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The company also explored the forging of an early online strategy with Netscape, whose founding management had recently come directly from SGI, the company which had designed the core Nintendo 64 hardware.[14][15] Within its budding online strategy, Nintendo reportedly considered multiplayer online gaming to be of the highest priority, even above 64DD, of way toward 64DD.[16] Several third-party game developers were also exploring 1999/2000-era features based on 64DD, including Ocean's Mission: Impossible, which was cancelled.[15] and Sega's competitive four-player Ultimate Fighting Championship (UFC) and online fighting game.[19] Nintendo would ultimately retain the core impetus of these ideas, but would drastically alter both plans over the following years, in favor of a floppy-based cartridge technology and the Randnet online software and service partner—although with no online multiplayer gaming support whatsoever. Announcement II would have been easier to understand if the DD was already included when the N64 first came out. It's getting harder to explain after the fact. (laughs) — Nintendo designer Shigeru Miyamoto[9] The 64DD was first announced at Nintendo's 1995 Shoshinkai trade show, at which time Nintendo said it would launch by the end of 1996.[20] although giving virtually no technical specifications yet,[21] However, its first public appearance wasn't until Nintendo's 8th Shoshinkai show of November 22—24, 1996, where IGN reported that the device nicknamed "Bulky Drive"[3][8] was one of the biggest items of the show.[22] There, Nintendo of America Chairman Howard Lincoln stated that the device had received its finalized hardware specifications and sported its own show booth. Nintendo's Director of Corporate Communications, Perrin Kaplan, made the company's first official launch window announcement for the peripheral, scheduled for late 1997 in Japan.[23][24][25][26] Reportedly several developers attended the show to learn how to develop for 64DD, some having traveled from the US for the 64DD presentation and some having received 64DD development kits.[15] The demonstration included an improvised disk conversion of the familiar Super Mario 64 game to demonstrate the drive's operation and performance, and a graphics application mapping the audience's photographic portraits onto live 3D animated avatars—a feature which was ultimately incorporated and released in 2000 as Mario Artist: Talent Studio and the Capture Cassette.[23][27] Included along with Enix in the early roster of committed 64DD developers, Rare officially discounted any rumors of the peripheral's impending pre-release cancellation.[28] The event featured Creator, a music and animation game by Software Creations,[29] the same UK company that had made Sound Tool for the Nintendo Ultra 64 development kit. They touted the game's ability to be integrated into other game titles and possibly create new levels and characters. There was no playable version of Creator available at this show, but the project was later absorbed into Mario Artist: Paint Studio.[29][30] Nintendo also announced their plans to bundle the 64DD with a RAM expansion cartridge at the show.[31] Much of the gaming press said the Shoshinkai show did not make as significant a 64DD reveal as Nintendo had promised, leaving the public still in the dark as far as the system's software lineup, practical capabilities, and release date.[32][33][34] Zelda 64 (eventually released as the cartridge game The Legend of Zelda: Ocarina of Time) was seen as the 64DD's potential killer app in the months following the system's unveiling.[35] On April 3–4, 1997, Nintendo of America hosted a Developer's Conference in Seattle, Washington, where a surprise overview was delivered by Nintendo Developer Support staff Mark DeLoura about the 64DD.[8] Delays The 64DD is notable in part for its multi-year period of many repeated launch delays, which created an interdependent cascade of delays and complications of many other business processes and product launches for Nintendo and its partners.[3][7][36][37] On May 30, 1997, Nintendo issued a press conference announcing the first in what would become a series of the product's launch delays, saying it had been rescheduled to March 1998, with no comment on an American release schedule. At that time, the delays were reportedly attributed to the protracted development of both the disks and the drive technologies.[25][38] On June 9, 1997, Nintendo and Alps Electric announced their manufacturing partnership for the still tentatively titled[8] 64DD.[39] We're hesitant to say [the status of the 64DD software lineup, but] if software doesn't come out consistently after we sell the 64DD, we'll be stuck.Don't worry. Feel easy about the 64DD. — Miyamoto, July 29, 1997[40] At the pre-3 press conference on June 18, 1997, the company lacked even a prototype unit to display, while Howard Lincoln stated that the company wouldn't release the device until sufficient numbers of software releases support it. Reportedly featuring at least twenty games in development including Donkey Kong 64 and the sequel to Super Mario 64, the device still retained its projected Japanese launch window of early 1998.[41] Also at the show, Nintendo confirmed that the 64DD would have Internet capability.[42] and Nintendo's main game designer, Shigeru Miyamoto, speculated that the first games to be released for the new system would be SimCity 64, Mario Artist, Pocket Monsters, and Mother 3.[43][44] [Nintendo can't guarantee that the 64DD will launch in the US in 1998], but what we can say is that it will launch when it is ready and when we have a compelling piece of software for it. But it's an accessory and we all know the history of selling add-ons in this marketplace, and to be successful we'd have to get a 60%-to-80% penetration of this 64DD into the installed base of N64 to be considered a success. We can't just have 10% or 20% of people buy it, otherwise it wouldn't make any sense to continue software support for it. —George Harrison, VP of Nintendo of America, April 1997[45] In a December 1997 interview with Shigeru Miyamoto and Shigesato Itoi, Miyamoto confessed the inherent difficulty in repeatedly attempting to describe and justify the long-promised peripheral to a curious public. He said that it "would have been easier to understand if the DD was already included when the N64 first came out. It's getting harder to explain after the fact. (laughs)" To illustrate the fundamental significance of the 64DD to all game development at Nintendo, Itoi said, "I came up with a lot of ideas because of the 64DD. All things start with the 64DD. There are so many ideas I wouldn't have been allowed to come up with if we didn't have the 64DD." Miyamoto concluded, "Almost every new project for the N64 is based on the 64DD. ... we'll make the game on a cartridge first, then add the technology we've cultivated to finish it up as a full-out 64DD game." [9] By 1998, IGN optimistically expected all major Nintendo 64 cartridge games to have software support for an impending expansion disk. Known third-party 64DD developers included Konami, Culture Brain, Seta, Japan System Supply, Titus, Infogrames, Rare, Paradigm Entertainment, Ocean, and Factor 5.[15][46] Despite NCL's confident announcements, we still suggest gamers looking to import the drive shouldn't hold their breath. Nintendo's 64DD delay track record still has a few openings for more entries. —IGN, April 8, 1999[37] More delays were subsequently announced. The American launch was delayed to late 1998.[24] The Japanese launch was delayed to June 1998, later adjusted by the apologetic announcement on April 3, 1998, that it would launch "within the year".[47] The 64DD was notably absent from E3 1998, having been briefly described the day prior as "definitely not" launching in 1998 and "questionable" in 1999, which Next Generation magazine interpreted as being "as close to 'dead' as we can imagine" [48] IGN pessimistically explained that the peripheral's launch delays were so significant, and Nintendo's software library was so dependent upon the 64DD, that this lack of launchable software also caused Nintendo to entirely cancel its Seta World 1998 trade show.[37] On April 8, 1999, IGN announced Nintendo's latest delayed launch date of 64DD and the nearly complete Mario Artist, as being June 1999.[37] Demonstrated at the May 1999 E3 as what IGN called an "almost forgotten visitor", there were no longer any plans for release outside Japan, and its launch there was still withheld by the lack of completed launch games.[49] As of the Space World 1999 event in August, Nintendo had set Randnet's launch date at December 1, 1999, but reportedly had not yet set a launch date for the 64DD.[50] Earthbound 64, which IGN cynically called "in development for nearly 1,000 years".[51] had been heavily anticipated inside the company and globally as a crucial 64DD launch game, but the announcement of its conversion from 64DD disk to 32 megabyte cartridge plus expansion disk was taken by IGN as unsurprising but also a sign of further delay or cancellation of the 64DD altogether.[52][51] Launch The 64DD was launched on December 13, 1999, exclusively in Japan,[53] as a package called the Randnet Starter Kit which included six games bimonthly through the mail, and a year of Internet service. Anticipating that its long-planned peripheral would become a commercial failure, Nintendo initially sold the Randnet Starter Kit via mail order.[7] Later, very limited quantities of the standalone 64DD and games were made available in stores. Discontinuation On August 25, 2000, Space World 2000 was signified by the launches of the GameCube and Game Boy Advance, and by what IGN considered to be the unofficial discontinuation of the 64DD, jokingly calling it "Dead". According to IGN, "Nintendo did not speak about 64DD during its opening speech, nor did the hardware itself have any booth presence. In fact, the unofficial 'No 64DD' policy seemed to be enforced by Nintendo so brutally that had we even muttered the name of the hardware, we would have probably been tossed out of the show." [54] The official discontinuation of the 64DD and Randnet was announced in October 2000, at a time when there were reportedly 15,000 subscribers.[2] The hardware and online platforms were both discontinued in February 2001. Only nine official disks, including three third-party games and one Internet application suite, were released for it. Most planned 64DD games were either released as cartridge-based Nintendo 64 games as cartridge storage sizes had increased, ported to other consoles like the PlayStation or Nintendo's next-generation GameCube console, or canceled entirely.[3] Hardware Dual storage CD-ROM cartridge 64DD low capacity503–64 MB moderate capacity64 MB avg36 MB large capacity650 MB read/write read/write read-only major production,10–12 weeks[55];5 earlier production/possible production,7–10 days[55];3 expensive/media cheapermedia cheap systemintegration moderatelypriced drive expensive/very fastest5–50 MB/s[56];48instantaneous mode45–70 MB/s[57] 43.9 KB/s[57]75 MB s/b[3] slowest30 KB/s peak[8]200+ ms avg proprietary proprietary PC-copyable durable magnetic[57][58];5 scratchable The 64DD, unattached 64DD disk, top 64DD Disk, bottom Nintendo designed the 64DD as an enabling technology for the development of new genres of games,[9] which was principally accomplished by its three main design features: its dual storage strategy of cartridges and disks; its new real-time clock (RTC); and its Internet connectivity.[59] The dual storage strategy of the Nintendo 64 plus the 64DD combines the traditional high speed cartridges, which are low-capacity, non-writable, and expensive but very fast along with the introduction of proprietary mass storage disks, which are large-capacity, rewritable, and cheap but only moderately fast. Though incompatible in every way with any other consumer electronic product, the 64DD's mass storage technology resembles the generic floppy disk, and the large and sturdy shell of the proprietary Zip disk for personal computers.[24][60] Though various prominent sources have mistakenly referred to the medium as being magnetic[8][57][58];5 complementing its proprietary and copy-protected cartridge strategy, the proprietary 64MB disk format was Nintendo's faster, more flexible, and copy-protected answer to the commodity Compact Disc format, which is cheaper to produce but is much slower, easier and easier to copy on personal computers. The most advanced CD technology developed by the contemporaneous Sega Saturn and Sony PlayStation game consoles can hold at least 650 megabytes (MB) of information with a peak 300k/8[8] throughput and more than 200 ms seek speed. This compares to the Nintendo 64's cartridge's 4 to 64MB size and 5 to 50MB/s[56] of low latency and instantaneous load times, and the 64DD's 64MB disk size and 1MB/s peak[57] throughput with 75 ms average seek latency.[3] The high seek latency and low maximum throughput of a 2x CD-ROM drive contribute to stuttering and to very long loading times throughout a gameplay session in many games, in addition to a much higher production cost, testing cycle, and potential development time for all the potential extra content.[61] As an example of variable storage strategies, Nintendo determined that the development of The Legend of Zelda: Ocarina of Time would be retargeted from 64DD disk format alone, to the much faster cartridge format, for performance reasons.[58];5 Similar in proportion of the historical comparison of Famicon Disk System floppy disks to early Famicon cartridges,[62] this disk format's initial design specifications had been set during a time frame when the initial Nintendo 64 cartridge size was 4MB as with Super Mario 64, and a 32MB size eventually became popular over the years. Nonetheless, the 64DD disk format would serve as significant storage size expansion upon its 1999 launch when 32MB cartridges were the norm[24] and on into future years when only three 64MB cartridges would ever be released for Nintendo 64. The service's [74] 64DD, the writable 64MB disk[63] would yield enough benefits to expansion. This 4MB RAM expansion disk upgraded the Nint 64's system RAM to a total of 6MB. 64DD cartridges have been programmed to detect the service as a 64DD drive and the game's corresponding optional expansion disk, most of which were never fully developed or ever released. Without an expansion disk present, such a standalone game carries on [3] Depending on the game's specific capabilities, these expansions can provide extra levels, minigames, and can store personal and user-generated content.[65] Any Nintendo 64 game which doesn't actively utilize the 64DD drive has potential access to only the few kilobytes of writable storage on the standard issue Nintendo 64 Controller Pak and on some cartridges' internal battery backed storage, for storing only the player's basic progress and preferences. In addition to writable storage, the real-time clock enables the existence of persistent game worlds according to a real-world clock and calendar, backed by a battery even when the system's main power is shut off. Nintendo's lead game designer, Shigeru Miyamoto, said this of the four-year development of the ultimately unreleased port breeding game Cabbage: "We're doing it on the 64DD because I wanted to make a clock function, such that even if the power is cut, can still raise the creature." [46][66][67] A modern cartridge is packaged with the system, allowing Internet connectivity through Randnet, in addition to the service's members-only portal sites. The 64DD has a chip containing an enhanced font and audio library for all software to share, further saving the potential available space of mass storage on cartridges and disks. The 64DD has a 32-bit coprocessor to help it read disks and to transfer data to the main console. The main Nintendo 64 deck uses its RCP and NEC VR4300 to process data from the top cartridge slot and the I/O devices. Like nearly all disc-based consoles, the 64DD can boot up without a cartridge on the top deck, because it has a boot menu. The 64DD is packaged with the 4MB RAM Expansion Pak, yielding a total of 8MB. The 64DD has its own software development kit that works in conjunction with the Nintendo 64 development kit. Accessories The requisite 4MB RAM Expansion Pak is bundled with the 64DD. The 64DD Randnet bundle includes a modem for connecting to the Randnet network and the 4MB RAM Expansion Pak. Other accessories include a keyboard, a mouse, and an audio-video capture port (female RCA jack and line in) called the Capture Cassette (or cartridge). The CPU-powered 22.8 kbps software modem cartridge[68] was developed in partnership between Nexus Telecommunications, Ltd. and Surf Communications.[68] It is housed on a special cartridge with a port for the included modular cable, which then connects to the network.[69] It is the Nintendo 64's only official Internet connectivity product, because the early discussions between Surf and Nintendo to have built one directly into the console did not materialize.[70] Coincidentally, an unlicensed third party alternative was produced by InterAct for America in the form of the SharkWire Online system. Randnet Recruit and Nintendo Co., Ltd. has [sic] established a joint venture "RandnetDD Co., Ltd.", which provides a membership network service through Nintendo 64 and its newly released peripheral device, 64DD in Japan. The joint venture offers several network-based services: web browsing; e-mail services; and publication of digital newspapers and magazines. — Recruit web site, June 30, 1999[41] In April 1999, Nintendo ended the partnership with St.GIGA which had created the Super Famicon's proprietary Satellaview online service in Japan, broadcasting from April 23, 1995, to June 30, 2000. The company then partnered with Japanese media company Recruit to develop the 64DD's completely new proprietary online service called Randnet (from "Recruit and Nintendo network"). The resulting equity-owned[71]1 joint Japanese corporation was announced on June 30, 1999, as RandnetDD Co., Ltd.[41][72] Active only ever in Japan, from December 13, 1999 to February 28, 2001,[71][73] the Randnet service allowed gamers to surf the Internet including a members-only portal, and to share user-generated game data. 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