

## The 2018 Winter Olympics: A Showcase of Technological Advancement

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Kshetri, Nir and Diana Rojas (2018). "The 2018 Winter Olympics: A Showcase of Technological Advancement" *IEEE IT Professional*, 20(2), 19-25.

Made available courtesy of IEEE: <https://doi.org/10.1109/MITP.2018.021921647>

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### **Abstract:**

The 2018 Olympic Winter Games in Pyeongchang was a showcase of South Korea's technological advancements and sophistication. Sponsors such as Intel, KT, and Samsung demonstrated some record-breaking achievements during the games, and viewers and athletes alike experienced some of the most advanced and sophisticated uses of a wide range of technologies.

**Keywords:** South Korea | 2018 Olympics | technology | 5G

### **Article:**

The 2018 Olympic Winter Games in Pyeongchang was a showcase of South Korea's technological advancements and sophistication. Sponsors such as Intel, KT, and Samsung demonstrated some record-breaking achievements during the games, and viewers and athletes alike experienced some of the most advanced and sophisticated uses of a wide range of technologies.

One of the most high-profile technologies deployed for the first time during the 2018 Winter Olympics was the 5G network. As an illustrative use case of 5G, consider cross-country skiing, in which athletes ski through mountains and hills at a high speed. With lower-generation cellular technologies, spectators are not able to track their favorite athletes or see the entire surroundings. With 5G, viewers could see athletes' exact locations and track their moves in real time, creating a more interactive way of watching sports.

Other technological highlights of the events included artificial intelligence, autonomous driving, drones, virtual reality, and Internet of Things (IoT) devices and sensors. High-tech clothing was also presented—Ralph Lauren-designed uniforms worn in the opening ceremony had special inks that could be charged, keeping the wearer warm for up to 11 hours. Samsung's smart uniforms were used by short-track speed skaters—the sensors in the uniforms sent data to the coach's tablet, allowing the coach to send feedback to the skaters in real time.<sup>1</sup>

Improving international image is a main motivation for hosting mega-events such as the Olympics and the World Cup. The host country has a chance to strengthen its soft power, pursue broader economic and geopolitical interests, and showcase new technological advancements. The 1964 Olympics in Japan featured live color footage of the some of the events such as opening and closing ceremonies, wrestling, volleyball, judo, and gymnastics. The 2014 World Cup in Brazil saw first-time uses of several advanced IT applications in making official decisions, broadcasting live events, and facilitating fans’ and viewers’ interactions in the game.<sup>2</sup> South Korea showed off its robotics capabilities<sup>3</sup> and became the first country to use 5G.

## ADVANCED TECHNOLOGIES USED IN THE 2018 WINTER OLYMPICS

The 2018 Winter Olympics have been described as “the highest-tech games yet.”<sup>4</sup> Table 1 provides details of some of the advanced technologies used in various events. Many applications required advances in multiple technological domains. For instance, self-driving cars consume huge amounts of data, as sensors and chips need to monitor road conditions, analyze the situation in real time, and take actions. 5G networks, platforms, and devices built by KT, Intel, and Samsung handled this data.<sup>5</sup>

**Table 1.** Advanced Technologies Used in the 2018 Winter Olympics.

Technology	Major organizations involved	Examples of uses	Comments
5G	KT (5G network), Intel (5G platform), and Samsung (5G tablet <sup>6</sup> )	Samsung’s 5G tablets allowed viewers to switch among multiple cameras placed along the cross-country skiing route so they could track an athlete’s real-time location on a 3D map of the course.	The 5G technology standard was finalized in December 2017. 5G streams’ transmission delay is about 1 ms—much shorter than human beings are able to notice.
Robotics	Korea Advanced Institute of Science and Technology (KAIST), LG, and Future Robot	Painting murals, distributing information, cleaning, and serving drinks; walking humanoid as a torch bearer.	The Ministry of Trade, Industry, and Energy invested about \$2 million to support eight companies working on robotics. <sup>7</sup>
Autonomous driving	Hyundai (teamed up with US start-up Aurora Innovation) and KT (two 5G-connected buses).	Self-driving buses used 5G to navigate roads with interior video screens showing live coverage of the events.	Hyundai and KT fought for the exclusive right to label their vehicles “autonomous.” Hyundai, the local sponsor for the transport category, received this right.
Drones	United States Forces Korea (USFK) and Intel	Intel’s Shooting Star drones were fitted with LED lights; USFK drones provided surveillance and security.	According to Intel, the drone techs employed at the 2018 Olympics will remain a key part of the Olympics until 2024. <sup>8</sup>
Virtual reality (VR)	Intel, Samsung, and Olympic Broadcast Services	Samsung’s Winter Ride simulated skiing: a viewer could sit in a chair that rotated along with what the viewer was seeing in the VR headsets.	Viewers could watch some events in high-definition video on a 5G-equipped tablet or a VR headset.

### 5G Network

In 2016, KT organized the PyeongChang 5G Special Interest Group (5G SIG)<sup>9</sup> and teamed up with Intel and Samsung to present the world’s first 5G trial service at the 2018 Olympics.<sup>10</sup> 5G

requires a new generation of compatible devices such as smartphones and tablets.<sup>11</sup> KT provided the 5G network, Samsung provided the 5G tablets, and Intel provided the 5G platform.<sup>6</sup> There were 22 5G links at 10 different sites, which delivered 3,800 terabytes of data during the 17-day event.<sup>12</sup> Using Samsung's 5G-equipped tablets, attendees viewing cross-country skiing races could follow the races by switching between multiple cameras placed along the skiing routes. This provided a multi-view, real-time presentation of every skier in the cross-country competition.<sup>13</sup> 5G's almost zero delay in transmission makes it possible to provide viewers with multiple real-time links.

A technology known as TimeSlice used about 100 cameras that were arranged in a 180-degree arc in the ice arena. The footage was combined to create 3D videos and freeze frames of figure skaters. Viewers could rotate the frames around and switch between different angles of figure skating performances at any moment.<sup>11</sup>

It was reported that KT's 5G peak speeds were up to 3.5 Gbps (billions of bits per second) on a Samsung tablet.<sup>12</sup> It is worth noting that, in January 2018, South Korea's average mobile broadband download speed (which was the fourth highest in the world) was 133.05 Mbps (megabits per second; [www.speedtest.net/global-index](http://www.speedtest.net/global-index)). This means that peak speeds in 5G networks were more than 26 times the country's mobile broadband download speed. The 5G service is expected to be available in South Korea and other developed countries starting in 2019.<sup>14</sup>

## Robotic Technology

A total of 85 robots were deployed to perform a number of activities during the Olympics, such as painting murals, serving drinks, cleaning, and distributing information about schedules, transportation, and tourist attractions to visitors and athletes. Robots also served drinks and cleaned Olympic venues. A walking humanoid was among the Olympic torch bearers. Talking robots guided people in the airport and other venues, and spoke English, Chinese, Korean, and Japanese. Robots also participated in a skiing competition: eight humanoid robots skied down a 70-meter slope to compete for a \$10,000 prize in the Ski Robot Challenge (see Figure 1).

**FIGURE 1 IS OMITTED FROM THIS FORMATTED DOCUMENT.**

**Figure 1.** A humanoid robot competing in the Ski Robot Challenge. (Source: Reuters)

## Autonomous Driving

Autonomous vehicles—capable of operating without human inputs in most conditions—drove guests around the city's stadiums, ski slopes, and ice rinks.<sup>15</sup> Hyundai and KT developed 5G-equipped autonomous buses (see Figure 2), whose interior video screens showed live coverage of events in 5G. The 5G buses operated in the town of Gangneung, where ice hockey and skating matches took place.

**FIGURE 2 IS OMITTED FROM THIS FORMATTED DOCUMENT.**

**Figure 2.** Hyundai and KT's 5G autonomous bus. (Source: Pietro DeCristofaro, Associated Press)

## Drones

At the opening ceremony, Intel's 1,218 Shooting Star drones flew simultaneously in the sky and created different patterns such as Olympic rings and a snowboarding athlete, setting a Guinness World Record for "most unmanned aerial vehicles airborne simultaneously."<sup>8</sup> The drones were fitted with LED lights and could be programmed to produce different shapes, animations, and choreography.<sup>16</sup> At the closing ceremony, Intel presented a smaller drone show with 300 unmanned aerial vehicles in the air.<sup>17</sup>

United States Forces Korea (USFK) drones were also used to provide surveillance and increase security during the events. The drones took video footage from inside and outside the athletic venues, and transmitted the footage in real time to the Olympics Security Control Center.

## VR

This was the first-ever live VR broadcast of the Winter Olympics. Intel teamed up with the Olympic Broadcast Services to record 30 events for VR, and over half were live events. Samsung also offered six VR experiences related to the games. In the Winter Ride, which simulated skiing, there were several dozen chairs that rotated along with what the viewers were seeing within their VR headsets as the athletes were making their way down a slope.<sup>19</sup>

## SOUTH KOREA'S TECHNOLOGICAL AND INNOVATIVE PROWESS

In the 2018 Bloomberg Innovation Index, South Korea was the world's highest-ranked country. The country has maintained this rank for the fifth consecutive year. The index is based on seven indicators: R&D intensity, manufacturing value-add, productivity, high-tech density, efficiency of tertiary education, researcher concentration, and patent activity.<sup>20</sup>



**Figure 3.** A comparison of key indicators related to innovation and R&D in South Korea and other economies.

Figure 3 compares some indicators related to innovations and R&D in South Korea and other countries where the Olympics were recently held or will be held (Japan will host in 2020). South Korea's emphasis on R&D and innovation is reflected in the country's R&D spending, concentration of researchers in R&D, and patent activities. The country is among the world's best performers on these indicators.

South Korea has been a global leader in R&D and innovation for some time. For instance, the country's ratio of the number of patents to GDP has been higher than any other countries in the world since 2004. South Korea had 9,115 patent applications per \$100 billion GDP in 2016. In comparison, Brazil, the host of the 2016 Olympics, had 406 applications per \$100 billion GDP in the same year.

South Korea's innovation is powerfully illustrated in its firms' activities. For instance, Samsung Electronics, one of the most high-profile sponsors of the 2018 Winter Olympics and the nation's most valuable company by market capitalization, received more US patents in the 2000s than any other firm except IBM. Its activities in semiconductors, smartphones, and digital-media equipment support a rich ecosystem that includes many suppliers and partners in the country.

South Korean technology companies' prowess can be attributed to the huge domestic market and their heavy engagement in exports. For instance, in 2016, South Korea's domestic sales and exports of robots amounted to \$3.33 billion and \$857 million, respectively.<sup>21</sup>

## CONCLUSION

Viewers of the 2018 Winter Olympics witnessed novel and highly sophisticated technologies, including 5G, drones, robotics, VR, and autonomous driving. We can expect a similar display of innovation in the years and Olympics to come.

## REFERENCES

1. J. Ogaard, "Technobabble: Technology Enriches the Olympics Experience," *Crow River Media*, blog, 2018; [http://www.crowrivermedia.com/hutchinsonleader/news/lifestyle/technobabbletechnology-enriches-the-olympics-experience/article\\_cd12af3f-d69d-57f6-b9d5-1d2dc93c19c3.html](http://www.crowrivermedia.com/hutchinsonleader/news/lifestyle/technobabbletechnology-enriches-the-olympics-experience/article_cd12af3f-d69d-57f6-b9d5-1d2dc93c19c3.html).
2. I. Bojanova, "IT Enhances Football at World Cup," *IT Professional*, vol. 16, no. 4, 2014, pp. 12–17.
3. A. Prakash, "During the 2018 Winter Olympics, South Korean Robots Reflect the Geopolitics of Technology," *Robotics Business Review*, blog, 2018; [www.roboticsbusinessreview.com/regional/during-the-2018-winter-olympics-south-korean-robot-reflect-the-geopolitics-of-technology](http://www.roboticsbusinessreview.com/regional/during-the-2018-winter-olympics-south-korean-robot-reflect-the-geopolitics-of-technology).
4. K. Gibson, "Winter Olympics in Pyeongchang Are the Highest-Tech Games Yet," *CBS News*, blog, 2018; [www.cbsnews.com/news/winter-olympics-in-pyeongchang-are-the-highest-tech-games-yet](http://www.cbsnews.com/news/winter-olympics-in-pyeongchang-are-the-highest-tech-games-yet).

5. P. Decristofaro and Y. Lee, "Olympics Showcases Korean Self-driving Vehicles," *Post and Courier*, blog, 2018; [www.postandcourier.com/automotive/olympics-showcases-korean-self-driving-vehicles/article\\_0c3e7622-12ad-11e8-bb14-6b1e4dc74adf.html](http://www.postandcourier.com/automotive/olympics-showcases-korean-self-driving-vehicles/article_0c3e7622-12ad-11e8-bb14-6b1e4dc74adf.html).
6. E. Ramirez, "In the Race for 5G, South Korea Shows Off Its Tech Prowess at the Winter Olympics," *Forbes*, blog; [www.forbes.com/sites/elaineramirez/2018/02/23/in-the-race-for-5g-south-korea-shows-off-its-tech-prowess-at-the-winter-olympics/#5cbdb6322853](http://www.forbes.com/sites/elaineramirez/2018/02/23/in-the-race-for-5g-south-korea-shows-off-its-tech-prowess-at-the-winter-olympics/#5cbdb6322853).
7. G. Nichols, "Robots Will Compete for Attention at 2018 Olympics," *ZDNet*, blog, 2018; [www.zdnet.com/article/robots-will-compete-for-attention-at-2018-olympics](http://www.zdnet.com/article/robots-will-compete-for-attention-at-2018-olympics).
8. "Intel Drone Light Show Breaks Guinness World Records Title at Olympic Winter Games Pyeongchang 2018," *Intel*, blog, 2018; <https://newsroom.intel.com/news-releases/intel-drone-light-show-breaks-guinness-world-records-title-olympic-winter-games-pyeongchang-2018>.
9. "KT Plans 5G for the Winter Olympic Games in 2018," *The Mobile Globe*, blog, 2016; [www.themobileglobe.com/kt-plans-5g-for-the-winter-olympic-games-in-2018](http://www.themobileglobe.com/kt-plans-5g-for-the-winter-olympic-games-in-2018).
10. "5G Mobile Technology Takes Center Stage at PyeongChang Olympics," *Korea Bizwire*, blog, 2018; <http://koreabizwire.com/5g-mobile-technology-takes-center-stage-at-pyeongchang-olympics>.
11. S. Captain, "The Winter Olympics Will Be a Coming-out Party for 5G Wireless," *Fast Company*, blog, 2018; [www.fastcompany.com/40528802/the-winter-olympics-will-be-a-coming-out-party-for-5g-wireless](http://www.fastcompany.com/40528802/the-winter-olympics-will-be-a-coming-out-party-for-5g-wireless).
12. M. Dano, "KT's Millimeter Wave 5G Network Transmitted 3,800 TB of Data during Winter Olympics," *Fierce Wireless*, blog, 2018; [www.fiercewireless.com/5g/kt-s-millimeter-wave-5g-network-transmitted-3-800-tb-data-during-winter-olympics](http://www.fiercewireless.com/5g/kt-s-millimeter-wave-5g-network-transmitted-3-800-tb-data-during-winter-olympics).
13. J. Horwitz, "PyeongChang Will Host First Major 5G Video Demonstrations for Olympics Viewers," *Venture Beat*, blog, 2018; <https://venturebeat.com/2018/01/31/pyeongchang-will-host-first-major-5g-video-demonstrations-for-olympics-viewers>.
14. "S. Korea Shows Off Tech Prowess at PyeongChang Olympics," *Yonhap News Agency*, blog, 2018; <http://english.yonhapnews.co.kr/news/2018/02/24/0200000000AEN20180224007400320.html>.
15. N. Turak, "The Coolest Tech Innovations You'll See at South Korea's 2018 Winter Olympics," *CNBC*, blog, 2018; [www.cnbc.com/2018/02/08/the-coolest-tech-innovations-youll-see-at-south-koreas-2018-winter-olympics.html](http://www.cnbc.com/2018/02/08/the-coolest-tech-innovations-youll-see-at-south-koreas-2018-winter-olympics.html).
16. M. Margaritoff, "Watch Intel's Shooting Star Drones at the 2018 Olympics," *The Drive*, blog, 2018; [www.thedrive.com/watch-this/18424/watch-intels-shooting-star-mini-drones-at-the-2018-olympics](http://www.thedrive.com/watch-this/18424/watch-intels-shooting-star-mini-drones-at-the-2018-olympics).

17. H. Kesteloo, "The 2018 Winter Olympics Close with Another Spectacular 'Shooting Star' Drone Show from Intel," *Drone DJ*, blog, 2018; <https://dronedj.com/2018/02/25/2018-winter-olympics-shooting-star-intel-drone-show>.
18. "USFK Drones are Utilized to Ensure Safety of Pyeongchang Olympics," *Hankyoreh*, blog, 2018; [http://english.hani.co.kr/arti/english\\_edition/e\\_international/832712.html](http://english.hani.co.kr/arti/english_edition/e_international/832712.html).
19. M. Swant, "How Samsung, NBC and More Are Bringing the Olympics to Life in Virtual Reality," *Ad Week*, blog, 2018; [www.adweek.com/digital/what-samsung-nbc-and-more-are-doing-to-bring-the-olympics-to-life-in-virtual-reality](http://www.adweek.com/digital/what-samsung-nbc-and-more-are-doing-to-bring-the-olympics-to-life-in-virtual-reality).
20. M. Jamrisko and W. Lu, "The U.S. Drops Out of the Top 10 in Innovation Ranking," *Bloomberg*, blog, 2018; [www.bloomberg.com/news/articles/2018-01-22/south-korea-tops-global-innovation-ranking-again-as-u-s-falls](http://www.bloomberg.com/news/articles/2018-01-22/south-korea-tops-global-innovation-ranking-again-as-u-s-falls).
21. F. Ghani, "Winter Olympics, Hubo and Future of Robots in South Korea," *Aljazeera*, blog, 2018; [www.aljazeera.com/indepth/features/winter-olympics-hubo-future-robots-south-korea-180223095906541.html](http://www.aljazeera.com/indepth/features/winter-olympics-hubo-future-robots-south-korea-180223095906541.html).

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