Next-Generation Arena Wristband

— A Case Study of Nokia Corporation

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Today, event arenas need to find solutions to attract more customers and provide new experiences at their events to stay competitive. The goal of this thesis was to ideate next-generation arena experiences at the Nokia Arena. The concept proposed is to include LED wristbands, to be called NOKIAband, at the Nokia Arena, to bring more atmosphere and interactivity during the performances. In the development phase, the Design Sprint method was used to establish a knowledge base by various research methods. Desk research found that LED wristbands are a new phenomenon that has been an enormous success. From a survey conducted, it became clear that there would be a demand for this service. Also, research into the technologies available today, including heat mapping and 5G, was conducted.

A prototype of the NOKIAband was designed and the usability and likeability were tested on potential users. A study of Nokia's technologies indicated that the concept can be realized and could be implemented by Nokia. The results demonstrated that the NOKIAband would be attractive to users, to the arena and technically feasible.

Future development prospects considered included adding new features like vibration to the wristbands. In addition, adding two-way communication between the individual NOKIAband and the system would make it possible to have a call button service, for example.

In conclusion, the proposed NOKIAband can technically be implemented and would be valuable to both visitors and the Nokia Arena as well as Nokia. Utilizing the latest technology and trends, an eye-catching concept was accomplished, the NOKIAband, providing new experiences for the Nokia Arena customers.

Keywords: 5G, Event Arena, Heat Map, LED Wristband, Nokia

Contents

1 Introduction

The objective of this thesis was to ideate a concept for next-generation experiences at the Nokia Arena, where events from sports, culture and entertainment are held. The goal was given by Nokia, a B2B company focused on telecommunications, which is a partner for the Nokia Arena (Nokia 2023a).

With today's rapidly changing entertainment industry, it is important for large arenas to stay up to date with the latest trends to stay competitive. In recent years, especially after the COVID-19 pandemic, remote participation in events has also been on the rise (Zipdo 2023). Event holders are under pressure to come up with innovative solutions to bring more participants to their arenas, in order to bring more atmosphere and interactivity during the performances. (PR Newswire 2021.)

The concept proposed is to include LED wristbands to be called NOKIAband, at the Nokia Arena. The Design Sprint method's five steps; empathize, define, ideate, prototype and test were used.

Initially, a knowledge base was established through literature research, benchmark, survey as well as interviews of our final design for the concept. With several in-depth interviews, the functionality, usability and appearance of the developed prototype was mapped.

The next topic discussed is how all the information gathered was used to create a prototype to support the use of a custom Nokia wristband. The prototype demonstrates a solution regarding both appearance and the different functions. In addition to the LED function, a feature allowing collection of location-based data was found to be a valuable addition that enables Nokia to collect actionable data on the attendees. The technology to make location data collection possible, in this proposal, is ultra-wideband (5G UWB) and the implementation of 5G is discussed more in depth.

In conclusion, future development prospects for the concept of a NOKIAband are discussed. Additionally, ways in which Nokia Arena's partners can benefit from the concept are also explored.

2 About Nokia Corporation

Nokia is a global B2B company, operating in the areas of network infrastructure and advanced technologies, especially focused on telecommunications. Nokia is dedicated to technology and

innovation covering mobile, fixed and cloud networks. Headquartered in Espoo, Finland, Nokia operates in 130 countries. (Nokia 2023a).

Originally founded in 1865, Nokia started off as a sawmill in southern Finland. In 1982 Nokia delivered its very first fully digital call center. GSM-standard enables higher quality sound reproduction and utilizes radio frequencies. The first GSM call was with a Nokia cellphone in 1991. Around this time Nokia made the strategic decision to focus on telecommunications devices and all the other industries Nokia had operated in were sold. By the year 1998, Nokia was a world-leading mobile phone manufacturer and the position was maintained by the company for more than a decade. (Nokia 2023a.)

The 2000s continued as an eventful decade for Nokia when its Network infrastructure operations with Siemens merged and a company called NSN was established. Later Nokia was forced to change its strategy by joining its forces with Microsoft on the extremely competitive B2C market of smartphones. (Nokia 2023b.)

From 2011, Nokia focused on the B2B market for mobile, fixed and cloud network solutions worldwide. Industries where Nokia currently operates include a wide range of industries and customers such as network operators, financial services, automotive, healthcare, logistics and manufacturing. Additionally, network management, analytics, network security and application services are offered by Nokia. (GlobalData 2023.) For the year 2023, Nokia expects net sales between EUR 23.2 and EUR 24.6 billion (Nokia 2023c).

Nokia Bell Labs explores and develops revolutionary technologies strengthening the innovative side of Nokia. Areas of research are Networks, automation, semiconductors and devices and AI and software systems. Experts are exploring the key technologies that will construct 6G in the future in the Bell Labs Core Research. With the help of modern technologies, Nokia aims for a safer, leaner, more responsible and more efficient world continuing to create new technology to enrich our daily lives. (Nokia Bell Labs 2023.)

2.1   Nokia Arena

The Nokia Arena is in the vibrant center of Tampere. It is jointly owned by LähiTapiola, OP, Ilmarinen, SRV and the city of Tampere. The Nokia Arena offers many facilities, such as a world-class hotel and an international casino. (Nokia Arena 2023a.)

The Nokia Arena holds up to 140 events annually. These events include ice hockey games, concerts and theatre performances. The venue attracts over one million visitors each year and can accommodate 15,000 spectators per event. The Nokia Arena covers an area of 50,000 square meters. (Nokia Arena 2023a.)

The Nokia Arena has ISO 20121 certification. This means that the Nokia Arena is sustainable from both environmental and social points of responsibility. What contributes further to

sustainability of the Arena, is that the Nokia Arena is fully digital. This means that the Nokia Arena has for example minimized the use of paper. Additionally, all electricity used in the Arena is from renewable energy sources. LED lighting helps to lower the consumption of electricity in the Arena. Overall, the Nokia Arena focuses on both visitor well-being and environmental sustainability. (Nokia Arena 2023b.)

2.2   Next-Generation Arena

The Design Sprint challenge was to create a next-generation stadium experience and consider different business opportunities for the Nokia Arena that would be possible in the next 3-10 years. The main goal of this thesis and the Design Sprint process was to find a solution to the given challenge and bring more attention to the events, benefiting both Nokia and the Nokia Arena.

The solution our team produced is called the NOKIAband, a next-generation wristband containing LED lights that can be controlled by users through scanning a QR code. The organizers of the Nokia Arena would be able to coordinate these wristbands to create spectacular light shows that harmonize with the ambience of the audience. The NOKIAband also incorporates ultra-wideband technology and has the remarkable ability to collect location data. This data provides insights on the audience's movements and whereabouts.

3   The Design Sprint Method

The Design Sprint Method is a five-day project developed by Jake Knapp. The main goal of a Design Sprint is to solve a challenge by creating a prototype and testing the idea with customers. With the Sprint you can compress a couple of months of work into a single week. Design Sprint is an efficient way to create groundbreaking ideas for companies. (Google Ventures 2019.)

Figure 1 illustrates how the Design Sprint Method can be implemented: Monday is started off mapping the problem and choosing what to focus on. On Tuesday benchmarking is conducted. On Wednesday, the best idea is decided and turned into a testable hypothesis. On Thursday, a realistic and comprehensible prototype is built. The Design Sprint ends by testing the prototype with target customers on Friday. (Knapp, Zeratsky & Kovitz 2016, 24.)
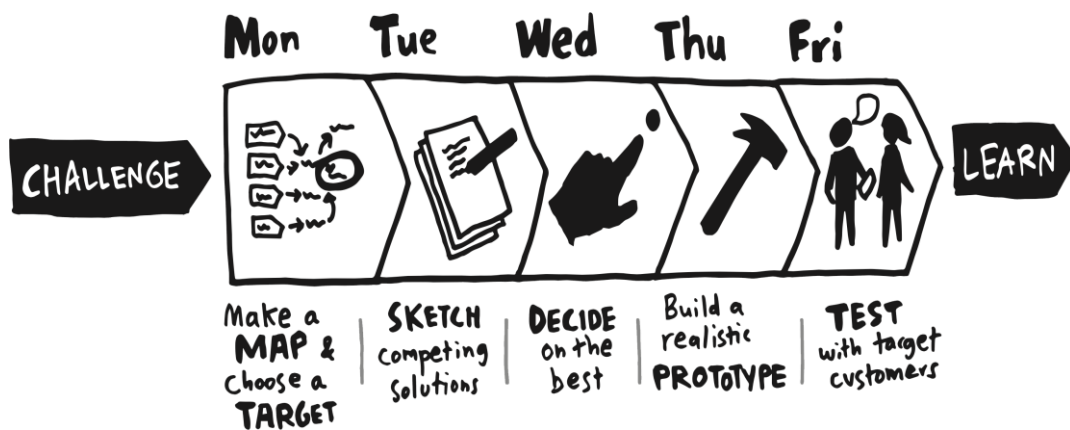
Figure 1: The Design Sprint Phases (Knapp et al. 2016, 24)

Before starting the Sprint, it is important to have the right team gathered. In the team, important questions are faced and ultimately a given challenge is solved. The team needs to be able to communicate with each other effortlessly. Finally, before starting, enough time and resources must be planned for the Sprint. (Knapp et al. 2016, 27.)

3.1   During the Sprint

The Design Sprint method used in this cooperation was an adapted version of Jake Knapp's Design Sprint. It involved an intensive period of work from Monday to Thursday. The Sprint culminated in a pitch on Friday to our partner company, Nokia Corporation. The team of six students conducted this Sprint in cooperation with Nokia Corporation and three tutor lecturers from Laurea University of Applied Science. Nokia's sparring employees and tutor lecturers provided valuable feedback and advice throughout the Sprint process.

Before the Design Sprint started, the team was given a few weeks to get familiar with the subjects and gather background information. Nokia provided three different Design Sprint challenges, from which the team had to choose one. The challenges were: A Next-Generation Stadium, Network as A Code for the Nokia Arena and Network as A Code Anywhere. The team chose to work on the challenge called "A Next-Generation Stadium," as this topic was found to support the existing knowledge of the team and generated the most ideas for a concept.

The Sprint week was from October 30th to November 3rd. During this week, the practical side of the concept was developed by the team in a workshop. The Sprint week started on Monday with a brainstorming session in the workshop (Figure 2). The idea of LED wristbands stood out from the rest and the development process was started. Cooperation with Nokia started with a sparring session that reinforced the team's development proposal.

Monday	Tuesday	Wednesday	Thursday	Friday
Orientation Individual ideas Mind mapping Nokia sparring	Benchmarking Starting the prototype and survey	"Field day" Interviews Analysing results of interviews and survey Customer journey Nokia sparring	Finished Prototype Finishing and practising the pitch Working on report	Pitching the idea to Nokia Team debriefing

Figure 2: The Sprint Schedule from Monday 30th of October to Friday 3rd of November

On Tuesday, the process of benchmarking started. Additionally, designing the application prototype for the Nokia Arena was started. An online survey was conducted and forwarded to recipients. By the end of Tuesday, the preliminary implementation plan had been finalized.

Wednesday was a field day. The team conducted interviews to gather feedback on the prototype of the application. Customer journey maps were created to visualize the concept's processes for all the stakeholders involved. Answers from the survey were gathered and analyzed. The cooperation with Nokia continued with a second sparring session. By the end of the day, the team had a better understanding of where to go with the idea thanks to the support and guidance received during the sparring session.

On Thursday, the prototype was finalized based on the feedback received from the interviews and the survey. Also, the presentation of the pitch was completed and the preparation for the pitch began. The workshop was concluded with a pitching event with Nokia Corporation on Friday. The NOKIAband concept got positive feedback from the representees of Nokia at the pitching event.

3.2   After the Sprint

The Design Sprint was followed by a three-week period where the team completed the report phase of the thesis. During and after the Sprint, the team completed tasks by assigning them to be completed both collaboratively and individually.

Throughout the Sprint there was close collaboration with the tutor lecturers and the client company through sparring sessions. Collaboration continued with the tutor lecturers after the Sprint when the thesis report was finalized. Communication took place through meetings on Microsoft Teams and e-mails.

4   Customer Journey

Customer journey is a visual representation that summarizes the process of a customer's interaction with a company. It is visualized through a customer journey map. The map describes the steps a person takes during their engagement with a product or service. It comprehensively visualizes every interaction, from the beginning with an awareness stage to the purchase and post-purchase stages. By performing a customer journey map, a company can put itself in the perspective of the customers and gain valuable information on how their offerings are experienced. (Stickdorn, Lawrence, Hormess, Scheinder 2018, 43-45)

The reason a company should use a customer journey map is to gain deeper insights into the customer's experience. This map serves as a tool that enables the company to better empathize with its customers. With the customer journey map, the customer experience can be improved as it helps to answer questions on what the user is experiencing and one's emotions on each step. The company can use the findings, for instance, to improve their customer service portal so that the customers can effortlessly contact the company or give feedback. (Stickdorn et al., 2018, 43-51)

The customer journey map can vary on the level of detail, either as an in depth or as a high-level overview. Each type has its own use cases and that is why it is important to decide in the beginning on how broad or narrow the map is. In case multiple goals to achieve exist, more than one customer journey map can be made. The first step is to consider what are the different steps and touchpoints the customer may have. Typically, the first step is having a problem or a need for something. But it can also be about finding out about the company. During the journey, the customer navigates through stages such as consideration, purchase, experience and feedback. All the steps should be clearly written out and explained. It is advisable to not base the experience and emotions with assumptions, but rather use real data gathered from surveys, analytics and market research. If such data is not available, the company can start the process with assumptions and elaborate on it later. (Stickdorn et al., 2018, 45-57)

4.1   Customer Journey of the Event Attendee

The event attendee goes through various stages in their customer journey. The experience stage is the key stage of the customer journey for an attendee. Prior to this stage, the attendee goes through stages of awareness, consideration and purchase (Table 1). The event

attendee discovers an event and considers attending it before deciding to purchase tickets. The attendees want an entertaining and atmospheric event, where they can move effortlessly and safely.

Table 1: Customer Journey of the Event Attendee

Phase of Journey	Awareness, Consideration	Purchase, Experience	Advocacy
Actions What does the customer do?	The customer discovers an ice hockey match that they would love to see. They go through reviews and recommendations.	The customer decides to purchase tickets. At the Arena they got to support their team with the NOKIAband. They also found the utilities easily by using the application for the NOKIAband.	The customer decides to purchase tickets to the next match. They have a need and a desire to come back.
Touchpoint What part of the service does the customer interact with?	The Nokia Arena website and Social media.	The Nokia Arena website, customer support, ticket selling website (Lippu.fi) and staff of the Nokia Arena.	The Nokia Arena website and post-event feedback.
Customer Thoughts What is the customer thinking?	The customer is planning to go to the next match of their favorite hockey team.	The customer was positively surprised and pleased with the addition of the new NOKIAband. They were satisfied with the experience.	The customer thought that the Arena had an entertaining atmosphere. They are looking forward to the next match.

The NOKIAband assists in fulfilling the needs of the event attendees mentioned in the customer journey map above. The location-based technology of the NOKIAband would help the attendees to find their way inside the Arena. The guidance offered helps to relieve the stress of the attendees with wayfinding.

With the help of the NOKIAband, attendees can show support to their preferred team by displaying the colors of the team with the LED lights embedded in the wristband. The NOKIAband enhances the experience, leaving attendees with unique and memorable moments.

Overall, the NOKIAband has what it takes to create a more special event experience. The wristband will not only guide the user effortlessly with its heat map function, but also synchronize with the show, creating a mesmerizing visual spectacle.

4.2   Customer Journey of the Nokia Arena Hall

For the Nokia Arena, the event itself is the key moment in the customer journey. Prior to this stage, the need, partner selection and deployment were identified (Table 2). The intention is to offer customers an innovative next-generation experience in the arena with the help of the NOKIAband.

Table 2: Customer Journey of the Nokia Arena Hall

Phase of Journey	Identifying the Need, Choosing a Partner	Development, Durning the Event	Post Event Experience
Actions What does Nokia and the hall company of the Nokia Arena do?	Nokia has a desire to provide its customers with next-generation experiences. A suitable and reliable partner is needed.	Easy and carefree onboarding. During the event, they want to allocate the right number of resources to places where customers are located, with the assistance of the data collected by the NOKIAband.	Data of the visitors' movements in the Arena has been collected. This data enables the development of dynamic staff allocation and the optimization of resource deployment.
Touchpoint What part of the service does Nokia and the Nokia Arena interact with?	Customer feedback and discussion in internal meetings.	Customer and partner feedback. Delivery of wristbands, deployment and training.	Customer and partner feedback. Discussion in internal meetings.
Customer Thoughts What are they thinking?	What is the next-generation experience that could be provided for the customers?	The live data from the NOKIAband is an effective tool to allocate staff to the right places.	There are countless options on how the data from the event can be utilized to provide better experiences.

The NOKIAband tracks individual attendee's movements in real time during the event. This data allows dynamic staff allocation and optimizes resource deployment. For instance, the Arena can add or reduce staff at merchandise stands as demand changes, reducing congestion and enhancing the overall event experience.

Safety is the main concern in any event. The NOKIAband improves security by enabling security personnel to monitor the flow of large crowds in real time. This data assists in making informed decisions to ensure the well-being of all attendees. The NOKIAband has a lot

of potential for further development. The Nokia Arena Hall can utilize this collected data as needed.

5   Technologies Behind the NOKIAband Concept

The technology behind the NOKIAband concept includes four key elements. These elements are 5G technology, Ultra-Wideband technology, heatmapping and LED lights. Embedded with this innovative technology, The NOKIAband will contribute to the transformation of the Nokia Arena into a next-generation arena.

5.1   Data Communication of the NOKIAband with 5G

The technology that the NOKIAband would convey data is 5G, which is the fifth generation of mobile networks. Compared to 3G or 4G/LTE, 5G is a more advanced radio technology. 5G makes UWB applications practical, unlike previous generation mobile networks 3G or 4G. Features of 5G include fast connectivity speeds, which can be as high as ten gigabits a second, achieving ten times faster connectivity than its predecessor, 4G. Ultra-low latency is another benefit of 5G, latency being the delay between sending and receiving data. The large bandwidth of 5G allows more devices to be connected to transmit and receive information. Bandwidth is the capacity of the network and bandwidths that 5G operates are low band, mid band and high band. (AWS 2023.)

In 5G, wireless signals get transmitted through a vast number of small cell stations, which can be located for example on light poles or building roofs. The high speed of data transmission is achieved with millimeter wave (mmWave) spectrum between 30 and 300 gigahertz (GHz). The performance of 5G relies on mmWave spectrum and can travel only short distances. Large growth in data as well as device connectivity is achieved through 5G. (Gillis & Gerwig 2022.)

To make data communication possible with the NOKIAband for the Nokia Arena, determining the technology of data communication was needed. In this concept, 5G technology would be installed into the wristband, to deliver a seamless connection with great capacity enabling UWB communication. High speed and response times are a benefit of 5G, which is needed for the location-based data to be updated in real-time for the planned heat map function. (EMF n.d.)

The connection range of mmWave frequencies is especially short. Therefore, small cells are fundamental as they fill in a bigger macro network. They do this in mini base stations which cover from ten meters to several hundred meters. Radio signals transmitted by 5G in the arena allow a lot of data to be transmitted and received from the NOKIAband. (EMF n.d.)

5G has the capability to transmit all the data from the large numbers of wristbands with an increased speed and no delay. The features of 5G allow better optimization of network traffic, compared to the 4G era, where crowded stadiums were often facing issues with seamless operation of usage spikes. (Intel n.d.) Installing 5G is energy efficient and therefore consumes less energy, making it a sustainable choice (Boyle 2017).

There are challenges that must be considered when implementing 5G. 5G technology is prone to disruptions, for example from physical obstacles such as walls and buildings, which can make it difficult to provide uninterrupted connection. For indoor network installation, there is a way to work around the challenges. (Gillis & Gerwig 2022.)

5.2   Ultra-Wideband Technology

Ultra-Wideband (UWB) is a wireless communication technology that uses a broad range of frequencies between 3.1 and 10.6 GHz. UWB transfers data precisely over short distances. (Arar 2021.) UWB is rising rapidly to the forefront of technology. Phone manufacturers Apple and Samsung have already incorporated UWB into their latest phone models, since UWB has great advantages over similar technologies. Consumers can now, for example, track their belongings with Apples AirTag which is using UWB technology. (Kämäräinen 2023.)

UWB transforms wireless communication through short-duration pulses across a wide range. Billions of radio pulses are being sent by a UWB transmitter. These pulses are then transformed into data by a UWB receiver. Two transmitters can then utilize the distances between them. To measure the distance, the shorter the duration of these pulses, the more precise the data collected with UWB can be. (Bleesk n.d.)

Locating via UWB is extremely accurate (Kämäräinen 2023). High accuracy makes UWB a suitable addition to the NOKIAband. The NOKIAband uses UWB technology to improve the navigation and logistics of events, as well as to provide an interactive and personalized experience at the Nokia Arena.

5.2.1   UWB'S Advantages

UWB's many advantages over similar technologies like Wi-Fi, Bluetooth or GPS make it ideal for location-based automation. Some advantages of UWB include high accuracy and transmission speed. UWB also provides consistent and reliable results. (Kinexon n.d.) The accuracy of UWB can be up to ten centimeters or even less. Compared to Wi-Fi or Bluetooth where the accuracy is only up to one meter. (Bleesk n.d.)

One of the key features of UWB is its low power consumption and wide bandwidth range. These make UWB an ideal technology for transmitting enormous amounts of data (Figure 3). In comparison to other similar technologies UWB's broadband range is particularly expansive. (Arar 2021.)
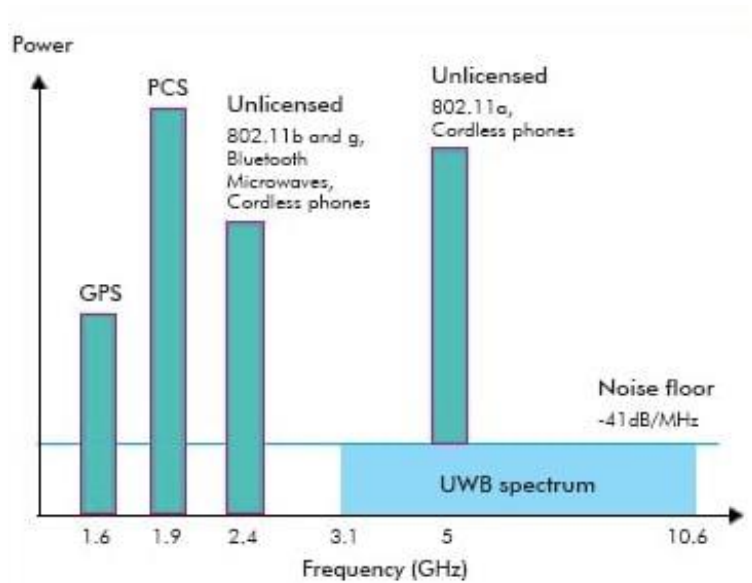
Figure 3: UWB Spectrum (Arar 2021)

These advantages are the reason the concept of the NOKIAband incorporates UWB over similar technologies. With the diverse technology and advantages of UWB, the NOKIAband aims to be the next-generation arena wristband.

5.2.2   Locating via Ultra-Wideband

There are diverse ways to locate via Ultra-Wideband. The most used ways are Time-difference of Arrival (TDoA), Two-way Ranging (TWR), Angle of Arrival (AoA) and Phase-Difference-of-Arrival (PDoA). Each of these ways has its own advantages with minor differences. (Kinexon n.d.)

Time-difference of Arrival (TDoA) has the lowest energy consumption (Kinexon n.d). TDoA works by measuring the difference in the arrival times of signals at several receivers. With these time differences, the sensor position is calculated using hyperbolas. (D. Coppens et al. 2022, VII.)

Two-way Ranging (TWR) has the highest precision and positional stability of all the ways to locate via UWB (Kinexon n.d). TWR functions by calculating the distance of the time it takes for the anchors to send UWB signals and for the sensors to return it back to them. The location for the tag can be calculated using trilateration after three anchors perform this. (D. Coppens et al. 2022, VII.) Trilateration means that the distance is measured using three satellites to determine the location (Advancednavigation 2023).

Angle of Arrival (AoA) offers higher precision with minimal infrastructure compared to the other methods. AoA determines the position by analyzing the angles of incoming signals in

relation to anchor points. It calculates the direction of signal arrival relative to the known positions of reference anchors, providing an accurate estimate of location. (Kinexon n.d.)

Phase-Difference-of-Arrivals (PDoA) advantage compared to others is that it can be implemented in restricted infrastructures (Kinexon n.d). PDoA works by measuring the phase differences of signals arriving at multiple antennas (Qorvo 2021,7).

When choosing a UWB location method, it is important to understand how each method works. In addition, the advantages and disadvantages of these methods need to be considered. This way the most suitable method can be chosen.

5.2.3   Implementing UWB for the NOKIAband

Out of the four methods for locating UWB (based on 5G), the Time-difference of Arrival (TDoA) is preferred method for the NOKIAband. With the help of TDoA, the NOKIAband will deliver a high performance and precise location-based experience in the Nokia Arena.

TDoA functions by sending a signal that will arrive at separate times to anchors. These arrival times then calculate a hyperbola. By calculating at least three hyperbolas, it gives a location of the tag (Figure 4). The anchors need to be synchronized with each other to work. (Coppens et al. 2022 VII.)
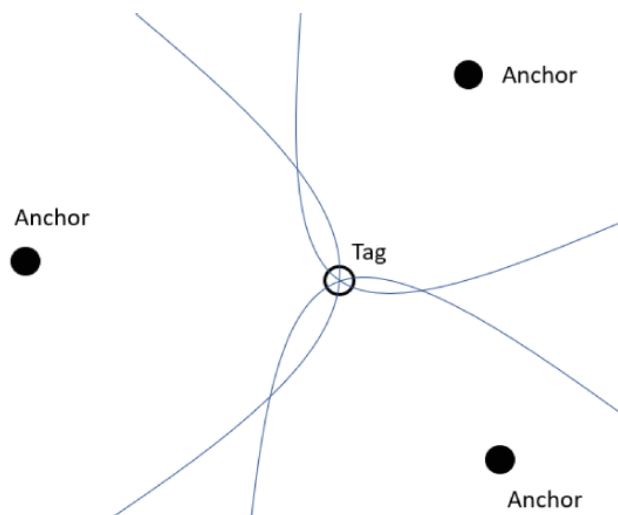

Figure 4: TDoA (Coppens et al. 2022)

Navigine, a technology company, uses TDoA when using UWB technology for indoor navigation (Navigine 2023). The Nokia Arena could potentially improve their indoor wayfinding through the usage of TDoA in the NOKIAband. TDoA provides high-accuracy and low signal latency (Inpixion n.d). These advantages ensure reliable performance, allowing the NOKIAband to perform perfectly in dynamic events.

5.3   Heat Mapping

Heat maps are often used for different forms of analytics or data visualization, for example measuring and analyzing the density of some parameters. Heat maps convert complex numerical data into a compilation of colored shapes. The color variation in a heat map is achieved with hue, saturation, or luminance to present more details. Human beings are visual learners, therefore heat maps are a good way to visualize very large masses of data. (Oracle 2023.)

Heat mapping for location typically displays density data in two dimensions. In general, warmer colors, like red or orange and dots closer together represent the denser areas. On the other hand, cooler colors such as blue and purple represent the less commonly used sections of a map. (Fullstory 2023.)

In figure 5, an example of color variation in a heat map is displayed. The figure demonstrates the traffic congestion areas in the city of Valencia, Spain. Red represents the most congested areas, while blue is the least congested. (Zambrano-Martinez, Tavares Calfate, Cano, & Soler 2019.)
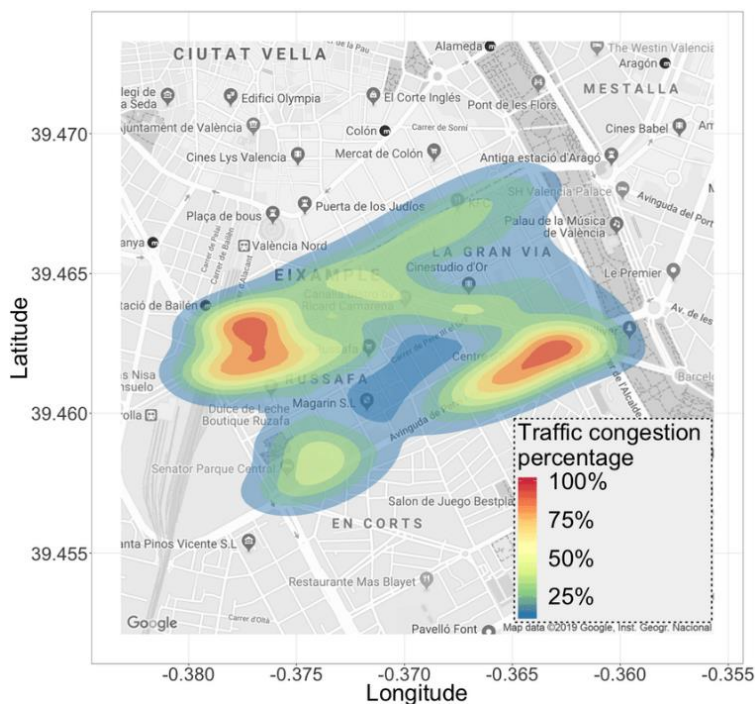

Figure 5: Example of a heat map with a typical color variation (Zambrano-Martinez, Tavares Calfate, Cano, & Soler 2019)

Heat mapping is a popular analyzing tool for many fields. Heat mapping makes distinguishing, analyzing and summarizing abnormalities easier. Drawing attention to trends, heat mapping is

a very adaptable and effective tool which is becoming popular in the field of analytics. (Insightsoftware 2022.)

5.3.1 Heat Mapping of Crowds

Heat mapping can be used to visualize crowd density in real-time. Additionally, heat mapping can be used to show and track the crowd's behavior over time or as a response to some action. The whereabouts of crowds can be positioned for example with device signals, from mobile phones. Heat mapping allows us to optimize, improve and react to the factor which is being monitored. (City of Helsinki 2023.)

A heat map is a good way to improve and communicate safely. For example, in 2021 the city of Helsinki introduced their new service of a website showing congested areas in Helsinki. The heat map covers main tourism-related regions, sights and services in the heart of the city, updating the status every minute. (City of Helsinki 2023.)

Some of the benefits of crowd mapping include data collection for various purposes, such as improving marketing and evaluating customer potential in different places. For the Nokia Arena the data gathered for the heat map could include three factors that would be measured. (City of Helsinki 2023.)

The first factor being crowd volumes at different times. This could include the total duration of an event; before the event starts, during, half-time and after closing. This gives the arena an opportunity to spot the congestion zones and make continuous improvements to the variety of events they have, as more and more information is gathered. This is important information to display for the attendees as well; it allows them to opt for the queues with the least number of people, resulting in smoother and more even navigation in the arena. (City of Helsinki 2023.)

The second factor would be the average time the event attendees spent at each point in the venue. This information would be useful for the Nokia Arena only, although not for the attendees. With this factor, the arena can analyze how long consumers queue up for services and where the waiting times need to be cut down. (City of Helsinki 2023.)

Finally, the third factor is the movement of the crowd and individual attendees' journey inside the Arena. This information can also be utilized only by the arena as it is not relevant information for the event attendees. This way consumer behavior of individuals can be analyzed with this factor and if automated it could provide valuable information, for example on how supply can be targeted to demand. (City of Helsinki 2023.)

5.3.2   Implementing Heat Mapping for Nokia Arena with 5G Ultra-Wideband

The positional data needed to display a heat map is collected through 5G Ultra-Wideband (UWB). Each event participant wears the NOKIAband, embedded with the UWB technology. The data collected is converted from numerical data into a collection of colored shapes displayed over the floor plan of the Nokia Arena.

UWB has low power consumption, therefore the wristband doesn't need to be charged often. The power lasts for a long time and therefore is an efficient way to map real-time data without unexpected power loss. Another benefit of UWB is low interference, which would mean that the wristbands are individual, and they can't be confused with each other which makes the data gathered for the heat map reliable. (Murata 2023.)

In this project, the focus was on using heat mapping to visualize population density, where the population is the event participants. In order to implement the heat mapping feature at the Nokia Arena, radio waves sent by the UWB would measure crowd volume and the movement of the crowd and update in real time. All this information would then be visible as an image-based heat map displayed over the map of the Nokia Arena, which the event participants could also access. The benefits of heat mapping are that it conveys complex data concisely as a visualization which is understandable to non-experts as well (Guo et al. 2020).

This addition of heat mapping would provide valuable data on consumer behavior for the Nokia Arena. By overlaying crowd density directly on the map of the Nokia Arena instead of data being collected to a separate graph, heat mapping allows easier and quicker data analysis (Oracle 2023). Analyzing the movements of the crowd would allow further improvements for the arena. Safety measures can be updated, and new hazards and anomalies can be detected. Long lines are often an issue in venues, which could be measured and monitored with heat mapping.

The proposal in this concept was a 2-dimensional map of crowd density laid over a 3-dimensional map inside the arena which will change with time. While heat mapping is a common way to measure crowd density outside using mobile phone radio signals, for example, heat mapping of location inside buildings is not widely in use due to technology issues. When implementing heat mapping, the UWB programmability in terms of performance, accuracy and interpretability may turn out to be a challenge.

5.4   LED Lights

LED stands for light-emitting diode and they are semiconductor devices that display light when power surges through them. They are able to produce infrared or visible light. The color

LEDs display is determined by the amount of energy needed for electrons to surpass the band gap. (Britannica 2023.)

Band cap refers to a situation where an electron is lifted from the valence band to the conduction band with a higher energy. When a voltage is applied to a semiconductor device, it causes an electron to move into the conduction band and leave an empty spot in the valence band. (Figure 6)
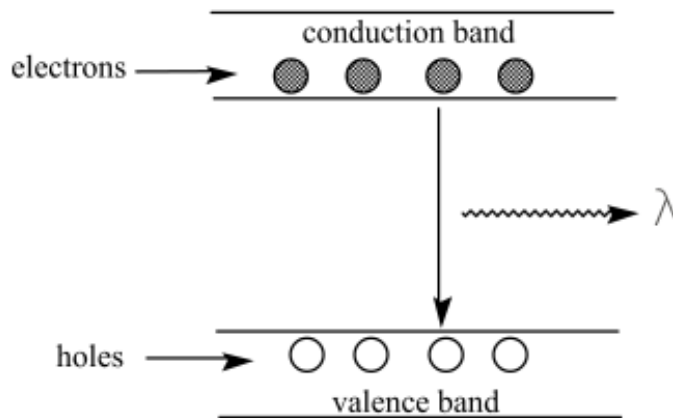

Figure 6: Electron Movement Between the Two Bands and Holes (UCI, 2005)

As the electron returns to the valence band photon is released, the wavelengths of these two bands determine what color the semiconductor displays (UCI 2005). Table 3 shows the wavelengths and LED color charts. To display various shades of colors, the LED lights are combined with three diodes. Together these diodes can generate different shades of a single color by the color one diode produces.

Table 3: Wavelengths and LED color chart (UCI 2005)

Color of Light	Wavelength (nm)
Violet	410
Blue	480
Green	530
Yellow	580
Orange	610
Red	680

When it comes to choosing the right LED lights to be integrated in the NOKIAband, several factors come into play. First, the size of the LED that can fit in the wristband needs to be considered. Other key factors are how much power the LED consumes so it can last the whole event without draining the whole battery. LEDs brightness needs to be controllable and, they must be durable to have a long-life cycle. It is also essential to think about how the LED is integrated to the wristband. How is it affixed in a way that it is durable and meets the expectations for its use. The wristbands are targeted by lots of movement during the events and they are most likely to face some sort of damage. One possible solution is to affix the LEDs inside of a flexible silicon that is also waterproof.

The LEDs are controlled by a control unit. The control unit is responsible for managing the LEDs color and brightness. LEDs can be managed individually or together so the right control unit is a vital component. Powering the LEDs is achieved by a battery that can be charged for reusability. Users will be interacting with the LED color through an application that is covered in more detail later this thesis.

6   Research Methods and Results

The research was started by figuring out how other companies' LED wristbands and similar products work. The technology commonly used in existing LED wristbands was examined. Finally, what people thought of these types of wristbands and whether they found them to add value to events were looked at. The methods chosen for the research were benchmarking and a survey. The information gathered was then used to come up with the best possible proposals for a product or a service.

6.1   Benchmarking

Benchmarking is the method of comparing and analyzing the processes, statistics, products and services of other competitors or partners. The main goal of this method is usually to help the company learn and find opportunities for improvement. (50Minuten 2018, 2.)

The uses of benchmarking include utilizing other companies' best practices and avoiding their mistakes or figuring out areas with little competition. Knowing the industry and how other companies navigate in said industry is essential for improving one's own business practices in the most efficient manner possible. (Tuulaniemi 2011, 138-139.) However, benchmarking should be used to help apply useful practices in a way that is suitable for the company and not simply copy what works for others (Niva & Tuominen 2021, 28).

During benchmarking the focus was set on measuring different companies' products, instead of the companies' strategies or other business processes, as it was found important to find

out the qualities of the best LED wristbands out there. Through benchmarking, the recurring and successful features of other LED wristbands and other products of those companies were looked at. Product benchmarking can then help make decisions based on data and common trends in the industry (Olmstead 2023).

6.2 Benchmarking Results

For benchmarking, LED wristbands made by three different companies, Xylobands, CrowdLED and PixMob, were analyzed. What was common among all of them was that the wristbands were recyclable and made from recycled materials and other LED products aside from wristbands are offered. Most of them have a large variety of different effects, customization and control options. Especially reusability and customization options were found important, as the wristbands could then be used again and together with sponsors. For example, Xylobands' LED wristbands allow branding and custom design, so they can have a logo displayed on them (Xylobands 2023a). CrowdLED's wristbands are reusable, and guests may keep them as memoirs, but they can also be taken back for reuse or recycling (CrowdLED 2023a). PixMob's wristbands can be recycled and refurbished and are made from recycled plastics (PixMob 2023a). The differences between these three companies are compiled in a summary in table 4.

Table 4: Benchmarking Results

Companies	Xylobands	CrowdLED	PixMob
Reuse and recycling	- Offers rebate for recycled wristbands	- Reusable and recyclable	- Recyclable, reusable and refurbishable
Battery	- 18-19-hour battery life	- Battery lasts for 2-3 events and is changeable	- 7 hours straight or possibly 2 hours per day for 2 consecutive days (depending on the wristband)
Effects and control options	- Radio-controlled - Hand-held HTXL for small events - Zonal control for refined effects	- Remote controlled - Built-in radio signal receiver - Advanced effects and control possibilities	- Infrared signal for wireless control - Different types of controllers for spatialized effects
Customization	- Custom design and branding with logo displayed	- Multiple customization options - Brandable with logo	- Brandable casing - Brandable fabric wristband

Other LED products aside from wristbands	- LED lanyards - LED inflatable balls	- LED balls - LED lanyards	- LED badges - Rechargeable NOVA and NOVA Plus - Custom products

Xylobands have radio-controlled wristbands (Xylobands 2023b). The battery lasts for 18–19 hours, but the battery life can be extended by putting it into power-saving mode. Xylobands offers a small hand-held HTXL transmitter for smaller events and their products can be activated in separate groups through zonal control, which allows them to do different refined effects. (Xylobands 2023a.)

CrowdLED's remote controlled wristbands have a battery life long enough to last two to three events. After the battery has died, it can be changed, allowing the wristband to still be in working order. The wristbands have multiple customization options, as well as advanced effects and various control possibilities, such as voice-activated, timed, manual, or kinetic. They also have a built-in radio signal receiver. (CrowdLED 2023b.)

PixMob uses infrared signal for wireless control, and they have different types of controllers for spatialized effects. One example of PixMob's interactive effects is achieved with PixMob Portable Transmitter, which allows the creation of different shapes or drawings with a wirelessly controlled light paintbrush. (PixMob 2023b.)

Other LED products offered are Xylobands' lanyards and inflatable balls (Xylobands 2023b), whereas PixMob has LED badges and their rechargeable NOVA (PixMob 2023c). LED wristbands are a popular product in certain events. As an example, CrowdLED's wristbands were used in the Eurovision Song Contest back in 2021 (CrowdLED 2023c).

6.3   Survey

To have a better understanding of how the idea of an LED wristband would appeal to potential customers, it was important to collect accurate data with various methods. It was decided that the best method to gather useful data was using an online survey. However, it is known that the effectiveness of surveys is declining, especially the traditional forms such as telephone and web surveying. In the future it could be more efficient to try to use data mining and already existing records from the internet. (Couper 2017, 122.)

Because of the tight schedule during the Design Sprint, Google Forms was chosen to be the platform of the survey and it was distributed to friends and family and other people who were thought to add valuable information about the needs of potential users for the NOKIAband. The goal was to keep the survey short so that it incentivizes participants to fill out the survey

completely. The survey was crafted to have multiple-choice and open questions for maximizing the quality of data.

6.4   Survey Results

After carefully analyzing the survey results, it became evident that such an idea would have a chance to succeed in the future. The survey sent out during the Design Sprint managed to reach 36 people. If the research is later continued, other stakeholders such as big corporations should be contacted for their input and interest.

With the collected data, it was determined that there is no need to educate the event participants about the LED function of the wristband, given that most participants in the survey already have some level of knowledge or experience with similar products (Figure 7). In figure 7, orange indicates respondents who are familiar with LED-wristbands through social media. Blue Indicates that respondents have used LED-wristbands themselves. Red represents respondents who are not familiar with the wristbands.

Ovatko rannekkeet entuudestaan tuttuja sinulle?
36 responses

- Kyllä, olen käyttänyt ranneketta
- Ei, en ole käyttänyt/kuullut
- Kyllä, rannekkeet ovat tuttuja sosiaalisen median kautta
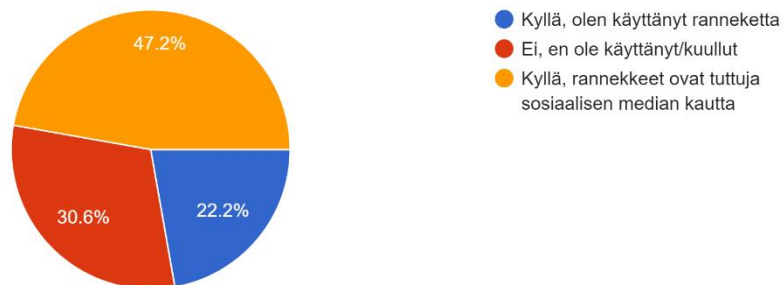
Figure 7: How familiar are you with LED wristbands?

It was paramount that the data collected indicated willingness from potential customers to use the wristband at the arena. When the survey respondents were asked to rank their willingness from 1 to 5, 5 being extremely willing, it can be determined that there is an opportunity to take the idea further (Figure 8).

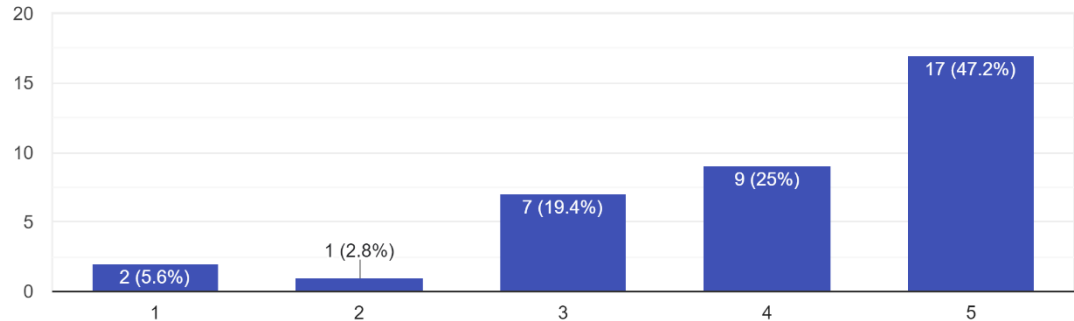Kuinka halukas olisit käyttämään LED-ranneketta?

36 responses

Figure 8: How willing would you be to use an LED wristband?

From a privacy point of view, data is collected anonymously, so users are more likely to be open to the collection of location-based data. Because the data is collected through the wristband, which is handed out randomly, the identity of the user is secured. As found from the survey, 2/3 (24 out of the 36) respondents would allow their location to be tracked (Figure 9). In figure 9, blue indicates respondents who would allow the data collection and red indicates the respondents who would not allow it.

Suostuisitko paikkatietojen jakamiseen ja datankeräämiseen rannekkeen avulla tapahtuman aikana tapahtuma-alueella?

36 responses
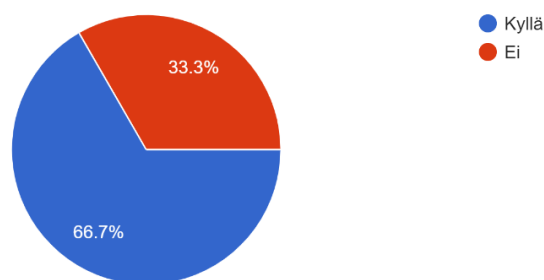
Figure 9: Would you allow location data to be collected and shared with the LED wristband during the event and on the event area?

Overall, the results from the survey showed that people are aware of the LED-wristbands and that there could be a desire to use them in the future. Survey responders gave great ideas in open questions about what the event attendees want to add to the events to make the

atmosphere better. It was said that for example there needs to be more special effects that activate the audience.

7 The Prototype of the NOKIAband Application

The objective of the prototype was to look at ways to connect the user with their individual NOKIAband. The initial ideation of the prototype was started by imagining possible functions for the wristband based on the results of the benchmarking of similar products. The final result was a prototype of a mobile application. The likeability and usability of the prototype was tested through interviews with potential users.

7.1 Design

The making of the NOKIAband prototype began directly after brainstorming ideas for the concept. The main functions of the application prototype were to connect the user to the wristband, for users to control the wristband and to gather valuable information for the Nokia Arena through the wristband. It was important that the user interface of the application would be simple yet informative.

The NOKIAband prototype was made with Figma, a popular cloud-based design tool for creating products such as mobile apps, websites and other digital products (Toptal 2018; Figma n.d.). Figma runs through a website, so it was practical for the whole team to follow and contribute the design process of the prototype in real-time. Creating a prototype with Figma seemed to be the best solution, since it was already familiar to most of the project team members, and it is highly recommended by the professionals in the industry due to its direct and intuitive user interface (Toptal 2018). The prototype application is built for mobile and is designed to be suitable for smartphones and tablets only. In the making of the prototype, the common design principles were used as guidelines on how the prototype should look and function.

7.2 Features

The wristband functions through the application that is downloaded to the users' phones. The application asks the user to scan a QR code from the wristband which then opens a layout on the application to control the lights. There are multiple different colors to choose from and the user can control it through a color wheel or just by pressing the color boxes offered during the event. The application also offers different functionalities to the user, such as tracking the crowd with a heat map and providing navigation to a selected destination inside the arena. The user can also see where the people with the same-colored wristband locate from the heat map. The application's functionality is explained below in more detail.

The application also provides meaningful information to the arena itself by capturing the movements of the users wearing the wristband. This information can be used, for example, to find out where people tend to move inside the arena and how many people are at a certain destination. Utilizing the information gathered, the arena's functionality can be developed and improved. The locational information that the arena receives from the application with the assistance of the wristband was highly appreciated by the Nokia representatives guiding the team during the Design Sprint phase.

7.3   Application Functionality

The application's home screen, as seen in figure 10, has the Nokia Arena logo on it. The text below the logo states that to continue to the application, the user must scan a QR code first. When pressing the arrow button, the user is then navigated to another screen showing the QR code. The QR code that needs to be scanned with the application is planned to be on the wristband, allowing users to easily capture it with their smartphones.

Figure 10: Prototype Home Screen

The QR code option was implemented because a login feature would be inconvenient for users, given that the application is typically used during events lasting only a few hours. Many of the target users are possibly first-time visitors or at least not daily visitors to the Nokia Arena. Perhaps they are seeing their favorite artist or coming to a hockey game during the world championships. They would not want to use too much of their time to sign up for the

application and fill in all the information that is required in the registration process to use the wristband. A simple QR code is familiar for most smartphone users and all the people interviewed liked the idea of using it.
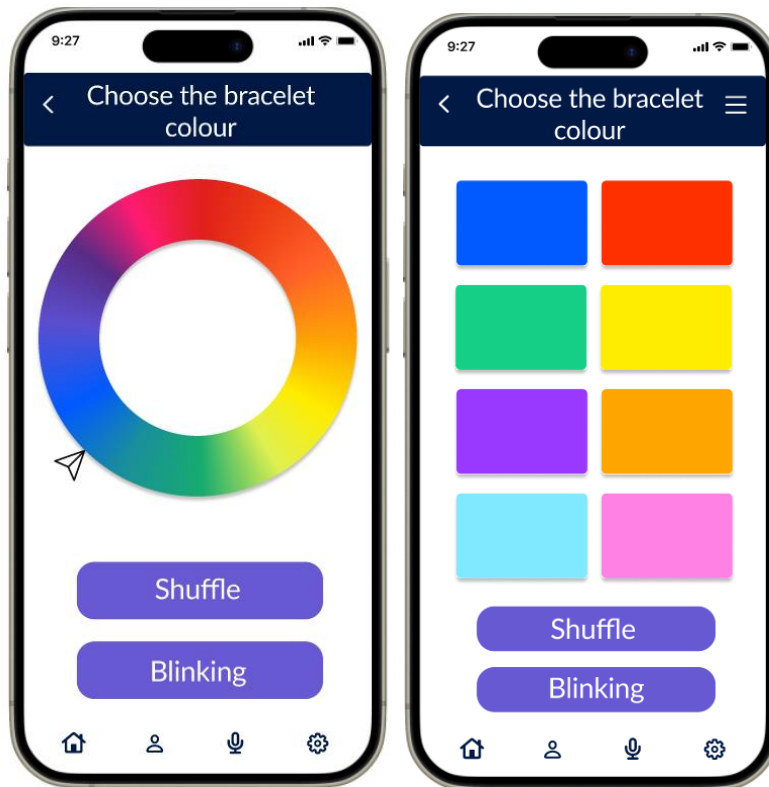

Figure 11: Prototype Color Picking Screens

The screens in figure 11 represent the color picking option in the application. The first screen has a color wheel option where the user can choose their own preferred color by moving the cursor around the wheel to the desired color. There are also two buttons below the wheel where the user can make the colors shuffle through all the available colors to appear in the wristband. Below the shuffle button there is a blinking button, which makes the wristband blink with the chosen color. The blinking could also happen to the beat of the sound, for example in a concert or any kind of event that plays music. The second screen has a simplified version for color picking. The screen shows color boxes with different colors that the user can select by simply pressing the box. Otherwise, it functions the same way with the shuffle and blinking buttons.

There is also an optional feature where the arena itself can control the lights on the wristband, overriding the users' own color or blinking selections. Therefore, the artist, event manager or sponsor could control the lights to show whatever color combinations they would like to see in the arena. If artists would like the crowd to have a certain color at specific times during the concert, then it would be possible for them to do so. If a sponsor would like

to present the brand colors or make animations related to its logo, this could also be done with the wristbands.
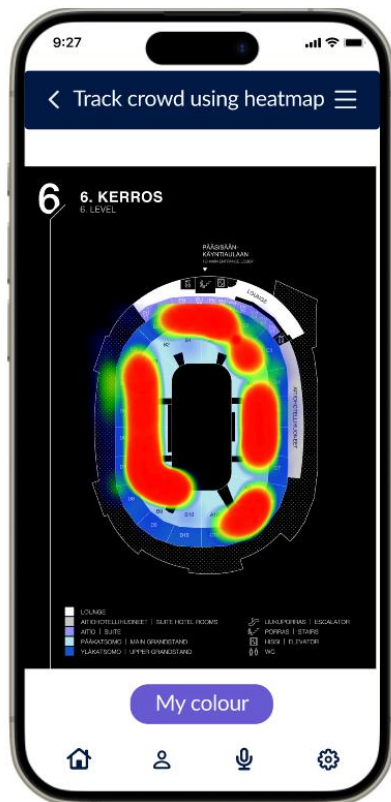

Figure 12: Prototype Heat Map

The application has a heat map function as seen in figure 12, where the arena visitors can observe the crowds that are moving inside the arena. By utilizing UWB-technology it is possible to provide live data insights directly from the wristbands for the user and the arena. As can be seen in figure 12, the heat map shows where the most crowded areas in the arena. The most crowded areas are in red and the less crowded areas in green and yellow. The heat map benefits both the user and the arena itself.

With the heat map function the user is informed where the biggest queues are inside the arena. In the survey conducted, it was found that some people think that the lines to restrooms are too long. With the help of the heat map function, the arena visitors do not have to wait in long queues anymore and can choose to go on the less crowded location, when searching for restrooms or restaurants. The heat map screen also has a feature called "My color." By pressing the "My color" button the application shows where the people who are using the same-colored wristbands as the user, are located. For example, if the user is in an ice hockey game and the team has a certain shade of blue as their team color, the user can then find all the fans that are using the very same blue as their wristband color and join them

as they are supporting the same team. This feature can unite fans and help them find the same fanbase that they belong to.

By getting locational information from the wristbands, the arena can enhance the safety of the arena by enabling security personnel to track the flow of large crowds in real-time. This offers better organized crowds and allows dynamic staff allocation as well as overall less disturbance to the arena's security.

Figure 13: Prototype Navigation Screen

The navigation function, which was said to be a useful addition to the application by a few of our interviewees, works as a tour guide throughout the whole arena. The navigation screen, seen above in figure 13, has the entire arena mapped. All the restrooms, restaurants and shops are pointed on the map so that they can be easily found. The user has access to the navigation feature from the application menu and the location is picked by simply tapping a place on the map or by searching the preferred location on the search bar. The application shows the current location of the user wearing the wristband and navigates them to the selected location. There is also thought to have a feature called "colored guiding," where the wristband changes its color when the user is not heading the right direction on the map.
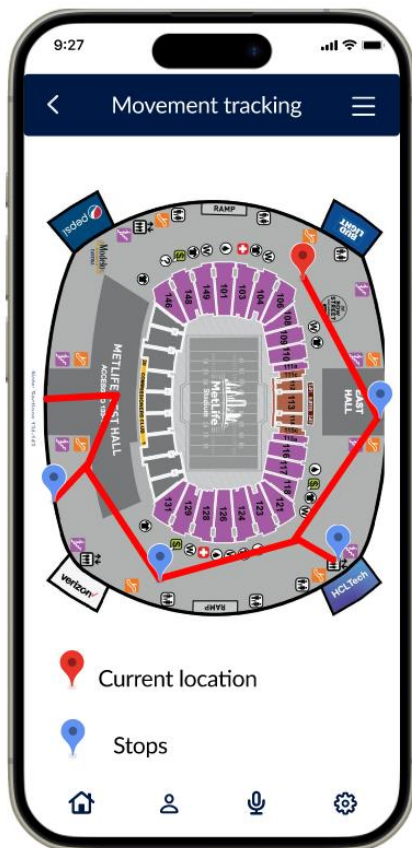
Figure 14: Prototype User Tracking Screen

The application provides a movement tracking function that could provide meaningful information to the arena and its management. The movement tracking screen in figure 14 is meant to be for the management of the arena and it is not visible for the event visitors using the application. This function tracks the users' movements throughout the whole arena utilizing the UWB-technology embedded in the wristband. It shows the current location of the wristband user and tracks the entire movement inside the arena including the stops that the user has made.

The data that this feature brings to the Nokia Arena and its management could be unbelievably valuable in the aspect of business longevity and the arena's security. The gathered locational data helps the business owners to see the customer's preferences and recognize the patterns that they have when moving inside the arena. The locational data could be crucial information on planning marketing strategies and improving the arena's functionality. From a security viewpoint, the location feature can save precious time in case of an emergency. With the wristband collecting the locations of the people in danger, evacuation plans can be improved. An alert could be sent directly to the application, giving instructions to the users and guiding them to the nearest exit.

8   Testing the Likeability and Usability of the Prototype Using Interviews

An interview is an effective way to gain access to a person's mind. When qualitative data is needed, an interview is one of the most popular methods out there. There might be tough questions that are not that easily answerable, in such a case, the interviewer can guide the person interviewed avoiding any confusion and specify the questions if needed. The interview process can be divided into seven stages: thematizing, designing, interviewing, transcribing, analyzing, verifying and reporting. Sometimes the process is linear, but often, it is not. That is why these stages are only guidelines for how to properly conduct successful interviews. (Pickard 2017, 196-197.)

There is a possibility that interviews produce responses that are difficult to analyze. Enough time and resources need to be reserved to analyze them thoroughly. Even though interviews can produce valuable and rich data, the quality might vary, and it might not always be reliable. (Pickard 2017, 200.)

8.1   Protocol of the Interviews

Prior to the interviews of the prototype, the team set up a protocol with questions that were to be discussed with the people interviewed. Due to time limitations, the team concluded that the best way to implement this would be for each of the group members to interview one person, which in this case meant a total of six interviews. The team was aiming to choose people who have participated or people who might want to participate in events at arenas. The people interviewed included friends and family between the ages of 20-65 years. The team formulated the interview questions with the objective of gaining insight into how the design and the usability of the prototype appeal to potential users. Interview questions are listed below.

1. Do you like to go to events held at arenas?

2. What kind of events (e.g., entertainment, music, sports)?

3. Would you describe the visual layout of the application prototype as intuitive?

4. How would you describe the design of the prototype?

5. Would you allow location data to be collected? If personal data would not be shared.

6. Do you find the feature of a heat map displaying congested areas in an arena a useful feature to be included in the application?

7. Would you like to use the application together with a wristband if attending an event where this service would be offered?

8. Any other comments regarding the prototype you would like to share?

The prototypes were shown to the interviewees by sharing the screen (if done online) of the prototypes made with Figma, an interface design tool, or by showing the prototypes on the screen (if done in person). The interviews were started by explaining the concept of the LED wristbands and how the application would support the usage of the wristbands. Each page of the prototype was shown, and the features explained.

8.2   Results of the Interviews

Overall, the feedback from the interviews was positive. The prototype of the NOKIAband application was described to look easy to use, but at the same time, it was visually pleasing and looked up to date. The interviewees thought that the prototype was practical and innovative. They also thought that the idea behind the prototype would bring a lot of additional value to the event. The concept of LED wristbands was familiar to the interviewees.

When asked about the possibility of agreeing to data collection, most interviewees would give permission to collect data, as it would also bring additional value for the event attendees through the heat map function. One interviewee said that "I wouldn't mind sharing my location because it means that I would get advantages from it, for example with wayfinding. In my opinion I think that a lot of people think the same way I do and would agree to share their locations". It was also said that the navigation feature would smooth the experience and ease the stress of navigating inside the arena.

Overall, the Interviewees liked the possibility that the wristbands would be established in the future in Finland. One of the interviewees said that "It would be amazing if the LED-wristband concept would be implemented in Finland. I have always wanted to experience LED-wristbands in a concert". The prototype of the application was clear and seemed easy to use. With the feedback from the interviews, it was concluded that the functionalities of the application for the NOKIAband appeal to potential users.

9   Discussion

When deciding on a concept, many factors needed to be considered. The team considered concepts like, for example, an online viewing platform or a mobile application for the Nokia Arena about its services. When deciding on the final concept, the team weighed whether the concepts are commercially possible, safe and technically feasible. It was concluded that it would not be a good idea to start from nothing, so something that exists and could be

improved was looked at. This led to the concept of LED wristbands, since this is a relatively new phenomenon that has been a success before.

Feedback from potential users was asked through an online survey, sent to friends, family and co-workers, to which 36 answers were received. What affects the reliability of the results is that our team could not ask a lot of people and presumably, not everyone to whom the survey was sent replied.

Identifying challenges in any development process is essential to avoid any unwanted surprises. Challenges that the concept of NOKIAband might face could be the reliability of the technology, adaptation, the end-users' desirability or cost related.

The costs of the development and implementation need to be realistic. It can turn out that the consumers will not pay (a lot) more, if so, the venue must cover the additional costs. If more people came to the event with this service, then it could be more profitable. Since the NOKIAband is a part of a system, it could collect information on users. The information can be used to earn money back, for example by selling the information to advertisers or to analyze the behavior of the attendees inside the venue.

The concept of NOKIAband is dependent on many different technologies. And as with any technology, there is always a risk of defects such as the system crashing. In case of any disturbances in location services, a fallback solution can be introduced. For example, Bluetooth could be introduced as a backup for 5G technology. Bluetooth low energy (BLE) can be used as an indoor positioning method to locate the wristbands embedded with this technology. If there is inaccuracy in one of the technologies, as fallback both 5G and Bluetooth can be used simultaneously to ensure continuous data collection. (Inpixon 2023.)

Due to time limitations, the team was unable to gather survey responses from all stakeholders involved in this concept. Additional surveys need to be conducted for all parties to assess the potential of this concept for further development. The technical side of how all of this would be fully implemented needs to be explored further.

10   Conclusions and Future Scope

The purpose of this thesis was to innovate and design a new concept for the Nokia Arena to provide a next-generation experience for its audience. The team's focus was to develop a concept that raises the overall engagement for various parties involved in the events. The proposed solution is an LED wristband designed to deliver dynamically changing colors and synchronized visual effects together with other wristbands making visually stunning spectacles. This wristband is also integrated with Ultra-Wideband (UWB) technology which

allows users to seamlessly navigate in the Nokia Arena. The knowledge base was achieved by using various research methods such as benchmarking, interviews and prototyping.

The service concept that the team designed is beneficial for all stakeholders involved. The service provides the audience with an immersive experience not offered at the Nokia Arena before. It collects crucial data for Nokia Arena on how its customers interact in the arena while allowing dynamic staff allocation. Also, the marketers are offered a new way to advertise their products and services during the events by sponsoring the wristbands.

Through benchmarking, it was found that such LED wristbands exist, but they do not have location functionality. The survey conducted suggested that potential customers would want to use the wristbands at the events for a new and overall better experience.

During the Design Sprint, several other features were discovered that would be interesting for further research. One such feature would be signaling the need for service by displaying a specific color. Additionally, the wristbands could produce vibrations for the user to feel different effects during the event. For instance, in a hockey game the wristband could produce a vibration to simulate the tackles that happen in the game.

What comes to any other further developments, there could be many opportunities and potential for this concept. The only way to know for certain if the concept would have success is by having a field test, where you test the new prototypes. In this case it would mean many thousands of prototypes of the NOKIAband. Through this try-out, you get some idea of how this will work, but the try-out would be costly as the arena needs to cover the costs of the test.

The wristbands are not limited solely to the Nokia Arena premises. They could be adapted across the world for every arena event equipped with Nokia's technology. The wristbands could be also extended to festival environments where navigation can be challenging and where there is a need for stunning visual spectacles.

Overall, the feedback from the survey results showed a high level of receptiveness towards the wristband concept. Initial analysis indicates that the potential for all the parties involved in the events is substantial. Also, there appears to be consumer demand for such a concept. The results show that the proposed concept of NOKIAband should be explored further by Nokia.

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Figures

Tables

Appendices

Appendix 1: Questionnaire

Are you familiar with Nokia Arena?

Onko Nokia Areena tuttu entuudestaan?
36 responses

- Kyllä
- Ei

52.8%

47.2%
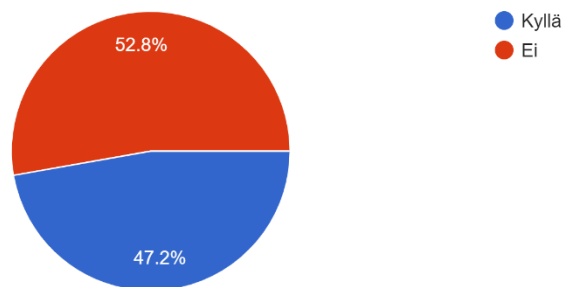
(Kyllä= Yes, Ei= No)

How often you participate in the arena's events?

Kuinka usein osallistut areenan tapahtumiin?
36 responses

- kerran viikossa
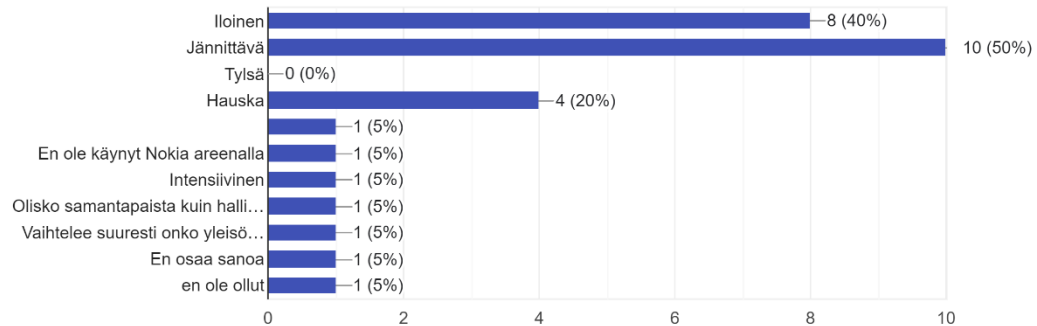- 1-2 kertaa kuukaudessa
- harvemmin
- useammin
- En ole osallistunut

72.2%

27.8%
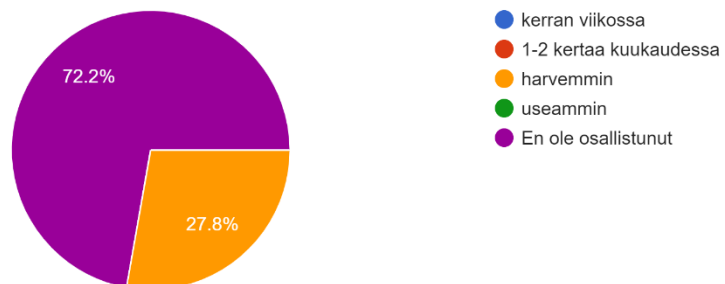
(Kerran viikossa = once a week, 1-2 kertaa kuukaudessa = 1-2 times a month, harvemmin= less than 1-2 times a month, useammin= more often than 1-2 a month, en ole osallistunut= I haven't participated).

How would you describe the atmosphere at the events?

Miten kuvailisit tapahtumien tunnelmaa?
20 responses

Predefined answers: (Iloinen = happy, jännittävä = exciting, tylsä = boring, hauska= funny)

Open answers:

1. En ole käynyt Nokia areenalla = I have not been to the Nokia Arena,
2. Intensiivinen = intensive,
3. Oisko samantapaista kuin hallissa Helsingissä, tunnelma riippuu tapahtuman luonteesta= similar to the atmosphere at halls in Helsinki? Depends on the nature of the event,
4. Vaihtelee suuresti onko yleisö mukana vai ei= varies a lot depending on if the audience is engaged or not,
5. En osaa sanoa= I do not know,
6. En ole ollu = I have not been (to the events).

How familiar are you with LED wristbands?

Ovatko rannekkeet entuudestaan tuttuja sinulle?
36 responses
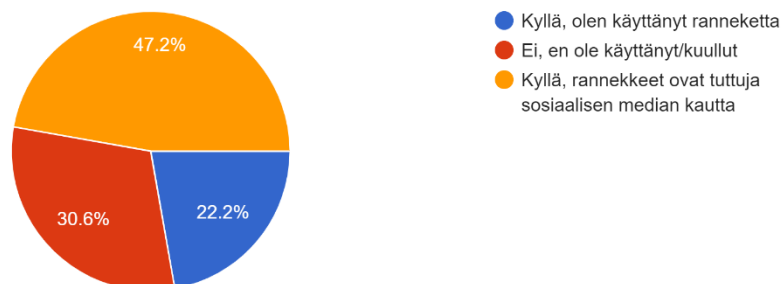
(Kyllä olen, käyttänyt ranneketta = I have used the wristband, Ei en ole käyttäny/kuullut= I have not used or heard about them, Kyllä, rannekket ovat tuttuja sosiaalisen median kautta = I am familiar with the wristbands through social media).

Would LED wristbands bring more atmosphere to the arena?

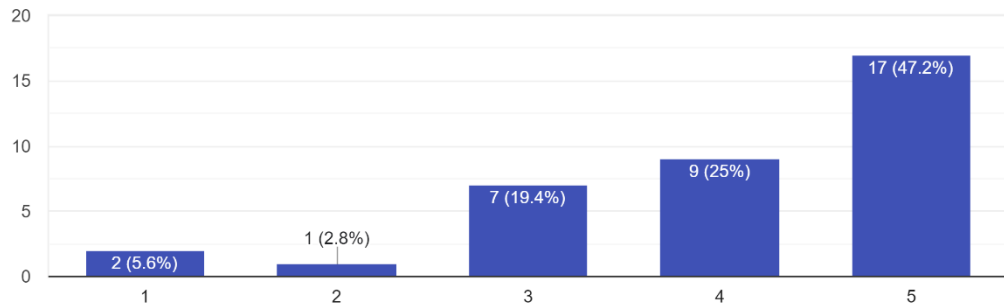Loisivatko LED-rannekkeet lisää tunnelmaa areenalle?

36 responses
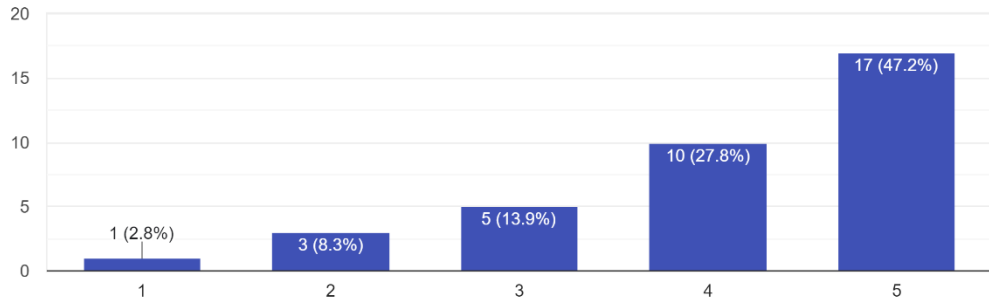
(Number 5 being the highest and 1 being the lowest).

How willing would you be to use an LED wristband?

Kuinka halukas olisit käyttämään LED-ranneketta?
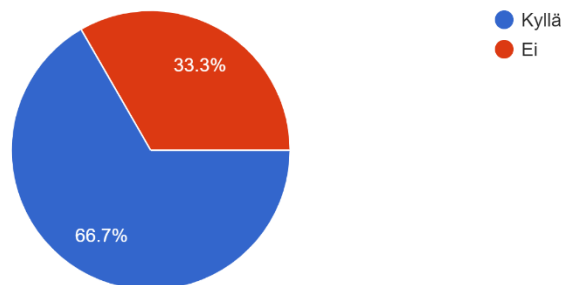
36 responses

(Number 5 being the highest and 1 being the lowest).

Would you allow location data being collected and shared with the LED wristband during the event and on the event area?

Suostuisitko paikkatietojen jakamiseen ja datankeräämiseen rannekkeen avulla tapahtuman aikana tapahtuma-alueella?

36 responses

● Kyllä
● Ei

(Kyllä = Yes, Ei= No)

What would you add to the events to make the atmosphere better?

(Open question, required)

Answers:

1. En osaa sanoa = I do not know,
2. Lisää esityksiä = more performances,
3. Yleisön aktivointia = activating the audience,
4. Asioita/aktiviteettejä joihin voi itse osallistua = things or activities that attendees can take part in,
5. Ei lisättävää= nothing to add,
6. Interaktiivisuutta = interactivity,
7. Mahollisimman paljon kaikkee interaktiivisuutta. = Interactivity in many forms as much as possible,
8. EOS. = I do not know,
9. Ennemmän erityistehosteita = more special effects,
10. Tarjoilua tapahtuman keskelle = catering during the event,
11. Näitä poistaisin: Kännyköiden käyttöä voisi vähentää, ja tilalle vaikka rannekkeita, kunhan eivät ole näköesteenä muille! = I would remove: less phones, replacements of wristbands as long as they are not a visual barrier for others,
12. Jos voisi tuoda artisti lähemmäksi, tai parempi kontakti = bringing the artist closer, with a better contact,
13. Special effects ja vuorovaikutus esiintyjien kanssa. Lavan sijainnin keskeisyys, jotta näkyvyys olisi hyvä paikasta riippumatta = special effects and interactivity with the

performers. Stage being in the center, so that the visibility is good regardless of the seat,

14. Hyvä valikoima juomia ja ruokia (jotain spesiaalia esimerkiksi järjestettävän tapahtuman teemaan liittyen). Ettei aina olisi sama valikoima. = a good selection of drinks and foods (something special depending on the event) so that the selection is not always the same,

15. Ehkä enemmän tilaisuuksien loppumisien parempaa järjestämistä. Saa odottaa aika pitkään että pääsee ulos = maybe better handling of exiting the event area. You have to wait a long time to get out,

16. Esimerkiksi happroilla gettomasan keikalla äänentoisto olisi saanut olla hieman lujemmalla!= for example at happrot, (an event for students) where the artist Gettomasa was performing, the sound reproduction could have been on a louder volume,

17. Hyvät juomat= good drinks,

18. enemmän vessoja :D = more toilets,

19. en tiedä = I do not know,

20. Vaihtelevuutta eri tapahtumiin efekteillä ym = variability to the event with effects for example,

21. En ole varma = I am not sure,

22. En osaa sanoa = I do not know,

23. Lisää asiakkaiden osallisuutta tapahtumiin = more participation of the customers,

24. Alkoholitarjoilu katsomoon = serving alcohol in the audience,

25. Yleisön osallistaminen, esim. lätkämatseissa look a like – kamera = participation of the audience for example at hockey games with "look a like" – camera,

26. Yleisö kilpailuja = audience competitions,

27. Väliaika tapahtumia = events during the half time,

28. Yleis sujuvuus esimerkiksi WC jonot ..... = the overall fluency, for example the lines to the toilets,

29. Hyvää musiikkia = good music.

Do you have any other thoughts you'd like to share about LED bracelets?

(Open question, optional)

Answers:

1. Panttia vastaan varmaan palautuisivat myös lähtiessä = in exchange for a deposit the writbands would probably also be returned,

2. Jossain tylsil hetkil vois ottaa jonku kevyen mielipidekyselyn, ja sit porukan rannekkeet värjäytyy vastauksien mukaan. Ja mielipidekyselyyn haetaan aina sponsori joka saa päättää kyssärin. = on the boring moments, a brief opinion poll could be

implemented and the audience could turn the color of the wristband to express their opinion. And a sponsor could determine the questions,

3. Lisäominaisuuksia ja palveluja rannekkeeseen. = more additional features and services to the wristband,

4. Tärkeintä olisi etteivät rannekkeet tuota häiriötä tapahtumassa. Mutta jos niihin saisi liitettyä viestintää, palveluja, frequent visitor's benefits jne. OK = the most important thing is that the wristbands don't cause any disturbances at the events. But if you could add communication, services, frequent visitor's benefits etc. to the wristbands,

5. Voisi olla enemmän kuin vaan ledi valo? = could be more than just the LED light?,

6. Rannekkeet voisivat luoda enemmän tunnelmaa keikoille mutta en ukso että urheilutapahtumiin ne olisivat niin hitti. = the wristbands could bring more atmosphere to concerts but I don't reckon that they would be a huge hit in sport events,

7. Uudelleen käytettävät rannekkeet, ladattavat jotka esimerkiksi jätetään portille lähtiessä. Ympäristövastuullisuus = reusable and chargeable wristbands that would be, for example, left at the gate when leaving the event, environmental safety,

8. Sen alkuperäinen synty = the origin of the wristband.