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Frontline Digital Mobility National Guidelines

Peripheral Keyboards

March 2020

FRONTLINE
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1. Context

Frontline officers and staff frequently enter data and type detailed text into reports and statements. These are often submitted into the evidential chain and so must be accurate and of a meticulous standard. Those officers and staff equipped with just a smartphone and/or a tablet report that the relatively small touchscreen keyboards are not suitable for extensive typing and so repeated journeys back to police stations are necessary to access a full-sized keyboard connected to a desktop computer. Where officers and staff are not able to return to stations and must use the keyboards on their mobile devices, user experience has been found to be poor and the accuracy of reports and statements can reduce. There is a continued focus on seeing frontline officers and staff both on our streets and visible to the public and as such there is a requirement to find solutions which make it easier for them to type remotely.

Some forces are exploring laptop shells (see [FDM's Laptop Shells guideline](#)), as part of a "mobile-only" solution, which provide a full-sized keyboard. Yet laptop shells are an emerging technology and are currently only available for pre-order. Low cost keyboards connected to smartphones and tablets are a tried and tested peripheral that can help officers and staff complete typing activities remotely.

There are many types of keyboards available in the market place with many variances in terms of specification, features and of course price. This guideline explores these variances and makes recommendations (see section 4. *Recommendations*, page 2) to help forces make informed selections so as to accelerate their mobility maturity.

2. An introduction to the technology

A peripheral keyboard is an input device with an arrangement of keys that act as mechanical levers or electronic switches. These keys are used to input letters, numbers and symbols. They are also composed of control keys, function keys and arrow keys. Keyboards are used as data entry interfaces for typing text and numbers into browsers and programs. They can also be used to give commands to the operating system of a computer.

Peripheral keyboards can be used with smartphones, tablets/phablets, laptops and desktop computers. Different keyboards may be required for different types of devices. Current keyboards on the market connect to a device either using a USB cable or wirelessly through either Radio Frequency or Bluetooth. Most keyboards are similar in capability but there are differences in their arrangement. Some keyboards are split down the middle for example, while others fold in half or roll up.

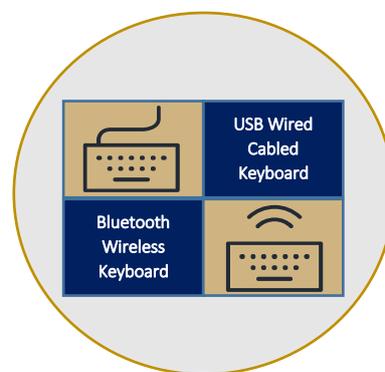


Figure 1

3. Benefits

Keyboards offer a range of benefits for frontline mobility enablement. These are detailed below.

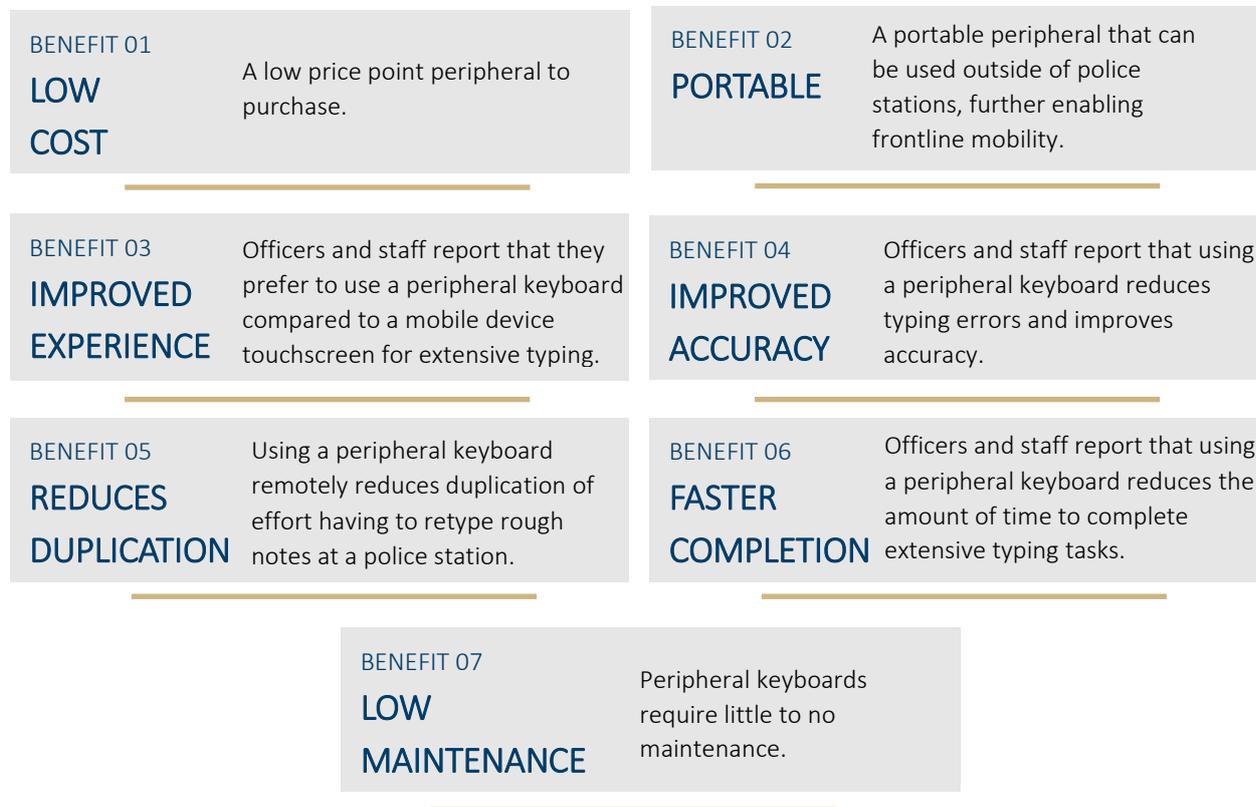


Figure 2

4. Recommendations

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

Guideline ID	Recommendation	Section Reference	Guideline Theme
GL-PK-01	Forces are recommended to engage with manufacturers to encourage the production of a United Kingdom QWERTY keyboard design that is back lit and foldable. This message should be reinforced by Police ICT Company on behalf of forces.	5.1 Technology Maturity	Availability
GL-PK-02	It is recommended that forces consider Bluetooth wireless keyboards as they are compatible with most smartphones and tablets without the need for a USB adapter (as would be required with a wired or Radio Frequency keyboard).	6.1.2 Wireless	Compatibility



Guideline ID	Recommendation	Section Reference	Guideline Theme
GL-PK-03	It is recognised that some forces do not permit the use of USB ports for anything other than the provision of power. Therefore, if USB adapters are required forces are recommended to ensure that they are permitted in line with force security policies.	6.1.1 Wired	Compatibility
GL-PK-04	A keyboard in the price range of £20 to £40 is recommended. Due to the circumstances in which keyboards would be used on the frontline and coupled with the fact many forces consulted do not repair damaged keyboards, devices above this price range are considered unlikely to deliver best value for money. Forces are also recommended to consider purchasing keyboards in bulk, which could reduce the price per unit.	6.8 Price	Cost
GL-PK-05	If selecting a wireless keyboard it is recommended the keyboard should have a dedicated on/off switch and sleep mode to conserve battery power when it is not in use. It is further recommended that keyboards have an LED indicator so that officers and staff can clearly see the remaining battery, preventing situations where keyboards run out of charge mid-shift. It is also recommended that keyboards requiring alkaline batteries are selected, since they have a longer battery life compared to rechargeable batteries and do not require a recharging cable that could conceivably be lost or damaged.	6.2 Power source	Performance
GL-PK-06	While forces could benefit from having Ingress Protected rated keyboards, they tend to be heavier and more expensive. Given that forces report that when selecting cheaper peripherals they are less concerned about damage, it is recommended to avoid that additional expense and weight by selecting non-IP rated keyboards.	6.7.3 Water-proofing	Ruggedisation and Environmental proofing
GL-PK-07	It is recommended that forces consider Bluetooth keyboards that are version 2.1 or higher as these provide the strongest security. If considering a Bluetooth keyboard with low energy functionality then version 4.2 or higher is recommended.	6.1.2 Wireless	Safety/Security
GL-PK-08	A keyboard with a United Kingdom QWERTY layout is recommended to ensure high user experience and adoption due to familiarity with this layout.	6.3 Layout	Usability



Guideline ID	Recommendation	Section Reference	Guideline Theme
GL-PK-09	It is recommended that forces consider low-profile scissor-switch keyboards, which provide a good user experience and are better at preventing the ingress of dirt than other keyboard types. Scissor-switch keys are also quieter and so better suited to sensitive environments where loud key clicks could be inappropriate and distracting.	6.4 Key type	Usability
GL-PK-10	Flexible and projection keyboards require a flat surface to function properly but frontline officers and staff often need to use keyboards on their lap, in the home of a member of the public or in police vehicles. It is recommended that forces consider foldable keyboards with a locking mechanism so they can be used on a person's lap. The locking mechanism should be fully tested prior to procurement.	6.5 Form	
GL-PK-11	To ensure the keyboard does not add additional burdensome weight to what an officer or staff already needs to "personally carry" it is recommended that a keyboard weighs no more than 250grams. It is also recommended that to ensure the keyboard can fit comfortably into uniform pockets that it is no larger than 15cm x 10cm x 2cm when folded.	6.6 Size and Weight	
GL-PK-12	Frontline officers and staff frequently require the use of keyboards in low light environments, for example when on night shift and working in stationary police vehicles. It is therefore recommended that forces select backlit keyboards.	6.7.1 Backlit	
GL-PK-13	It is recommended that forces consider ergonomic keyboards for those officers and staff recovering from injuries or other health-related needs to their hands and wrists in line with their local Reasonable Adjustments policy.	6.7.2 Ergonomic	

Table 1

5. Market place

5.1 Technology maturity

Keyboards are a tried and tested technology and are used across police forces nationally. Today there is a competitive keyboard market with many different suppliers and specifications and features available. Despite this, no supplier on the market appears to provide a foldable, backlit UK QWERTY keyboard (which this guideline recommends is the most suitable for frontline use).



Forces are recommended to engage with manufacturers to encourage the production of a United Kingdom QWERTY keyboard design that is back lit and foldable. This message should be reinforced by Police ICT Company on behalf of forces.

6. Technology specification and features

6.1 Connection type

Peripheral keyboards currently available are either wired or wireless. Many wireless keyboards can also be connected via a USB cable, so can be used even when a wireless connection is not available. Wireless keyboards tend to be more expensive than wired keyboards.

6.1.1 Wired

Wired keyboards are cheaper than their wireless counterparts. They are compatible with all devices with a standard full size USB connection and are most often plug and play (if drivers are required they are easy to install). Wired keyboards connect to devices via a USB cable. Mobile devices, such as smartphones, do not have full size USB ports and therefore require an adapter, either USB-to-Micro-USB or a USB-to-USB-C, depending on the device. Adapters add clutter to what should be a portable device. A further disadvantage of a wired keyboard is that the connecting cable is susceptible to wear and tear. Additionally forces should consider the ligature risk associated with the cables. However, wired keyboards have the advantage of providing a secure connection so that keystrokes cannot be intercepted (as they potentially could be with wireless keyboards).

It is recognised that some forces do not permit the use of USB ports for anything other than the provision of power. Therefore if USB adapters are required forces are recommended to ensure that they are permitted in line with force security policies.

6.1.2 Wireless

Wireless keyboards transmit information over the air, which creates an often overlooked security vulnerability. There are two main types of wireless keyboard: Radio Frequency (RF) and Bluetooth. Wireless keyboards may also use infrared (IR), but these are becoming less common and so have been excluded from this guideline. Historically, RF keyboards were cheaper than Bluetooth, but today they are roughly the same price.

Radio Frequency (RF)

- RF, like any wireless transmission, can be vulnerable to keystroke interception. This vulnerability can be overcome by selecting RF keyboards that have the protection of Advanced Encryption Standard (AES) security. AES is one of the most secure encryption standards available and is used by many governments and financial institutions to protect confidential data.
- RF wireless keyboards have a wireless signal that typically operates in the range between 27MHz and 2.4GHz, with many of those currently available using frequencies centred on 2.4GHz. A RF keyboard consists of two parts, a transmitter, and a receiver. The radio transmitter is inside the keyboard. A full-sized USB dongle acts as a receiver plugged into the device you want to



connect. Mobile devices, such as smartphones, do not have full size USB ports and therefore require an adapter, either USB-to-Micro-USB or a USB-to-USB-C depending on the device. Adapters add clutter to what should be a portable wireless device. Many mobile devices do not have the required hardware to support USB adapters either. Therefore, RF keyboards are not widely used as peripherals for mobile devices.

Bluetooth

- Bluetooth keyboards are compatible with all the leading operating systems such as Android, iOS, Linux, MacOS, and Windows. Bluetooth is an open standard for short-range radio frequency communication that was created specifically for peripheral devices such as headsets and keyboards. Bluetooth sends and receives radio waves in a band of 79 different frequencies (channels) centred on 2.45 GHz.
- Bluetooth keyboards connect to a device without the need for a USB receiver. Instead the connected device must have Bluetooth hardware installed. Bluetooth devices must then be “paired” with each other before they can communicate. This involves making them discoverable and, if required, entering a correct PIN. The pairing process works with “Bluetooth profiles”, and each device has to be compatible. It is only necessary to pair Bluetooth devices on first use - once paired they should automatically discover each other by default. Bluetooth keyboards can be connected to non-Bluetooth devices with the use of a Bluetooth adapter. Bluetooth keyboards can also be paired with multiple devices.
- Devices connected via Bluetooth wireless technology can be at risk from various wireless networking threats, as well as Bluetooth specific attacks that target known vulnerabilities in the Bluetooth architecture. These attacks can provide the instigators with both unauthorised access to confidential information being transferred via Bluetooth and the ability to access data on the device, or on other systems and networks to which the device is connected.
- Every device must operate in one of the security modes defined by the Bluetooth specifications. Bluetooth devices that are version 2.1 or higher are able to reach a higher security mode and are therefore more secure. For Bluetooth low energy devices, version 4.2 upwards provides higher security.



It is recommended that forces consider Bluetooth wireless keyboards as they are compatible with most smartphones and tablets without the need for a USB adapter (as would be required with a wired or RF keyboard).

It is recommended that forces consider Bluetooth keyboards that are version 2.1 or higher as these provide the strongest security. If considering a Bluetooth keyboard with low energy functionality then version 4.2 or higher is recommended.

For further guidance on RF and Bluetooth connection, see [FDM's Connection Types guideline](#).



6.2 Power source



Wired keyboards take their power from the connected device and as such do not require their own separate power supply.

The majority of wireless keyboards require batteries to provide their power. Wireless keyboards typically use either alkaline batteries (AA or AAA) or rechargeable lithium batteries. Alkaline batteries tend to provide more battery life than lithium batteries, with some keyboard manufacturers advertising a battery life of up to two years (on one set of two AAA batteries). Keyboards with rechargeable lithium batteries can provide a battery life of up to six months on a single charge. These keyboards come with a Micro-USB or a USB-C cable for charging.

Many of the wireless keyboards on the market currently have a dedicated on/off switch and will automatically go into “sleep mode” after a period of inactivity. Many models also have an LED indicator that displays how much charge is remaining.

If selecting a wireless keyboard it is recommended the keyboard should have a dedicated on/off switch and sleep mode to conserve battery power when it is not in use. It is further recommended that keyboards have an LED indicator so that officers and staff can clearly see the remaining battery, preventing situations where keyboards run out of charge mid-shift. It is also recommended that keyboards requiring alkaline batteries are selected, since they have a longer battery life compared to rechargeable batteries and do not require a recharging cable that could conceivably be lost or damaged.

6.3 Layout

Keyboards have a particular layout, comprising the specific mechanical, visual and functional arrangement of the keys. The mechanical layout is the placement of the keys on the keyboard; the visual layout is the arrangement of the legends, such as labels, markings or engravings that denote what each key does; and the functional layout is the arrangement of the keyboard mapping determined in the software of the keyboard.

There are two types of key arrangement for keyboards: QWERTY and Non-QWERTY. QWERTY is the global standard keyboard that it compatible with all operating systems.

The Dvorak layout is the most popular Non-QWERTY keyboard. It has been designed to reduce finger movement offering ergonomic benefits. Despite claims that the Dvorak layout can improve the speed and accuracy of a user’s typing, the layout is not currently used in policing and nor is it widely used in the consumer mobile device market. The introduction of peripheral Dvorak keyboards on the frontline would present huge training requirements due to its unfamiliarity. It is likely that officers’ and staff members’ user experience would be poor and adoption low.



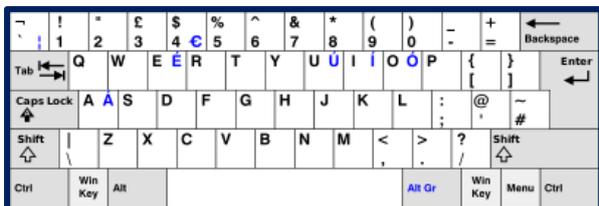


Figure 3 – QWERTY UK keyboard

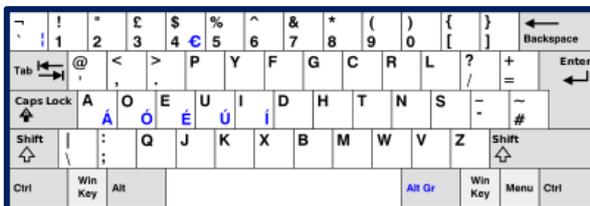


Figure 4 - Dvorak UK Keyboard

Some forces have purchased United States QWERTY keyboards and have found them to be very difficult to use. This is due to the number of differences between a United States and a United Kingdom keyboard. The key differences 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.

A keyboard with a United Kingdom QWERTY layout is recommended to ensure high user experience and adoption due to familiarity with this layout.

6.4 Key type

Keyboards can be classified by the switch technology that they use. Alphanumeric keyboards typically have 80 to 110 durable switches, generally one for each key. The choice of switch technology affects key response (the positive feedback that a key has been pressed) and pre-travel (the distance needed to push the key to enter a character reliably), determining user experience on the keyboard.

Key types for frontline use should offer both a good user experience and avoid the ingress of dirt. Minded of the environments in which officers and staff often work, such as the homes of members of the public, keyboard keys should ideally be as quiet as possible for use in these sensitive environments. There are many kinds of keyboard switches, but dome, scissor, mechanical and butterfly switches are the most common.

- *Dome-switch*
Dome-switch keyboards bring two circuit board traces together under a rubber or silicone keypad. When a key is pressed, it collapses the dome, which connects the two circuit traces and completes the connection to enter the character. Less expensive keyboards typically use dome switches, such as those included with pre-built PCs. The switch type tends to produce a less precise feel. Dome switch keyboards use taller keys and require greater travel distance to register a key press.

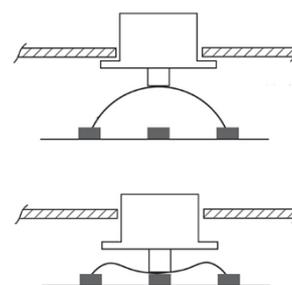


Figure 5 – Dome-switch



- *Scissor-switch*

Scissor-switch keyboards are a variation of the dome-switch design. The keys attach to the keyboard via two plastic pieces that interlock in a scissor-like “X” shaped fashion, and snap to the keyboard and the key. This mechanism links the keycap to a plunger that depresses the rubber dome with a much shorter travel than the typical dome-switch keyboard. Typically, scissor-switch keyboards provide a snappier feel with more precision, and they are usually quieter and require less force. They are often found on the built-in keyboards on laptops and keyboards marketed as “low-profile”. Because of their low profile scissor-switch, the keys are also resistant to the ingress of dirt.

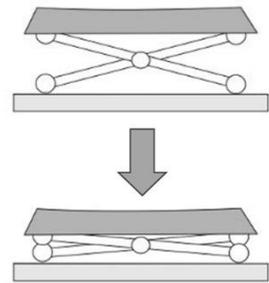


Figure 6 – Scissor-switch

- *Mechanical-switch*

Mechanical-switch keyboards use metal springs that are depressed when a user presses a key. Switches come in three variants: linear with consistent resistance; tactile with a non-audible bump; and clicky, tactile with an audible click. Depending on the resistance of the spring, the key requires different amounts of pressure to actuate. Mechanical-switch keyboards are popular among high-volume typists because of their precise responses and robustness.

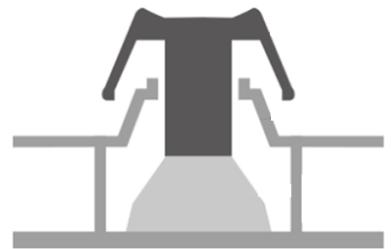


Figure 7 – Mechanical-switch

- *Butterfly-Switch*

Buttery-switch keyboards are so called because the keys look like a butterfly’s wings. While the scissor-switch has two crossing supports, the butterfly key has a hinge in the middle. Another way of putting it is that the scissor switch has an “X” shape, while the butterfly key is closer to a wide “V”. It is a thinner mechanism and is reputed to be the most enjoyable with which to type. However due to the butterfly key’s “V” shape, it is much easier for food, debris, and general dirt to get underneath the mechanism — something that is better prevented from happening with an “X” shape.

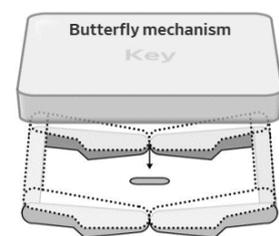


Figure 8 – Butterfly-switch

It is recommended that forces consider low-profile scissor-switch keyboards, which provide a good user experience and prevent the ingress of dirt better than other keyboard types. Scissor-switch keys are also quieter and so better suited to sensitive environments where loud key clicks could be inappropriate and distracting.

6.5 Form

The body type of keyboards for frontline use should offer the ability for an officer or member of staff to use the keyboard both at a desk and on their lap. Many keyboards on the market are designed to be fully portable, some examples include:

- *Foldable keyboards*

Foldable keyboards are typically made from plastic or aluminium and fold with the help of hinges, either vertically or horizontally. They can fold in half or in thirds. On some foldable keyboards, the third section is a touch pad, which officers and staff report that they find very useful. It is important to note that not all foldable keyboards come with a locking mechanism, which would be necessary to allow effective use if wanting to use the keyboard on your lap.



Figure 9 – Foldable Keyboard

- *Flexible keyboards*

Flexible keyboards tend to be made from silicone rubber and as the name suggests, they are designed to bend and flex without breaking. This flexibility allows them to be rolled into a compact size for portability and the silicone material makes them water and dust proof. They typically contain a full arrangement of keys, although the distance between the keys is typically shorter than that of a traditional keyboard. In order to function properly, these keyboards need a hard, plain surface, such as a desk.



Figure 10 – Flexible Keyboard

- *Projection keyboards*

Projection keyboards project an image of a virtual keyboard, usually with a laser, onto a flat surface. When a user touches the surface covered by an image of a key, the device records the corresponding keystroke. Some connect to Bluetooth devices, including many of the latest smartphones and tablets with Android, iOS or Windows operating systems. As the "keys" are simply projected images, they cannot be felt when pressed. Users of projected keyboards often experience increased discomfort in their fingertips because of the lack of "give" when typing.



Figure 11 – Projection Keyboard

Flexible and projection keyboards require a flat surface to function properly but frontline officers and staff often need to use keyboards on their lap, in the home of a member of the public or in police vehicles. It is recommended that forces consider foldable keyboards with a locking mechanism so they can be used on a person's lap. The locking mechanism should be fully tested prior to procurement.

6.6 Size and weight

The size and weight of a peripheral keyboard is an important consideration (if the intention is for personal issue) to ensure that officers and staff are comfortable carrying it on their person. Keyboards come in a range of different sizes and weights.

Peripheral keyboards generally do not have all the keys available that are on a full-sized keyboard so as to make them more compact and portable. Typically the number pad, normally found to the right of a full-sized keyboard, is absent. Additionally peripheral keyboards often do not have duplicate keys or other keys that are seldom used.

To ensure the keyboard does not add additional burdensome weight to what an officer or staff already needs to “personally carry” it is recommended that a keyboard weighs no more than 250grams. It is also recommended that to ensure the keyboard can fit comfortably into uniform pockets that it is no larger than 15cm x 10cm x 2cm when folded.

6.7 Other features

6.7.1 Backlit

A backlit keyboard contains a light underneath the keys. The backlight illuminates the letters and symbols on the keys to make them visible in low light environments. Usually, the backlight also illuminates the space surrounding the keys, which further enhances the visibility of the keyboard. Most backlit keyboards allow you to adjust the brightness levels.

Frontline officers and staff frequently require the use of keyboards in low light environments, for example when on night shift and working in stationary police vehicles. It is therefore recommended that forces select backlit keyboards.

6.7.2 Ergonomic

An ergonomic keyboard is designed to encourage users to hold their hands at angles that are more comfortable and that reduce muscle strain. These designs can range from simply changing a keyboard’s angle so that the hands and wrists remain at a natural angle to splitting the keyboard to keep the hands and wrists in a “V” shape. Research has found that ergonomic keyboards do not prevent typing injuries, rather they are useful to people recovering from injuries to their hands and wrists.

It is recommended that forces consider ergonomic keyboards for those officers and staff recovering from injuries or other health-related needs to their hands and wrists in line with their local Reasonable Adjustments policy.

6.7.3 Waterproofing

To mitigate unfortunate accidents, some keyboards are waterproof. Keyboards can come with an environmental proofing rating known as an Ingress Protection (IP) rating. An IP rating is used to define levels of sealing effectiveness of electrical enclosures against intrusion from foreign bodies (dust etc.) and moisture. The numbers that follow the letters “IP” each have a specific meaning: the first indicates the intrusion protection and the second defines the moisture protection.

While forces could benefit from having Ingress Protected rated keyboards, they tend to be heavier and more expensive. Given that forces report that when selecting cheaper peripherals they are less concerned about damage, it is recommended to avoid that additional expense and weight by selecting non- IP rated keyboards.



6.8 Price

Keyboards vary in price depending on the specification and features. Prices are most likely to be affected by the following:



- The connectivity mechanism of the device. Wireless keyboards tend to be more expensive than wired keyboards.
- Radio Frequency keyboards that have Advanced Encryption Standard (AES) security are more expensive.
- Backlit keyboards tend to be more expensive.
- Waterproofed keyboards tend to be more expensive.

A keyboard in the price range of £20 to £40 is recommended. Due to the circumstances in which keyboards would be used on the frontline and coupled with the fact many forces consulted do not repair damaged keyboards, devices above this price range are considered unlikely to deliver best value for money. Forces are also recommended to consider purchasing keyboards in bulk, which could reduce the price per unit.

7. How to get the best from the technology – Do’s and Don’ts

Advice on how you should and should not use your keyboard is detailed below.

DO’s	DON’Ts
<ul style="list-style-type: none"> ✓ Do avoid bending cables on wired keyboards. Do not place anything heavy on the cables to avoid stress which can cause cuts or breakage. ✓ Do try to press the keys softly. It helps prolong the life of keys and the characters printed upon them. ✓ Do use a lint free cloth when cleaning a keyboard to avoid scratching on the keyboard. ✓ Do take regular breaks when using a keyboard to prevent repetitive strain injury. 	<ul style="list-style-type: none"> x Don’t expose keyboards to moisture (if not spill proofed). The spilling of liquids can be very harmful. It can damage a keyboard’s internal circuit or can cause malfunctioning of the keyboard. x Don’t eat while sitting near the keyboard. Small pieces of food may fall and enter inside the circuit, which can result in stopping one or more keys from functioning. x Don’t type with sticky or oily hands as it may damage the characters printed on the keys. x Don’t use ethyl based alcohol to clean keyboards as it can cause harm to them.

Table 2



