Observations on the Trends of Mobiles Users: The Irresistible Trend of Multi-Screen Display

Ultimate Users’ Experiences: Multitasking + Multi-Functions + Eye Protection + Authentic USB Type-C

- A brief history of notebook computer
- Ultimate users’ experiences in the time of multi-screen display
- The popular use of USB Type-C in the time of multi-screen display
Introduction

People are surrounded by all sorts of “screens” in daily life. Limited by physical space, using “small screens” on smartphones, laptops, and more, on a short-term basis may cause visual fatigue. Worse, when using them on a long-term basis, it may even bring permanent injuries to your vision, neck, and shoulders.

In the era of multiple screens, the demand of a professional and large monitor with the following advantages is increasing:

- **Multi-link screen display and optimal multi-task experience**: It promotes productivity greatly. In regular copy editing, it boosts up at least 20% of the output.
- **Wider viewing angle display, high definition, and wide-gamut**: It creates a realer visual immersion experience.
- **Ergonomically friendly**: It comes with many eye-protecting technologies, allowing people to enjoy healthier internet and high-tech life.

In addition, its strength is that it comes with a “full-fledged” USB Type C port, bringing users to another level of using experience: Humanized port design, it makes using it more convenient. Bi-directional power supply and two-way fast charging, high speed data and audio-visual transmission, and more, it needs just one cable to enable multi-link screen display, simplifying complicated process.
# Table of Contents

## A Brief History of the Notebook Computer Market

- Current Conditions of the Market of Notebook Computers 2
- Transformation of Display Screens 3
  - Professionalization of Screen 3
  - Prevailing Trend of Multi-link Screen Display 3

## Ultimate Users’ Experience in the Age of Multiscreen

- Analysis of the Advantages of the Multiscreen Era 4
  - Visual Pleasure of Large Display Screen and Smooth Multitasking Experience 4
  - Multi-Screen Applications Promote Efficiency and Double the Productivity 4
  - Professional Display Screen Is More Ergonomically Friendly 5

- Reflections on the Multiscreen Era 5
  - Health Crisis Caused by Multiscreen Convenience 5
  - How Can Users Protect Their Vision in the Multiscreen Era? 6
  - Suggestions to Multiscreen Configuration 6

## In the Multiscreen Era, USB Type-C Will Become More Common

- The Advantages of USB Type-C in the Multiscreen Era 7
  - Easy to Use and Convenient 7
  - Two-Way Power Supply and Fast Charge Support 8
  - High Speed Data and Audio-Visual Transmission 8

- Applications of USB Type-C on Professional Display Device 9
  - An Analysis of Supports of USB Type-C Equipment 9
  - An Analysis of the Competitiveness of USB Type-C 9
  - An Analysis of the Applications USB Type-C 9
The Current Situation of the Notebook Computers Market

Launched in 1975, notebook computer’s total sales has exceeded desktop computer since 2009 because of its convenience and enhancing functions when compared with desktop computers. It has replace desktop and become the major force in the PC market. In the Past 30 year, with the launch of new technologies, manufacturers can provide notebooks that are lighter in weight, smaller in size and with more powerful functions. Due to economic crisis and the rise of smartphones, the demand of notebook computers is decreasing. Fortunately, as the main force of PC market, overall sales has been turn around after years of negative growth.

According to the statistics of the Ministry of Industry and Information Technology of the People’s Republic of China, 290,090,000 microcomputers were manufactured in 2016. From January to February 2017, 37,130,000 microcomputers were manufactured, at the decrease of 1.1%. Among them, there were 22,480,000 notebook computers, at the growth of 11.5%; and 9,120,000 tablet computers, at the decrease of 24.5%.

<table>
<thead>
<tr>
<th>Average in January and February (2016)</th>
<th>Average in January and February (2017)</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>August</th>
<th>September</th>
<th>October</th>
<th>November</th>
<th>December</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1843</td>
<td>1856</td>
<td>2514</td>
<td>2092</td>
<td>2282</td>
<td>2385</td>
<td>1976</td>
<td>2318</td>
<td>2942</td>
<td>2812</td>
</tr>
</tbody>
</table>

Table 1 Monthly Production of Microcomputer Since 2016 (Ten Thousand)

Source: Bureau for Performance Inspection & Coordination, Ministry of Industry and Information Technology of the People’s Republic of China(1)
Evolution of Monitor

Professionalization of Monitor

With the increasing demand of notebook computers in the market, people’s requirements on computer monitor are getting more refined, personalized, and professionalized. For example, the consumers working in fields that require high professionalism, such as monitoring, medical, financial, and game businesses, especially, busy stock investors need professional monitors to help them accomplish their works. Simply speaking, the function of a monitor is to display graphics and colors accurately. The major difference between consumer monitor and professional one is that a professional monitor can restore the original colors. They cover wider gamut. The wider the color gamut, the more colors can be displayed, showing better images. It is beyond the capacities of regular consumer class monitor.

It should be noticed that although professional monitors are powerful and functional, they are expensive. It is advised that consumers analyze their needs before purchasing. Especially, for professional class monitors, people demand higher on the hardware specifications. For example, in the e-sports industry, in addition to the comfort in using, it is necessary to consider their speed, accuracy, and reliability, which requires much higher than regular products. Therefore, when installing a monitor at an e-sports class, it is suggested to consider its refresh rate and resolution (such as higher refreshing rate to renders harper and crisper graphics,) in order to maximize players’ accuracy during contests.

Prevailing Trend of Multi-Screen Display

As monitors are becoming more professional day by day, the tradition of the application of monitors on desktop computers has shifted. It is connected to notebook computer to provide dual-screen or multiscreen display. Many consumers choose to purchase professional monitors at home or workplace.

At present, we are surrounded by all sorts of screens. In the multiscreen era, different people interpret it differently. Tracing the origin of “screen” – from single screen to dual screen, and to multiscreen today, we have entered the age of information exchanging and sharing through screens on smartphones, computers, tablet computers, TV and more. Satisfying the demand of human machine interface, people begin to pursue after higher quality multiscreen experience.

The era of multiscreen can be interpreted as the exchange among multiscreen and multi-terminal devices (smartphones, tablet computers, desktop computers, and notebook computers) and more. According to current development, because of portability, small screens are becoming consumers’ favorites. Meanwhile, increasing number of people tend to buy one or few extra professional monitors at home or offices. To a certain extent, although large screens are not portable, they provide higher productivity at home and at offices. In addition, they come with eye-protection functions too. Likewise, they work well with small display screens to become mutual-dependent bringing excellent users’ experiences.
The Advantages of the Multiscreen Era

From dual screen (TV and computer), to three-screen (TV, computer, and tablet computer), four-screen (TV, computer, tablet computer, and smartphone), and notebook computer, the use of screens has developed from one to many. As the advantages of multiscreen display are discovered, people that are getting used to work on multiscreen, swapping among monitor of different sizes, find it uncomfortable to working on a single monitor on notebook computers.

From the use of single display screen on a notebook computer to the applications of dual screen to even multiscreen, what are their advantages? Considering from the perspective of word processing, audio-visual entertainment, there are three advantages:

### Visual Pleasure of Large Display Screen and Smooth Multitasking Experience

The sizes of mainstream monitors fall between 21.5 to 27 inches. Compared with small display screen on notebook computers – 11-15.6 inches, there are bigger space coverage and broader viewing angles to provide users with live-like feelings. In addition, the resolution of regular monitor is 1080P. And, monitors with 2K and 4K resolution are emerging in the market rapidly. The color rendering index (CRI) of some of the high-ends models reach 1.07 billion, providing richer colors and more delicate image quality. In both work and entertainment, users can experience the visual pleasure that a single notebook cannot provide.

In addition, multi-window and multitasking functions allow large display screens to have opportunities to expand their functions further. At present, some notebook computers allow users to connect extra screens to actualize the goal of multi-link screen display. It makes multitasking easier, bringing users’ unprecedented visual pleasure of watching large screens and smooth multitasking experiences.

### Multi-Screen Applications Promote Efficiency and Double the Productivity

In a single screen operation environment, how do most users search websites and create documents? Normally, they either switch between windows using hotkeys or minimize windows to display many windows on the same screen. In the first mode, they waste time in swapping among windows. Users need to spend time in returning to the original visual point. And they need to track back to the previous window by gliding the mouse’s pointer. Comparing with the time wasted in the first mode, although user can watch two or more windows at the same time, bound by the physical dimensions of a single screen, they need to switch among windows repeatedly on a small screen. It is not only time wasting but also eyes exhausting to operate in such a complicated manner. It also lowers productivity significantly. It saves the trouble of switching back and forth between screens when using more than two. In addition, they can view many windows at the same time. According to the experiment conducted by researchers at Utah University, it indicates that the operation mode of two screens or multiscreen can promote about 20% of productivity in regular word processing. On the evaluation of easy to use, testees feel it to be effective, comfortable, productive, and easy to trace their works when working on two screens. They also feel positive in the concentration at work and the retrieve of data. In editing and comparing many documents, searching information online, writing new documents, or tracing massive data, such as stock marketing information and graphics processing, users can obtain perfect experiences when working with two screens or multiscreen.
Professional Monitors Tend to be Ergonomically Optimized

In addition to convenience in operation, most users choose to purchase a second display screen mainly because of the elevation of health consciousness. Limited by the structure of notebook computer, its design is regulated. It is unable to adjust the monitor’s height. About its design, it is not user-oriented. According to medical report, display screens should be place at the height of the eyes to avoid bending the head forward bringing harm to the cervical vertebra. Substantially speaking, when people use computers, it is suggested to place the monitors from 40 cm (for short-sighted people) to 74cm (regular sighted people) in front of users. The horizontal sightline is preferably 15 degrees to the center of the monitor and 30 degrees from the bottom of it. The monitor should not be too low to avoid bending the head down.

At present, notebook computer stands and adjustable notebook computer tables in the market are effective ways to adjust the height of monitors. However, bound by the size of the screens of notebook computers, the viewing distance between operator’s eyes and the screen is still a difficult issue. Considering it, ergonomic design stands provide solutions to adjust the height and turn the angles of screens freely. It is effective in soothing the burden of users’ eyes and shoulders.

Reflections on the Multiscreen Era

Health Crisis Caused by Multiscreen Convenience

As mentioned above, the trend of multiscreen brings people convenience in daily life. However, staring at the screen for a long time brings health alerts to people. As people’s health awareness is getting stronger, most of them tend to choose professional monitors.

The most direct harm brought by display screens is short-sightedness. When the crystalline lenses are exposed to high refraction condition for a long time, it will cause irreversible loss of visions. In fact, the harms brought to us are more diverse and complicated than we can imagine. For example, over or insufficient brightness or unsuitable contrast on screens will cause certain degrees fatigue to eyes. When such conditions persist for a certain period, it will cause computer vision syndrome (CVS).

According to Wikipedia, “Computer vision syndrome (CVS) is a condition resulting from focusing the eyes on a computer or other display device for protracted, uninterrupted periods of time. Some symptoms of CVS include headaches, blurred vision, neck pain, fatigue, eyestrain, dry eyes, irritated eyes, double vision, vertigo/dizziness, polypia, and difficulty refocusing the eyes. These symptoms can be further aggravated by improper lighting conditions (i.e. glare or bright overhead lighting) or air moving past the eyes (e.g. overhead vents, direct air from a fan).”

According to the statistics of National Institute for Occupational Safety and Health, people that spend three hours or more in working on computers, about 90% of them may suffer from CVS. Moreover, a research is conducted in Malaysia that interviewed 795 college students at the age from 18 to 25. Most of them suffer from the symptoms of headache and eyestrain. And about 89.9% of them feel that they have CVS symptoms.

A report reveals that, adults in United States spend around 10 hours and 39 minutes each day in media (including TV, laptop, smartphone and tablet). A dramatic increase in screen time is also occurring among children. Moreover, the time spending in staring at display devices is increasing. More worrying, the age of using computer for the first time is decreasing gradually. The eye protection functions in monitors are no longer optional issues but standard issues.
Ultimate Users’ Experience in the Age of Multiscreen

How to Maintain Visual Health in the Multiscreen Era?

It is known that the short wave blue light in the backlight of LED display screen and the flashing of screens will bring eyestrain and permanent damages to eyes. When monitors were developed in the primary stage, to achieve high resolution and sharper and clearer graphics, manufacturers tended to overlook users health. As the technology of display device has become mature, many manufacturers are endeavoring in poducing concept display device with “eye protecting technology.” In the past couple of years, it is becoming more mature. Some manufacturers begin to promote blue light filtering technology. For example, the use of LED backlight and fluorescent powder can decrease the discharge of harmful shortwave blue light without affecting the quality of graphics. In addition, the splash screen technology allows the display device to maintain the smoothness and clearness of the screens. At the same time, it will be healthier for users to choose ergonomic friendly monitors because it is helpful to the health of the vision and spinal cord. It helps alleviate users’ eye strain and fatigue and decrease their eyes’ burden.

Suggestions to Multiscreen Configuration

The Top of Screen Should be in Line with Eye’s Level

The distance between the screen and the eyes should be 40-74 cm

Fig. 2 Illustrations on Multiscreen Configuration

Fig. 3 The Suggested Distance and Angle When Using Display Devices
In the Multiscreen Era, USB Type-C Will Become More Common

The Advantages of USB Type-C in the Multiscreen Era

Easy to Use and Convenient

The physical size of Type-C port is much smaller than any other port. It just needs a cable to accomplish the tasks of charging, and transmission of Class 1 data and audio-visual materials transmission. And traditional power cords, data transmission cables (such as USB cables) and audio-visual cables (such as VGA or HDMI cables), all three of them, will be replaced by just one Type-C cable. In addition, Type-C port supports reversible connector shape, with higher mechanical strength. It is not necessary to worry about plugging in the wrong way. Or break the pins because of plugging in and out repeatedly for a long time.

In other words, USB Type-C acheives the goal of connecting all existing devices, such as desktop computer, notebook computer, professional monitor, smartphone, tablet computer, and many other accessories. All of them can share just one cable, one port, and one charging, providing maximum application convenience.
Two-Way Power Supply and Fast Charge Support

USB Type-C supports USB PD protocol that can reach the maximum of 100W. It is 10 times of current USB BC1.2 (the USB Battery Charging 1.2 Compliance Plan announced in 2010) of power supply capacity. It can be charged and act as a charger providing fast charging. The two-way high-power electricity supply provides electricity without interruption. Substantially speaking, enhanced USB charging standard – BC 1.2 supply the charging currents up to the maximum of 5V 1.5A. However, when smartphones consume 3000 mA or above appear in the market, BC 1.2 can no longer satisfy their needs. If we want to support the power supply of most of the notebook computers in the market. The output power should reach 45W or higher.

And USB PD function is the major appeal of USB Type-C. USB PD (USB Power Delivery) uses a USB port to accomplish the standard of supplying 100W of electricity. It is also high voltage and high electric current tolerant. The electricity supply in this standard contains five “specifications” 10W, 18W, 36W, 60W, and 100W. The rated voltages are 5V, 12V, and 20V. The rated currents are 1.5A, 2A, 3A, and 5A. In other words, it supports USB Type-C in USB PD protocol. Its flexible configurations allow two-way power supply to most of the smartphones, tablet computers, digital cameras, notebook computers, external hard drives, game consoles, and more with just one USB cable.

High Speed Data and Audio-Visual Transmission

USB Type-C supports USB 3.1 Gen2 data transmissions. It reaches 10 Gbps at the maximum speed, more than enough to match with a 4k screen. Corresponding to Thunderbolt 3, it reaches up to 40 Gbps that is enough to match with two 4K screens or one 5K screen. In addition to transmitting files, USB Type-C can also output pictures when connecting with a monitor. At the same time, it supports two forms of display standards DisplayPort and HDMI USB Type-C. Moreover, the output pictures are two-way transmission. For example, at one side it connects with smartphones; and on the other side, it connects to a TV. It enables the pictures on the smartphone to be seen on the TV or the other way around.

It should be noted that although Type-C port has already become a trend in the market development, not all devices equipped with Type-C port possess the advantages above. In fact, Type-C is just a physical form of a port. Only Type-C ports that meet the standard specifications, support related transmission protocol, with compatible transmission specifications and with transmission cable at similar standard that is able to accomplish the tasks of power supply, and data and audio-visual transmission with one cable. Therefore, when consumers choose a monitor, they are highly suggested to confirm the technical specifications of Type-C port. At present, many products that come with Type-C USB ports only function to charge power and transmit data transmission, unable to transmit audio-visual signals. It should be noted that some inferior products may also harm the equipment. For example, in 2016 Amazon stopped selling some Type-C cables that did not meet with the specifications. It was because some incompetent manufacturers produced cables with improper wiring and coarse connection points. When transmitting data with them, they damage the equipment. Therefore, when choosing cables, it is highly recommended to choose products made by reputed manufacturers to protect the equipment.

In the Multiscreen Era, USB Type-C Will Become More Common
Applications of USB Type-C on Professional Monitor

An Analysis of Supports of USB Type-C Equipment

USB Type-C mainly applies on smartphone, tablet computer, and notebook computer. At present, USB Type-C has replaced all the applications in USB port. USB Type-C is tiny, possible to be equipped in computers and smartphones, and even small accessories. It is foreseeable that this whole new port will be installed in smartphones, tablet computers, multimedia display screens, TVs, external drives, mobile powers, multimedia ports in vehicles, game consoles, and more to be released in the future.

According to the prediction of IHS, a leading US supplier for key information, products, solutions, and services, in the future electronic devices with built in USB Type-C port will grow very rapidly. In three years’ time, it is expected to reach the capacity of about 2 billion. In addition to data transmission, the USB port also has a very important function – power transmission, aka fast charging. Therefore, with the expansion of USB Type-C market, USB-PD, a smart power protocol based on USB Type-C will also grow speedily.

MacBook is a notebook computer model that supports USB Type-C. Considering that PC manufacturers paid tributes to new Apple computer models after their release in the past, it is estimated that USB Type-C will appear very soon in the next generation of notebook computers.

An Analysis of the Competitiveness of USB Type-C

Type-C is only a particular USB specification. In fact, there are many USB specifications. At present, there are three kinds in total: Type-A (Standard-A), Type-B (Micro-B), and Type-C. Type-A is the most common used USB standard, generally equipped in personal computers. Through this port, users can plug in mouse, keyboard, flash drive, printer, and more to computers for operations. In fact, Type-B is smaller than Type-A, more frequently seen on Android smartphones. It is also frequently seen on mobile HD, printer, monitor, and more. The support rate of Type-C has already mentioned above. It supports all sorts of Type-A and Type-B equipment.

It can be said that Type-C is the product of current trend, possessing a few major advantages – higher transmission speed, higher power, faster charging, single port that supports many protocol... It is the future trend of the industry. At present, the market price of USB Type-C and the accessories supported by it have improved significantly. Regarding its common applications, it is just a matter of time. Especially, many transmission protocol organizations have given up the ports developed by them. Instead, they begin to support USB Type-C (for example the new generation of Display Port and Thunderbolt). Its competitiveness is beyond doubt.

An Analysis of the Applications USB Type-C

At present, some leading enterprises have already introduced USB Type-C specifications. They also propose the solution of “one cable connects to USB Type-C for full functions.” It suggests that Type-C port can provide the three-in-one function of power supply, data and audio-visual transmission, fully developing all functions of USB Type-C. In the domain of USB Type-C, Lenovo’s deployment is quicker. Recently, it has already launched a few models of notebook computers and monitors with full Type-C support. Lenovo has also been a longtime collaborative manufacturer of UL, a leader in testing and certification in the world. USB Type-C port has already become a standard issue in all the monitor it manufactures. With the built-in functions of standard USB charging, data transmission, and monitor output, it interfaces with many external equipments, providing convenient and speedy connection.

Notebook Computer Charging, Audio Signal Transmission, Video Signal Transmission, Files Transmission, USB Expansion

Fig. 5: One Cable Connects All; Features of All-Function Type-C Product
Conclusion

Due to the promotion of consumers' health conscious, the traditional “small screen” has already upgraded to “large screen” that is more efficient, higher in productivity, better in visual quality, safer for the eyes, and better in using experience.

At the same time, USB Type-C is faster in transmission speed and charging, and provides higher power, supportive for many protocols with just one port. In the future, it will become the trends of development in the industry.

However, due to the lack of industry standard and the best code of practice, Type-C products uneven in quality are abundant in the market. Those products that support the “specification of the port” only are “fake” Type-C products with insufficient power supply, unable to accomplish the expectation of “one cable connection” for all. Moreover, they will bring many troubles. To a lesser end, due to insufficient data transmission, it cannot support HD output, unable to charge devices with small display screen, and more. Worse, it may damage devices because of abnormal charging.

In order to protect the ultimate user experience of multiscreen applications, UL provide the following suggestions to consumers when purchasing Type-C devices:

1. **Choose monitor tested and certified by authoritative organizations, bearing safety marks**
   
   Safety is the uncompromising basic needs for users. Most countries demand products to meet the national class safety requirements and certification to lessen the risks of electric shock and flame causing. For example; the 3C certifications in China and UL certification for products export to the US, and more.

2. **Make sure the labeled functions of monitors are tested and certified by the third party**
   
   When purchasing monitor, consumers need to pay attention to the features of the products, such as color rendering, angle of view, and more to see if they are tested and certified by the third party, not just announced by manufacturers.

3. **Choose eye-protecting monitor tested and certified by an independent third party**
   
   Consumers are recommended to choose monitors with ergonomic design and eye-protecting functions to minimize eye injuries. And they should make sure these announced functions are tested and certified by independent third parties or independent testing organizations.

4. **Make sure the monitor with USB Type-C is fully functional**
   
   Devices equipped with USB Type-C ports do not mean that they provide all the Type-C functions discussed above. Before buying related products consumers should confirm if the port supports the protocols announced by the manufacturers. It is necessary to pay attention that the power supply should reach 45W to the least to satisfy the power supply by most notebook computers in the market.

All in all, regarding the product functions, specifications, eye protecting functions announced by the manufacturers or in ads, if they lack the testing and certifications of the third party, it is not convincing to consumers.

For years, UL has already expanded its testing capacities to the listing mark, efficiency mark, ergonomic (eye-protection) mark of Type-C monitor. In addition, it also launches the certifications of power brick, power delivery, e-Marker, cable, and connectors.

Recently, UL is endeavor in developing new standards for the blind spot of Type-C industry to ensure users enjoy the easy-to-use and convenience of Type-C port. Moreover, regarding the issues concerned by consumers mentioned above, UL will explore further in later reports to continue provide professional suggestions.

---

**About UL**

UL fosters safe living and working conditions for people everywhere through the application of science to solve safety, security and sustainability challenges. The UL Mark engenders trust enabling the safe adoption of innovative new products and technologies. Everyone at UL shares a passion to make the world a safer place. We test, inspect, audit, certify, validate, verify, advise and train and we support these efforts with software solutions for safety and sustainability.

For more information, please visit: China.ul.com
(1) "Operation conditions of electronic manufacturing industry in 2016 and 2017."
Bureau for Performance Inspection & Coordination.
http://www.miit.gov.cn/n1146312/n1146904/n1648373/index.html


(3) “Positioning the Monitor”, CCOHS (Canadian Centre for Occupational Health and Safety) posting, August 4, 2009
https://www.ccohs.ca/oshanswers/ergonomics/office/monitor_positioning.html

(4) "Computer vision syndrome", Wikipedia,

(5) "How the World Consumes Media—in Charts and Maps", Derek Thompson posting, May 28, 2014

(6) "Digital Overtakes Traditional Media in China, but TV Consumption Holds Strong" eMarketer posting, April 27, 2016

(7) "The USB Type-C Revolution: Increased Bandwidth, Increased Power and Alternate Modes", Brian O’Rourke, Sr. Principal Analyst, Consumer Devices/ MEMS & Sensors, 2015

(8) "USB Type-C Overview", USB Developer Days, October 19, 2016
http://www.usb.org/developers/presentations/USB_DevDays_Hong_Kong_2016_-_USB_Type-C.pdf

(9) https://thunderbolttechnology.net/consumer/