

# **Individual Project Report**

## **Xbox Series X**

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# 1. Introduction

## 1.1. Product Evolution

Xbox is a video gaming brand created and owned by Microsoft. The brand consists of five video game consoles, as well as applications (games), streaming services, an online service by the name of Xbox network, and the development arm by the name of Xbox Game Studios.

The brand was first introduced in the United States in November 2001, with the launch of the original Xbox console.

Microsoft's second console, the Xbox 360, was released in 2005. The third console, the Xbox One, was released in November 2013. The fourth line of Xbox consoles, the Xbox Series X and Series S, were released in November 2020.



Fig. 1. Xbox Evolution

The Xbox Series X/S are home video game consoles developed by Microsoft. They were both released on November 10, 2020, as the fourth generation Xbox, succeeding the Xbox One.

Along with Sony's PlayStation 5, also released in November 2020, the Xbox Series X/S consoles are part of the ninth generation of video game consoles.

The Xbox Series S is comparable in its hardware to the Xbox Series X, similar to how the Xbox One S relates to the Xbox One X, but has less processing power.

The price of Xbox Series X is NT\$ 15380 and Xbox Series S is NT\$ 9480.



Fig. 2. Xbox Series X/S

## 1.2. New Features/Technologies

As the fourth generation of Xbox, Xbox Series X/S has many new features and technologies, the new features are not only about hardware but also the software. Compare with third generation of Xbox “Xbox one X”, Xbox Series X has many new features.

The new features of hardware are including the new CPU, new GPU and faster GPU clock speed, bigger memory, higher memory bandwidth, video resolution can up to 8K@60fps, 4K@60fps(up to 120fps).

The new features of software are including Auto HDR, Auto Low Latency Mode (ALLM), DirectML, Quick Resume, Smart Delivery, game pass, X cloud, Variable Rate Shading (VRS) and Variable Refresh Rate (VRR)

## 2. Spec

In this part, I summarize and compare the spec of the Xbox Series X and Xbox one X. And Xbox Series X and Series S. Table 1 and Table 2 show the different spec between the different products:

Table 1. comparison between Series X and One X

	Xbox Series X	Xbox One X
<b>CPU</b>	8x Zen 2 Cores at 3.8GHz (3.6GHz with SMT)	8x Custom Jaguar Cores at 2.13GHz
<b>GPU</b>	12 TFLOPs, 52 CUs at 1.825GHz, Custom RDNA 2	6 TFLOPs, 40 CUs at 1.172GHz, Custom GCN + Polaris Features
<b>Die Size</b>	360.45mm <sup>2</sup>	366.94mm <sup>2</sup>
<b>Process</b>	TSMC 7nm Enhanced	TSMC 16nmFF+
<b>Memory</b>	16GB GDDR6	12GB GDDR5
<b>Memory Bandwidth</b>	10GB at 560GB/s, 6GB at 336GB/s	326GB/s
<b>Internal Storage</b>	1TB Custom NVMe SSD	1TB HDD
<b>IO Throughput</b>	2.4GB/s (Raw), 4.8GB/s (Compressed)	120MB/s
<b>Expandable Storage</b>	1TB Expansion Card	-
<b>External Storage</b>	USB 3.2 HDD Support	USB 3.2 HDD Support
<b>Optical Drive</b>	4K UHD Blu-ray Drive	4K UHD Blu-ray Drive
<b>Performance Target</b>	4K at 60fps - up to 120fps	4K at 30fps - up to 60fps

Table 2. comparison between Series X and Series S

Component		Series X	Series S
Processors	CPU	Custom AMD Zen 2 8 Cores @ 3.8 GHz (3.66 GHz with SMT)	Custom AMD Zen 2 8 Cores @ 3.6 GHz (3.4 GHz with SMT)
	GPU	Custom RDNA 2 52 CUs @ 1.825 GHz 12 TFLOPS	Custom RDNA 2 20 CUs @ 1.565 GHz 4 TFLOPS
Memory		16 GB GDDR6 with 320-bit bus 10 GB @ 560 GB/s, 6 GB @ 336 GB/s	10 GB GDDR6 with 128-bit bus 8 GB @ 224 GB/s, 2 GB @ 56 GB/s
Storage	Internal	1 TB PCIe Gen 4 custom NVMe SSD 2.4 GB/s raw, 4.8 GB/s compressed	512 GB PCIe Gen 4 custom NVMe SSD 2.4 GB/s raw, 4.8 GB/s compressed
	Expandable	0.5–2 TB expansion card (rear)	
	External	USB 3.1 external HDD support	
Optical drive		Ultra HD Blu-ray	None
Performance target		4K resolution at 60 FPS, up to 120 FPS	1440p at 60 FPS, up to 120 FPS
Dimensions	Size	301 mm × 151 mm × 151 mm (12 in × 5.9 in × 5.9 in)	275 mm × 151 mm × 65 mm (11 in × 5.9 in × 2.6 in)
	Weight	4.45 kilograms (9.8 lb)	1.93 kilograms (4.3 lb)

We can clearly see that the third generation and the fourth generation are very different. Series X has more faster CPU/GPU and bigger memory, and Series X size even smaller.

And in Series X and Series S, we can find that they use the same CPU but in different Ghz(Series X is 3.8Ghz and Series S is 3.6Ghz).In GPU part, Series X has better CUs(compute units), and bigger memory and storage

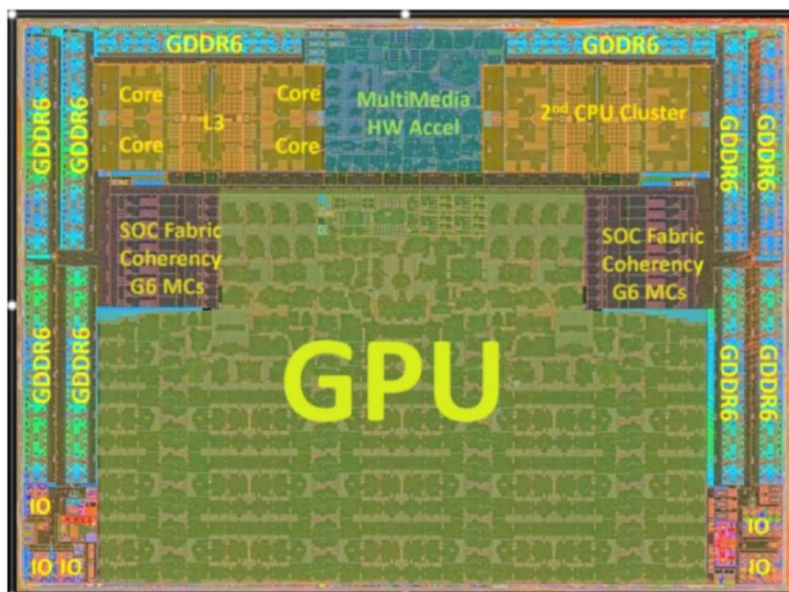
### 3. Technology Analysis

In this section, I will introduce the new technologies and its special structure and some applications in Xbox Series X. With the fourth generation console, Xbox Series X not only has a better hardware, it also has some special application to support, like Ray Tracing, Quick Resume, Smart Delivery, Xbox Game Pass and Xbox Cloud Gaming.

#### 3.1. SoC

Xbox Series X's SoC built on TSMC's N7 process node. The design has 15.3 billion transistors, measuring 360.4 mm<sup>2</sup>, with dimensions of 15.831 x 22.765 mm<sup>2</sup>.

Inside the chip are eight Zen 2 mobile cores, configured into two groups of four cores, each sharing 4 MB of L3 cache similar to AMD's mobile Renoir/Lucienne processors. These cores are connected through the Scalable Data Fabric to a custom RDNA-based GPU capable of 12 TFLOPS of peak performance, enabling variable rate shading, ray tracing, and other new graphical features. This GPU is built as a 56 compute unit design, however only 52 are used in the final product (more on this later).



Parameter	XBOX SERIES X
Technology Node	TSMC 7nm
Transistor Count	15.3B
Area	360.4 mm <sup>2</sup>
Package type	12 layer (5-2-5)
Package size	52.5 mm x 52.5 mm
Ball count	2963
Ball pitch	0.80 mm (minimum)

Fig. 3. SoC Die Photo and spec

And about the memory, the memory system features 16 GB of GDDR6 through 20 x16 channels. 10 GB of this memory is higher performance, enabling 560 GB/s of memory bandwidth for games, while the other 6 GB is of lower performance, at 336 GB/s of memory bandwidth, for games or circumstances where memory is not the limiting factor. This also enables a lower power state.

## XBOX SERIES X Block Diagram

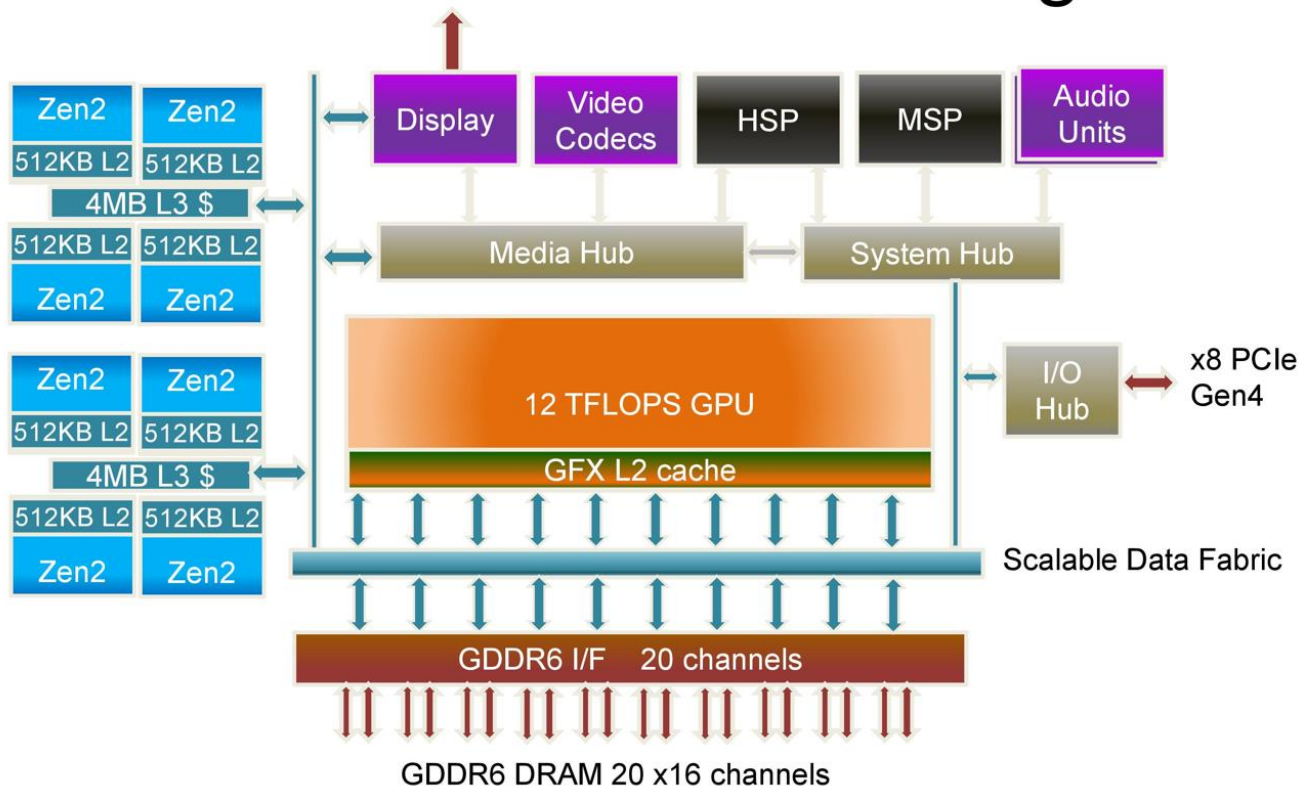


Fig. 4. SoC block diagram

Compared to the previous generation, Series X has better performance in everywhere. 3x the CPU performance, 2x the GPU performance, 1.7x the memory bandwidth, 2x the IO bandwidth.



## XBOX SERIES X SoC vs. XBOX ONE X (GPU/MEM/CPU)

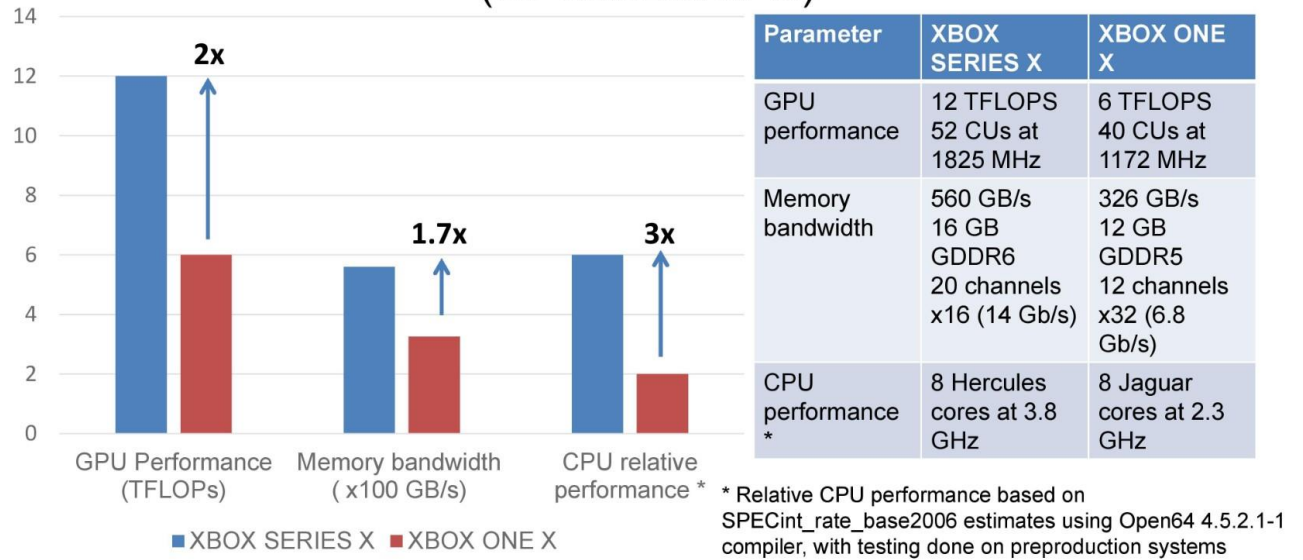


Fig. 5. Comparison between Series X and One X

### 3.2. Balancing Acoustic, Power, and Thermals

Balancing Acoustic, as with any self-contained system like a console, finding the right balance between power consumption, thermals, and acoustics is a multi-dimensional equation, especially when the updated system is going for more power and the goal is a slimmer system. For many company these are very importance.

And in Xbox Series X, Microsoft enabled a three-channel parallel airflow design combined with a vapor chamber cooler for the main SoC and memory, a center chassis air flow baffle that cools the voltage regulators and other southbridge-related IO, and a custom 130mm axial fan with a 3-phase brushless DC electric motor for high-performance but low acoustic and low maintenance features. Fig. 6. Shows the airflow look like.

## XBOX SERIES X Tower Form Factor

### Parallel Airflow Channels

- Lowers overall flow resistance
- Maximizes PCB cooling

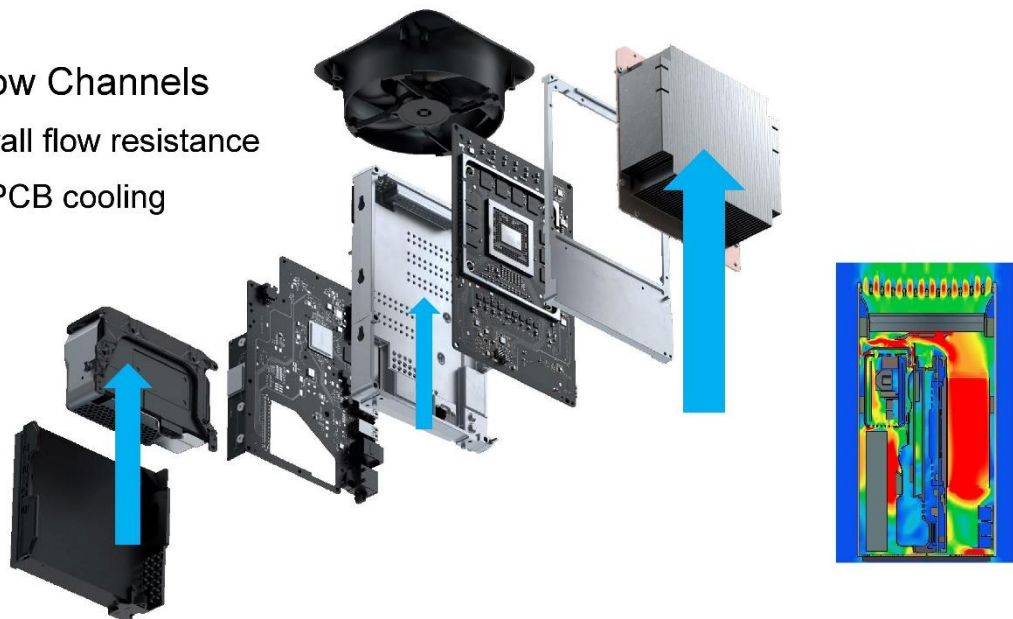


Fig. 6. Tower Form Factor and the airflow

Fig.7. show the simulation about the thermal. On the right is the main aluminum heatsink for the SoC, then in the middle is center chassis air flow baffle, and on the left is the rest of the system, including the second PCB with the IO. Microsoft split the system into two PCBs, one for the Scarlett SoC and the second for all the IO related connections, to distribute the thermals as well as enable a smaller footprint.

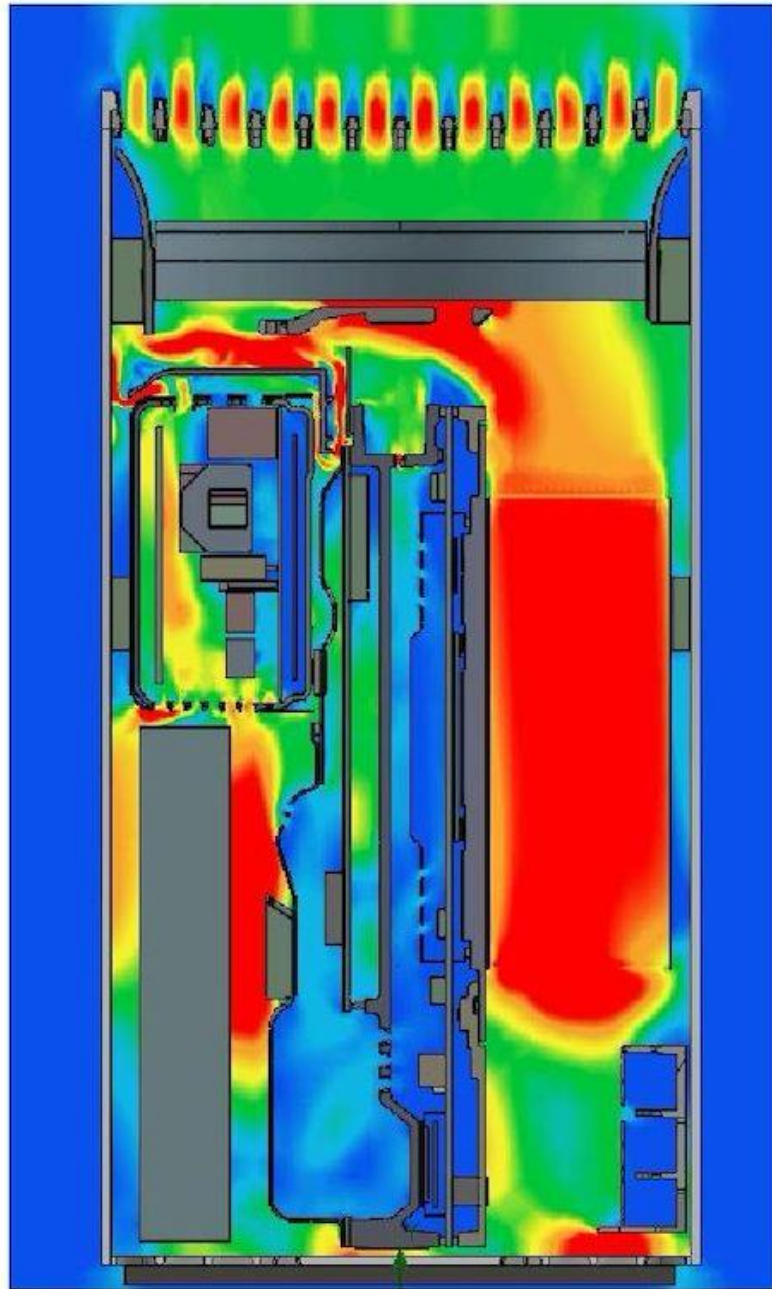


Fig. 7. Thermals simulation diagram

### 3.3. Ray tracing

Ray tracing is a technique for modeling light transport for use in a wide variety of rendering algorithms for generating digital images. Fig.8. has a red circle, you can see the different, if the ray tracing is on, then the mirror will reflect the light, but if you turn off, then the mirror will just let the light pass.

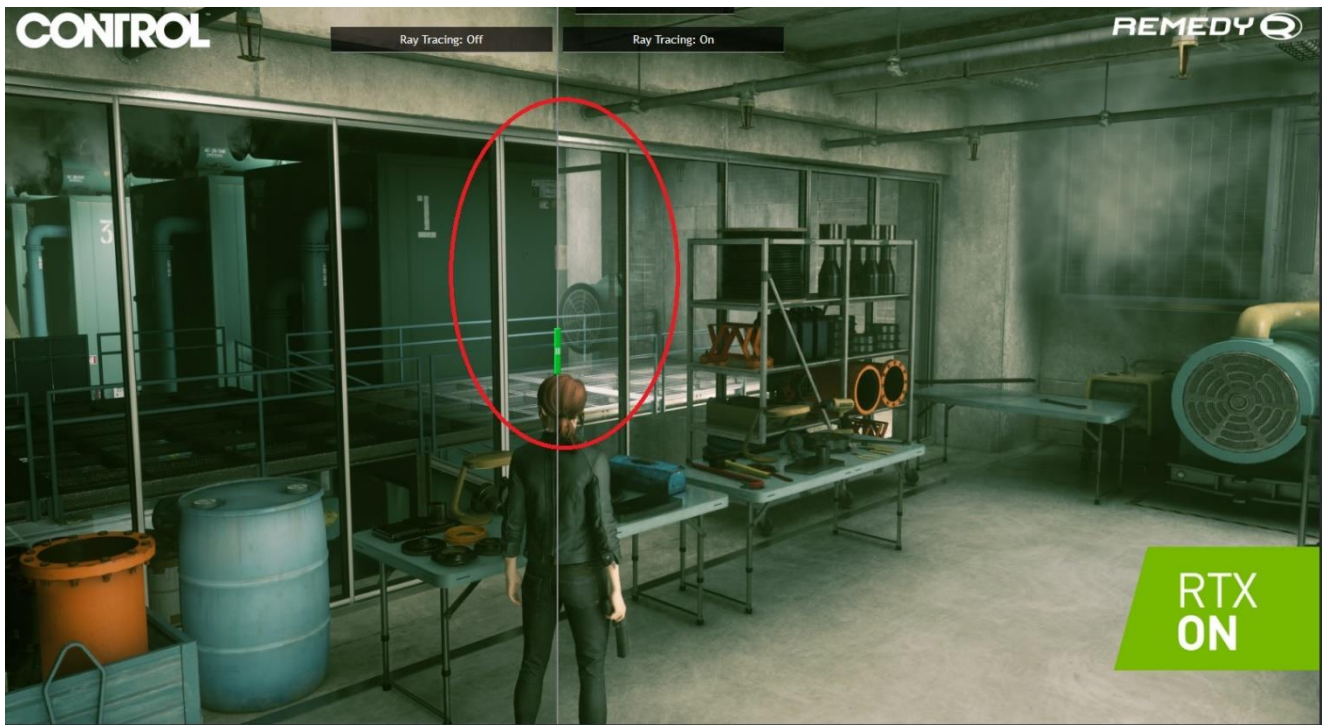


Fig. 8. Ray tracing example

### **3.4. Quick Resume**

Quick Resume can let you jump back into your games right where you left off. When you switch from one game to another, the console saves the state of the current game. If there's a Quick Resume state for a game that you switch to, the console will load that state for you. So you do not have to read/load the game, and do not have to come back to main menu to change other games.

I think Xbox run games through virtualization technology. The contents of this virtual ram can be saved to disk which is basically a freeze frame of the game. Then when you want to play again it gets loaded back into ram and it continues completely unaware there were any interruptions. Not all games respond well to this which is why quick resume doesn't always work. You can go to the Xbox support website to check which game is supported Quick Resume.

### 3.5. Smart Delivery

Smart Delivery is technology that automatically delivers the best version of a game you've purchased to your console. You do not have to do any extra step for the game.

### 3.6. Xbox Game and Xbox Cloud Gaming

Xbox Game pass gives you access to many games to download and play on your Xbox Series X/S for one monthly fee. You can download the games and play them as often as you like, if you continue to pay the monthly fee. Some titles might become unavailable as others are added, but you also have the option of buying any of the collection outright at discounted prices.

Xbox Cloud Gaming can let you play and access a host of Xbox Game Pass games on a variety of devices. The feature streams the games via the Cloud instead of downloading them directly, so you can pick them up and play them almost instantly just about anywhere if you have a stable internet connection.

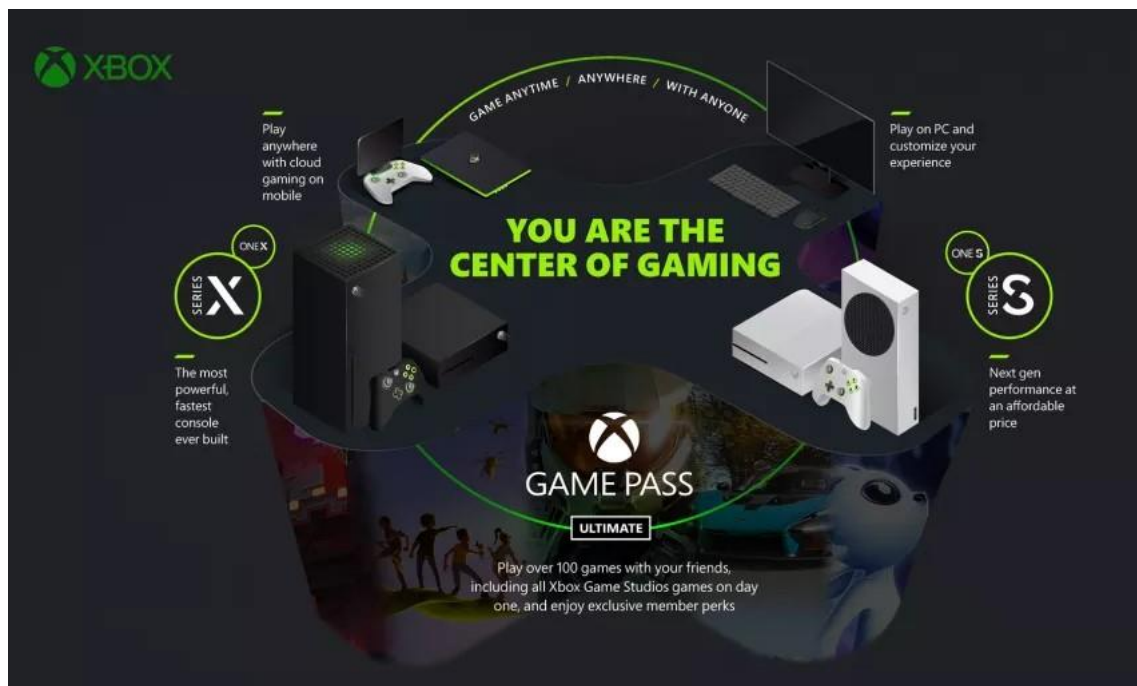


Fig. 9. Xbox Game Pass









## 4. Market analysis & SWOT analysis

In this section, we analysis the market of Xbox Series X, and make a SWOT analysis to find out its advantage and disadvantage.

### 4.1. Market analysis

Here we can see data representing the global sales through to consumers and change in sales performance of the three current platforms (PS5, Xbox Series X/S, and Nintendo Switch) and three legacy platforms (PS4, Xbox One, and Nintendo 3DS) over comparable periods for 2019, 2020, 2021, and 2022. Also shown is the market share for each of the consoles over the same periods.

And in Fig.10., you can see that only Xbox X/S % is up, and PS5 and Switch is going down. I think these happened due to the COVID-19 and the chip shortage.

Current	2019	2020	2021	2022
 PS5	-	-	8,148,852	6,663,570
 X/S	-	-	4,422,396	5,730,468
 Switch	8,848,254	15,478,034	14,125,054	11,565,754
Legacy				
 PS4	7,916,556	6,659,919	1,838,072	426,010
 Xbox One	2,173,399	2,061,387	422,541	35,697
 3DS	964,447	395,640	29,740	-
Total	19,902,656	24,595,980	28,986,655	24,421,499






Current	2022 v 2020	% up/down	2022 v 2021	% up/down
 PS5	-	-	-1,485,282	-18.2%
 X/S	-	-	1,308,072	29.6%
 Switch	-3,912,280	-25.3%	-2,559,300	-18.1%
Legacy				
 PS4	-6,233,909	-93.6%	-1,412,062	-76.8%
 Xbox One	-2,025,690	-98.3%	-386,844	-91.6%
Total	-174,481	-0.7%	-4,565,156	-15.7%

Fig. 10. Year to Date Sales Comparison

And Fig. 11. Show the total sales and market share for each year, you can find out Xbox Series X number is increasing, so maybe in the next year 2023 Xbox Series X will win PS5, due to next part, SWOT analysis.







Current	2020	2021	2022	Lifetime
	4,390,029 12.5%	12,589,953 27.6%	6,663,570 27.8%	23,643,552 15.4%
	3,036,468 8.6%	8,320,346 18.2%	5,730,468 23.9%	17,087,282 11.1%
	27,758,846 78.9%	24,762,809 54.2%	11,565,754 48.3%	113,290,609 73.6%
<b>Current Total</b>	<b>35,185,343</b>	<b>45,673,108</b>	<b>23,959,792</b>	<b>154,021,443</b>
Legacy	2020	2021	2022	Lifetime
	8,368,159 74.6%	2,207,717 81.9%	426,010 92.3%	117,004,007 69.8%
	2,850,882 25.4%	487,779 18.1%	35,697 7.7%	50,534,689 30.2%
	469,092 -	34,395 -	- -	75,940,755 -
<b>Legacy Total</b>	<b>11,688,133</b>	<b>2,729,891</b>	<b>461,707</b>	<b>243,479,451</b>
<b>All Total</b>	<b>46,873,476</b>	<b>48,402,999</b>	<b>24,421,499</b>	<b>397,500,894</b>

Fig. 11. Total Sales and Market Share for Each Year



## 4.2. SWOT Analysis

I make a SWOT analysis in this part, which contains four parts, strength, weakness, opportunity, and threat.

About Strength, Xbox Series X has a larger controller, many people said that Xbox controller is one of the reasons why they buy Xbox. And Xbox also has a deep pockets, as everyone knows, Xbox comes from the house of Microsoft, it is safe to say that Xbox has deep pockets and can survive a price war for a long time.

About Weakness, Xbox is always behind PlayStation and NS(switch) in its overall sales and has rarely taken over the number 1 spot. However, Microsoft always want to be the market leader in a technology segment. And you can compare the design between PS5 and NS(switch), you can easily find Xbox has a terrible design, maybe Xbox spend all money on the hardware and software, not include the design.

About Opportunity, I think Xbox can be lowering prices of games, because people will want to buy a console, one of the biggest reasons must be there is a game that people interested, so people buy console to play the game. And Xbox can also have some exclusive games, just like PS5.

About Threat, Sony and Nintendo, two biggest company about video, they are Xbox's threats definitely. And another threat is dropping console sales, because many people have their own game console, if the new console do not have some very special feature, why people but it? People can still play their own old console.

## **5. Conclusion**

Even in the market analysis, it shows that Xbox is the third one, but as you can see, the number of Xbox is increasing. I think it is because not only the hardware part, but it is also about the software part. In hardware part, I think the two company, Sony and Xbox will not be very different. They both use newest chip and newest technology, but in software part, there can be many new things, just like Xbox's Quick Resume and Smart Delivery, these two applications give player more convenient. So, maybe when Xbox publish more and more exclusive games, one day Xbox will win PS5.

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