appropriate "desktop mode" feature is also a required feature of the connected smartphone. Desktop mode can be used to connect a premium smartphone to both a monitor, (any other peripherals like a keyboard and mouse) and a laptop shell.

Currently there are a number of companies manufacturing smartphones with desktop mode operated by Android, such as Samsung, Huawei, OnePlus and LG. It is a developing market and it is anticipated more suppliers will be entering the market in the next 12 months.

Figure 7 - Desktop Mode enables connection to a monitor, keyboard and mouse, as well as a laptop shell.

Samsung's flagship smartphones provide desktop mode through their Samsung DeX feature, while Huawei's Easy Projection (EMUI Desktop Mode) is built into flagship
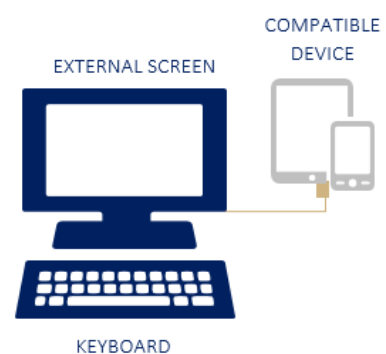
Huawei smartphones. LG premium smartphones, such as the G8 ThinQ, also provide desktop mode through Android Q.

Desktop mode allows an application to be resized and its user interface to be presented on an external screen in a windows-like form. Additionally, the smartphone and the laptop shell can be used independently of each other while connected. In recent years, forces have shown a predisposition to Samsung devices, which benefit from a pre-installed security platform called Samsung Knox. The Samsung A series and Samsung Galaxy Note are both popular Samsung smartphones selected by many forces. As such the rest of this section will focus on the use of laptop shells with Samsung DeX.

Samsung DeX was first included on Samsung's Galaxy S8 and S8+ smartphones, and has continued to feature on all Samsung flagship smartphones, including the Galaxy S9, S10, Note8, Note9 and Note10. It has also been introduced on several premium tablets, including the Galaxy Tab S4, S5e and Tab S6. Initial iterations required the use of docking accessories, such as the DeX Station or the DeX Pad. Samsung have since introduced the DeX HDMI adapter, cable and multiport adapter, eliminating the need for the previous docking accessories.

Some forces have reported no issues with desktop mode disconnection rates between the smartphone and the laptop shell, while other forces have reported that disconnection rates can be very high. Forces that have trialled peripherals which mount the connected smartphone to the laptop shell report that this assists with ensuring the smartphone remains connected.

The decision to explore mobile only supported by laptop shells requires a force to have a mobile solution that is very mature. Forces should carry out a comprehensive application inventory in order to ensure that the tools frontline officers and staff need will be available and usable from the start. Connected smartphones will need to have a mobile operating system with the appropriate "desktop mode" feature to be compatible with the pre-order laptop shells available.

> Since no reported policing metrics are currently available with respect to drop out rates between smartphones and the currently available pre-order laptop shells, it is recommended that forces conduct rigorous pilots to ensure that disconnection rates are below locally decided acceptance levels.

8. What to expect from apps using Samsung DeX

For Android mobile applications, the user experience is seamless in Samsung DeX. Custom-built mobile applications, on the other hand, can also be optimised very well for DeX. Many of the leading productivity applications, for example Microsoft Office suite, have not only been ported to Android, but have also been optimised for use in DeX to support features such as keyboard shortcuts, drag-and-drop and right-click mouse functions. Some examples are listed in table below.

Application Family	Optimised for DeX
Office Productivity	Microsoft Office
Browser	Chrome Browser
Document Viewers	Acrobat Reader, OfficeSuite

Audio/Videoconferencing	Skype, GoToMeeting
Email	Microsoft Outlook
Photo Editing	Photoshop Express
File Sharing	OneDrive, Google Drive

Table 4

Applications that are not compatible with Samsung DeX can still be launched, but operate in a fixed-size window on the laptop shell with limited functionality. Activating DeX Labs, which is a feature that can force resizing, can allow non-DeX apps to operate in full screen mode, however this is not a recommended solution to accessing critical applications as users are more likely to experience bugs and apps crashing.

Most modern web-based applications can be accessed from the Samsung Internet or Chrome mobile browsers within Samsung DeX. However, some sites (particularly those with plug-ins such as ActiveX) will present compatibility or user experience challenges. Business-critical web-based applications should all be thoroughly tested.

Windows-native applications are not compatible with Samsung DeX. This should be an important consideration for forces since most legacy police applications are Windows (Win 32) based. A potential workaround here is to leverage Virtual Desktop Infrastructure (VDI) environments, such as Citrix or Microsoft Remote Desktop (note no longer in Beta). The Citrix receiver app, for example, can be launched from inside Samsung DeX, providing access to Windows desktops. This has costs however, and it is important to note that it could lead to a reduction in performance of DeX.

Forces have reported that when using Samsung DeX there have been issues such as spell check not working and PDF viewer not loading properly.

> It is recommended that forces carry out a comprehensive application inventory in order to ensure that the tools officers and staff need will be available and usable from the start. A comprehensive application inventory for each user group will identify business-critical mobile and web-based apps, as well as Windows-native applications. Forces should also consider their strategy for new applications to ensure that these are portable between devices and operating systems.

9. How to get the best from the technology – Do's and Don'ts

Advice on how you should and should not use a laptop shell is detailed below.

DO's	DON'Ts
✓ **Do** charge the laptop shell with the USB-C PD charger provided by the manufacturer or a third party certified cable. ✓ **Do** ensure that the correct port is used for the correct purpose (crucially to ensure that the correct USB-C is used for charging). ✓ **Do** clean the LCD screen with the correct cleaning product as recommended by the manufacturer. ✓ **Do** take care when handling as dropping a laptop shell could lead to damage of the device or the lithium-ion battery.	x **Don't** apply pressure to the LCD screen or let it come into contact with sharp objects as the soft film is vulnerable to scratch. x **Don't** expose laptop shells to extreme temperatures as this could lead to damage of the lithium-ion battery as well as damage to the LCD screen. x **Don't** expose laptop shells to moisture as this could lead to damage of the lithium-ion battery as well as damage to the LCD screen. x **Don't** expose laptop shells to dusty environments as this could lead to damage of the lithium battery as well as damage to the LCD screen.

Table 5

10. Considerations for early adopters

Going mobile only using premium smartphones, supported by peripheral laptop shells, appears to be the obvious next step in the evolution of computing. This shift is indeed already well underway. Businesses that have migrated some or all of their tasks to mobile devices are reaping huge productivity gains.

Laptop shells have considerable potential for frontline policing and many potential benefits for forces. However, forces that wish to seriously explore laptop shells should understand that this is an emerging technology being led by start-up companies and with only two devices currently offered which are both only available to pre-order. While some mobility leading forces accept the current necessary workarounds, such as US keyboards, reported high desktop mode disconnections and USB-C cables that are too short to allow an officer to place their connected smartphone in their pocket, other forces are keeping an active watching brief. The next 12 months are likely to see more laptop shell and desktop mode manufacturers enter into the market and an associated improvement in the technology capabilities.

The decision to explore mobile only supported by laptop shells requires a force to have a mobile solution that is very mature. Forces should carry out a comprehensive application inventory in order to ensure that the tools frontline officers and staff need will be available and usable from the start. Users will expect that their experience with mobile-only matches or surpasses what they have come to expect

from their desktop PCs: software needs to launch as smoothly, web browsers should perform as quickly and be as compatible, and collaboration tools such as video/audio conferencing need to be well integrated. This will require IT departments to make honest assessments of their capacity and capabilities. In addition help desks are likely to need to shift resources or receive training as device populations shift. If support is outsourced, additional time or even contractual considerations may arise.

Forces considering being early adopters of laptop shells are advised to give consideration to their long term plans for ESN adoption.

> Forces who are keen to be early adopters should conduct rigorous pilots of laptop shells to be sure adoption is right for them. It is further recommended that they work with other forces with a similar ambition and engage with the manufacturers to influence the shaping of the next generation laptop shells.