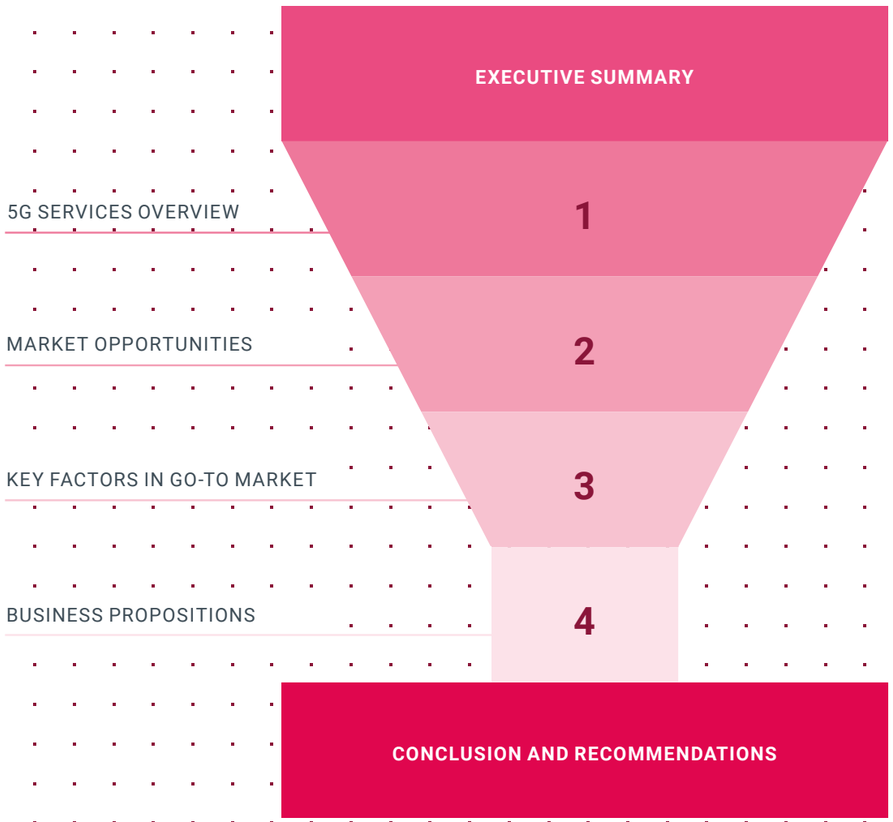
CATAPULT Digital

5G VISTA

Bringing new dimensions to in-stadia sporting events

5G VISTA

Sustainability Report
March 2022



Contents

3 EXECUTIVE SUMMARY
- The 5G VISTA project
- Project partners
- Key output and outcomes
- Summary of recommendations

7 5G SERVICES
- Broadcast / Multicast / Unicast
- 5G Broadcast / Multicast
- 5G Broadcast: current industry and case studies
- The market opportunity
- The rise of Long Term Evolution (LTE) / 5G private networks
- The role of Wi-Fi

29 MARKET OPPORTUNITIES
- GWS consumer research
- Industry workshop
- Primary use cases
- End-user research

44 KEY FACTORS
- 5G deployment considerations
- Business considerations
- 5G in-stadia: case studies
- 5G at “widespread” events: case study
- Stakeholders

56 BUSINESS PROPOSITIONS
- Products introduction
- Football product
- Motor racing product

78 CONCLUSION

01. EXECUTIVE SUMMARY

THE 5G VISTA PROJECT

5G VISTA (Video in-stadia Technical Architecture) is part of the UK Government's Department for Digital, Culture, Media and Sport (DCMS) **5G Testbeds and Trials programme**, a £200 million investment in testbeds and trials across the UK to explore new ways that 5G can boost productivity, grow existing businesses or spark new ones.

5G VISTA was funded as part of the **5G Create portfolio** and aims to test and demonstrate the potential of 5G Broadcast/ Multicast to deliver new and exciting digital experiences to spectators at live events.

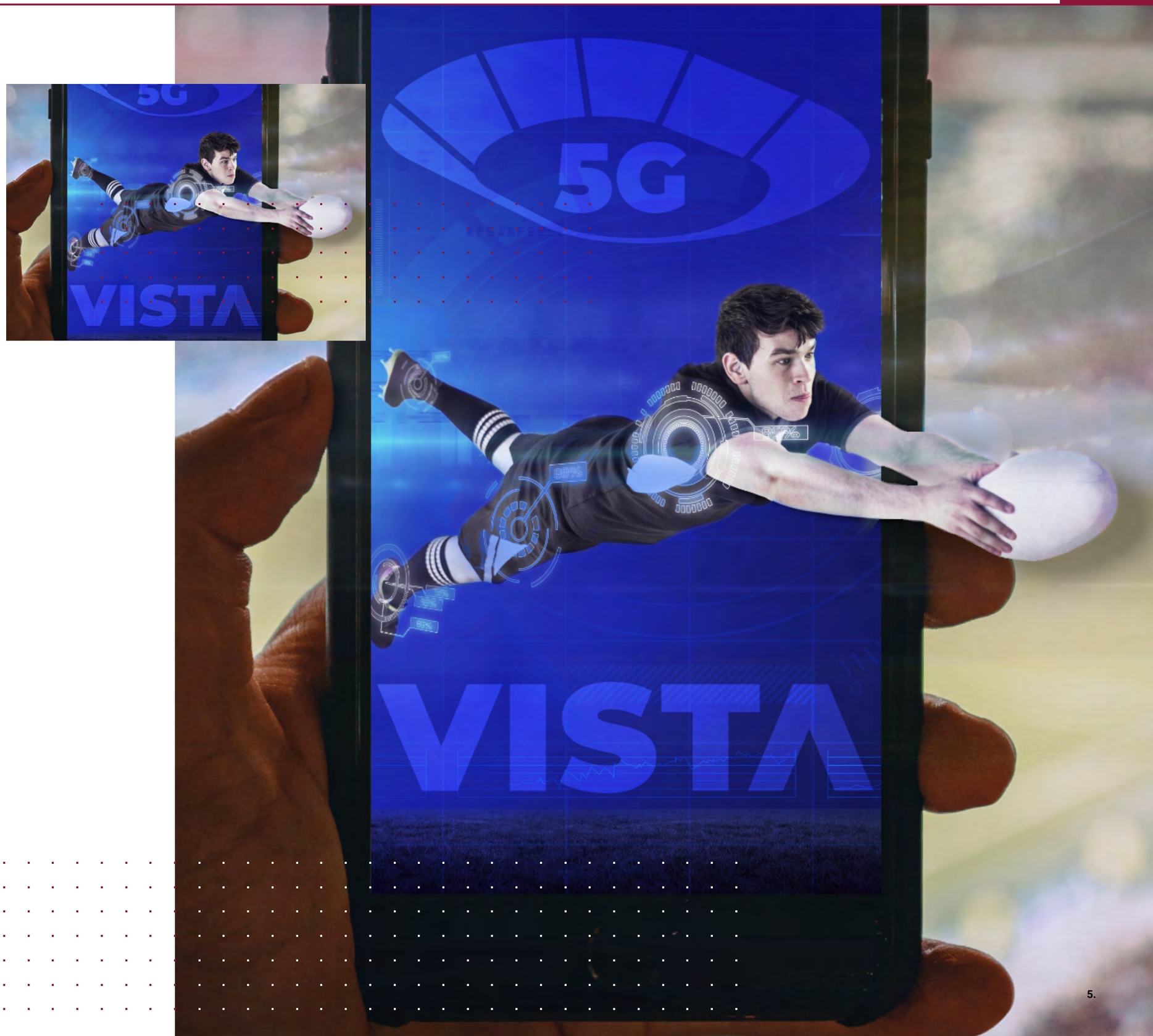
The project uses Further-evolved Multimedia Broadcast and Multicast Service (FeMBMS) technology to support innovative use cases - to both enhance customer experience at events, and increase engagement. Whilst most mobile and internet communications are modelled on a "one-to-one" system, FeMBMS is a "one-to-many" service; it will take a single stream and send it to multiple users.

THE OPPORTUNITY

By providing live, multi-angle HD video streams and interactive content direct to devices in stadiums and across the UK, the 5G VISTA project aims to deliver new dimensions for live events. Showcasing new in-stadia digital experiences, VISTA aims to not only enhance customer experience but to increase existing channels of engagement for live sport.

THE PROBLEM

VISTA primarily addresses the frequently-cited problem of a **lack of bandwidth** at live events to deliver important and relevant content to large audiences. By using FeMBMS rather than one-to-one Unicast, VISTA delivers multimedia content efficiently and effectively from a single source to many users, whilst maintaining quality of service (QoS) regardless of the number of users.



Project partners

VISTA brings together industry players with complementary skills, knowledge and experience from across the mobile media ecosystem - from handheld and stationary devices, to networks, broadcast, content and venues. The project has seen partners testing and demonstrating the technical feasibility and the business potential of the 5G Broadcast/Multicast technology in several user scenarios.

Working in partnership with DTG, GWS, Virgin Media O2, 5GIC, Ori and Rohde and Schwarz, Digital Catapult is responsible for the infrastructure of the 5G testbed network, validation of the business use cases, and assessment of further applications and market verticals. This report focuses on the first phase of the latter two deliverables.

Ateme

Provides a software encoding system, that encodes and packages the camera feeds into the correct formats for broadcast distribution by the 5G broadcast technology.

Digital Catapult

Provides the 5G testbed network, validation of the business cases and assessment of further applications and market verticals.

Ori Industries

Provides a multi-access Edge Compute platform to enable Ateme's solution for live sport streaming to be deployed on the O2 4G and 5G network.

GWS

Provides consumer research and insight from a mobile network operator perspective.

Imaginary Pictures

Provides production and live camera expertise for technical demonstrations.

DTG

Provides project management, coordination, and collaboration with the creative industries.

Rohde and Schwarz

Provides the equipment, systems and expertise for a Multicast/ Broadcast overlay network based on 5G Broadcast technology.

The University of Surrey's 5GIC

Provides Multicast/Broadcast security within the VISTA project, including the design and validation of E2E security for group communication.

Virgin Media 02

Virgin Media O2 has the UK's largest and most reliable mobile network. As the project's technical lead, VMO2 has driven the development of the broadcast solution and has also provided the final showcase venue.

Key outputs and outcomes

The key output of the VISTA project is to test, trial, and demonstrate 5G Broadcast services at in-stadia events, using key consumer feedback to deliver sustainable solutions that will highlight commercial opportunities.

This business sustainability report, produced by Digital Catapult, assesses how the project will achieve a commercially viable product. It will outline how the 5G VISTA project will transform the experience of attending live, in-stadia sporting events by delivering innovative, high quality and reliable 5G services to customers.

Key research findings, including summaries of dedicated feedback workshops, market research and stakeholder feedback, will be outlined in order to illustrate the commercial viability of the chosen use cases.

The report draws on a number of selected use cases to illustrate the product's sustainability and its potential application in broad sectors.

02. 5G SERVICES OVERVIEW

5G SERVICES

This chapter provides an overview of services available in the contemporary 5G ecosystem and outlines the choices made for the 5G VISTA project specifically. It will begin with a comparison of Broadcast/Multicast to Unicast options, exploring the benefits and environmental implications - with some chosen examples of each service.

Following this overview, the chapter also explores how Multicast/Broadcast services can be implemented and outlines market opportunities across different sectors. We will provide some illustrative examples of how 5G Broadcast services are being used across in-stadia events, and highlight where there are gaps that 5G VISTA seeks to address.

5G is already being used to enhance the experience of live events by a number of companies worldwide. However, 5G VISTA offers a unique opportunity, using 5G Broadcast/ Multicast specifically, to offer further insights into gameplay statistics, footage angles and behind the scenes content. In this chapter we outline some examples of 5G applications that have sought to enhance the live user experience in order to illustrate the broad potentials of FeMBMS.

Broadcast / Multicast / Unicast

INTRODUCTION

In order to realise the central ambition of the VISTA project - of enabling the seamless delivery of multimedia content direct to large audiences at in-stadia events - conscious decisions have been made to choose the most effective services for this form of delivery.

5G Broadcast/Multicast services provide the best opportunity for 5G VISTA due to their “one-to-many” model (where data traffic is sent from a single point to many). Through usage of this technology, stadium broadcasters will be able to control customer viewing experiences from one transmission point and deliver to multiple users at any given time.

On the other hand, Unicast - the primary alternative solution available to Broadcast/Multicast in the current market - is less cost effective and has **additional negative environmental implications.**

We will outline some of the key features of each option, making the case for the sustainability of Broadcast/Multicast 5G services across a range of different sectors, as well as its suitability for in-stadia roll-out and commercialisation.

Broadcast / Multicast / Unicast

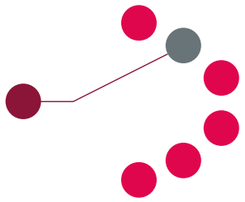
5G BROADCAST/MULTICAST VS UNICAST

5G Broadcast/Multicast is the fastest, most reliable 5G service that most effectively allows for a "one-to-many" distribution approach. This approach extends the capabilities of 5G Unicast services, which deliver traffic "one-to-one" (see illustrations). As such, these unique capabilities have influenced the decision to identify the Broadcast/Multicast service as the most suitable for implementation in the VISTA project. The service has the key capabilities required to enable broadcasters to transmit chosen content to all customers within a coverage area from one single transmission point.

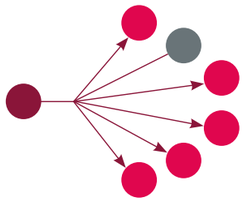
The combination of both Broadcast and Multicast services increases the capacity of existing cellular network base stations within a location, with the addition of supplementary broadcasting transmitters.

5G Broadcast/Multicast is part of the "3rd Generation Partnership Project" (3GPP) family of standards and can be fully integrated into 3GPP equipment and services.

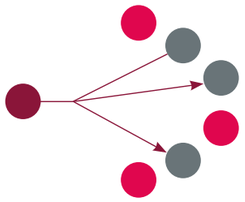
THE DIAGRAMS BELOW ILLUSTRATE THE WAY IN WHICH BROADCAST/MULTICAST WORKS IN COMPARISON TO UNICAST



Unicast allows data traffic to move across networks from a single transmitting point to another single receiving point (one-to-one communication). Bi-directional Unicast communications is the foundation of cellular networks.



Broadcast enables data traffic from a single point to all possible endpoints within reach of the network, all at the same time. This is very efficient, and the easiest technique to ensure data reaches its destination.

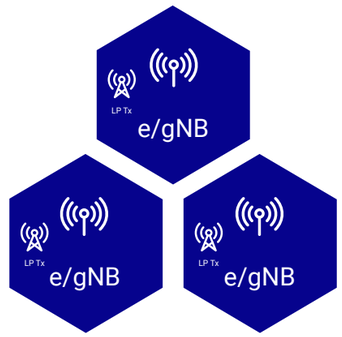


Multicast enables data traffic from a single point to many receiving points, simultaneously. It is a one-to-many distribution concept which exists between Unicast (one-to-one) and Broadcast (one-to-all) communication.

Images: TEO Limited, Mar. 2022

Supplementary Downlink (SDL) non-standard architecture standalone concept

Overlay non-standard architecture (NSA) standalone concept



Rohde and Schwarz, "5G Broadcast/Multicast Report", Mar. 2021

Unicast

Other technology solutions analysis

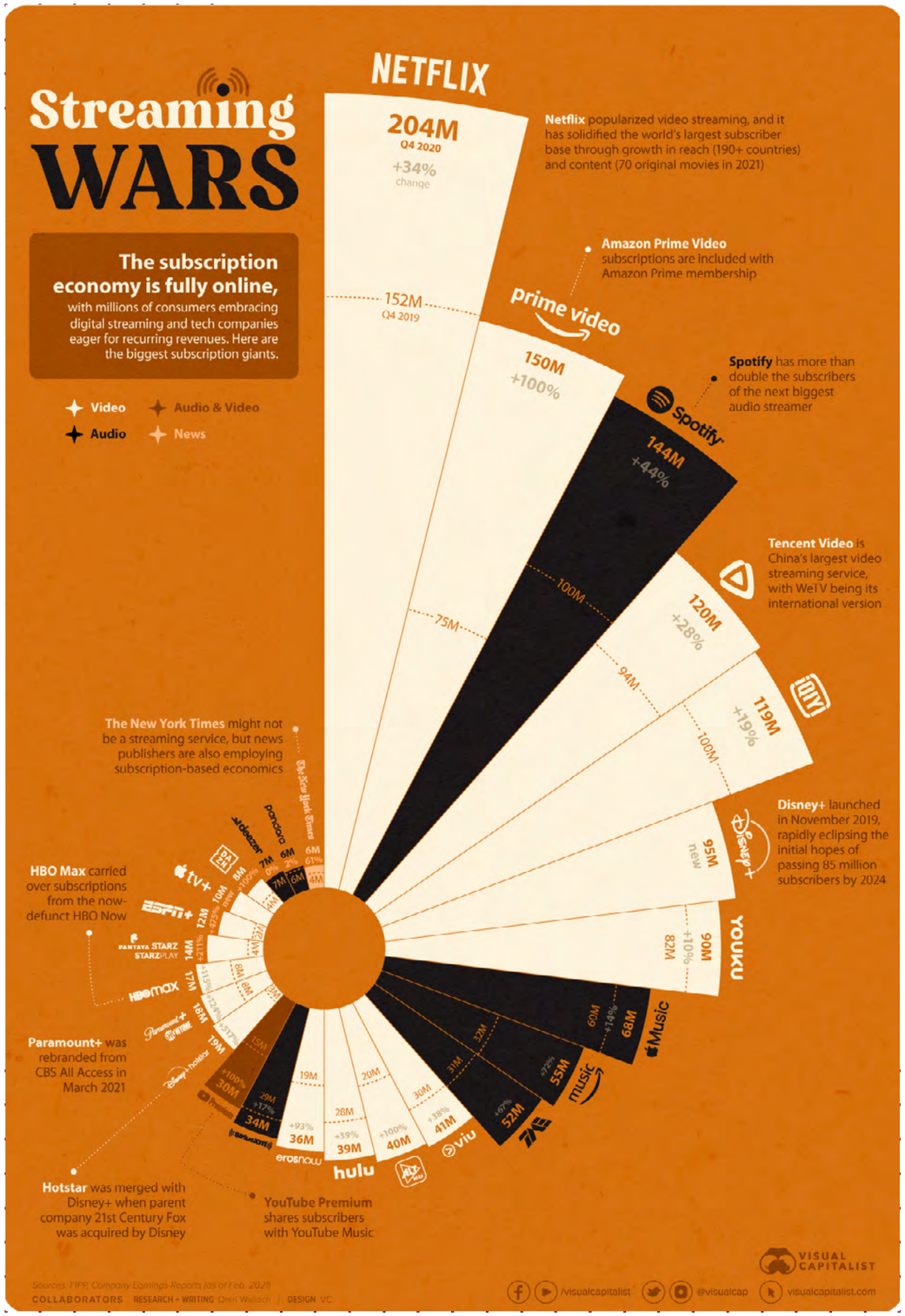
Unicast is the primary alternative technology solution to Broadcast or Multicast distribution. It can be extremely expensive in terms of bandwidth, due to the fact that a unique stream is created by the sender for every unique receiver.

Online video-on-demand services including Netflix, Amazon Prime, and YouTube all utilise the Unicast method of streaming.

Only a few streaming services support live TV:

- Most popular on-demand streaming services: **Netflix**, **Disney Plus**, **HBO Max**, **Hulu**, **Peacock**, **Apple TV Plus**, **Paramount Plus**, **Discovery Plus**, and **Amazon Prime Video**
- Most popular live TV streaming services: **Hulu + Live TV**, **YouTube TV**, **Sling TV**, **FuboTV**, **Philo TV**, and **DirecTV Stream**
- Most popular channel-specific streaming services: **Showtime**, **Starz**, and **ESPN+**

The figure shows the market share for each of the most popular online streaming services. Live TV services, like **Verizon's Go90**, are having difficulty competing in this extremely competitive landscape.



www.visualcapitalist.com: https://www.visualcapitalist.com/which-streaming-service-has-the-most-subscriptions

Broadcast / Multicast / Unicast

Comparison table

SERVICES	BROADCAST	MULTICAST	UNICAST
TYPICAL USE	Live TV	Video over IP	Over-the-top / streaming applications
EXAMPLE SERVICES	Broadcast TV (BBC, ITV, …)	Virgin Media, Sky TV, TalkTalk	Netflix, Hulu, streaming providers
BEST FOR	Live TV	IPTV	Video-on-demand
SECURITY	Strong (conditional access)	Very Good, operates in a private IP network	Poor, operates over public Internet
QUALITY OF SERVICE	Guaranteed	Managed (“Guaranteed”)	Best effort (adaptive streaming/CDNs)
BANDWIDTH USAGE	Fixed	Uniform	Variable
USER EXPERIENCE	Excellent (lean back)	Very good (lean back)	Interactive (lean forward)
NETWORK REQUIREMENTS	Dedicated broadcasting system	Own private/managed IP network	Works over public Internet
EASILY SCALABLE	Easily scalable to millions	Not easily scalable (esp. heterogeneous)	Expensive to scale up (in line with number of nodes and receivers)
ENDPOINT UNIFORMITY	Assumes endpoints have same bandwidth requirements	Assumes endpoints have similar bandwidth requirements without bandwidth fluctuations	Endpoints receive video based on their capability and available bandwidth

Table: TEO Limited, Mar. 2022

Broadcast / Multicast vs Unicast

Though streaming services are extremely competitive in the market, unicast video distribution has **up to ten times the environmental impact*** of 5G Broadcast, due to its one-to-one model.

The **Low Carbon TV Delivery Project** (LoCatT)* is a collaborative initiative backed by leading European broadcast and technology players, to assess the energy and carbon impacts of the delivery of TV content (both linear and on-demand) across Europe and across Digital Terrestrial Television (DTT), Internet Protocol Television (IPTV) and Over-The-Top media services (OTT).

LoCaT estimates that unicast streaming (OTT or managed IPTV) requires a considerably higher energy consumption, and thus, carbon equivalent emissions, than linear DTT delivery.

EU28 AVERAGE	BROADCASTING (DTT)	UNICAST (OTT)	UNICAST WITH LIVE TV (IPTV)
ENERGY CONSUMPTION ASSOCIATED WITH ONE DEVICE VIEWING HOUR (IN WH)	14 Wh	109 Wh	153 Wh
CARBON DIOXIDE EQUIVALENT EMISSIONS (IN CO2E)	3.3 gr	26.2 gr	37.0 gr

* The LoCaT Project: https://thelocatproject.org/
** Carnstone, "Quantitative study of the GHG emissions of delivering TV content", (2021)

5G Broadcast / Multicast
Key features

With all of these factors in mind, key features have been outlined that illustrate the effectiveness of 5G Broadcast/Multicast for the 5G VISTA project, particularly in relation to the enhancement of unlimited user access for event customers in a secure and reliable manner with minimal access barriers.

Receive-only mode / free-to-air reception in which no uplink or SIM card is required

Encrypted services, including authentication mechanisms to enhance security

Dedicated broadcast networks and related infrastructure to support seamless delivery

Standard Application Programming Interfaces (API)s for easy design and integration of media services

Fixed, portable and mobile reception to extend coverage

Quality of service (QoS) defined and trusted by service providers

Single frequency networks (SFNs) with multiple transmitters that send a singular signal increasing coverage and reliability

5G Broadcast / Multicast

Capabilities and limitations

5G BROADCAST ENABLES:

- Distribution of **public and commercial linear radio and TV services,** including free-to-air or encrypted, to 3GPP compatible devices such as smartphones, smart TVs, or car 'infotainment' systems
- **Personalised media** can be delivered via linear broadcast, alongside catch-up and on-demand content, using the same family of 3GPP standards
- **Broadcast distribution of linear TV and radio services** integrated into existing media applications with 3GPP-defined APIs
- The potential to be **combined with broadband connectivity** (in which case a SIM card or subscription would be required to access the latter)

LIMITATIONS INCLUDE:

- **No native support of non-linear features,** in that it is difficult to incorporate elements such as: pause live broadcast, rewind/fast-forward, record, buffering, etc. unless these features are implemented in the receiver
- **Synchronisation with the 5G core network not supported**

SET UP TO COMPATIBLE DEVICES THROUGH 5G BROADCAST IS ILLUSTRATED IN DIAGRAM BELOW

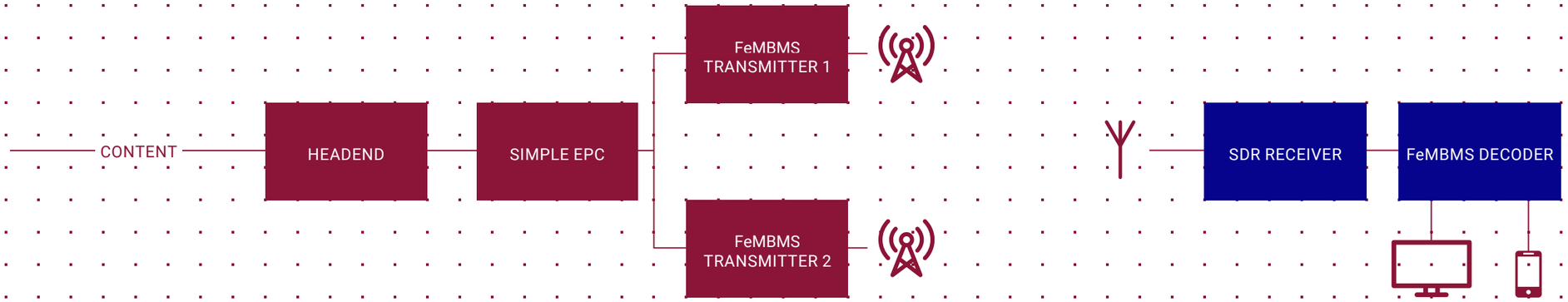


Image: Mohamed Aziz Taga, "5G Broadcast - Where does it stand?", DVB Webinar, Jan.2022

5G Broadcast / Multicast

Use cases

5G Broadcast supports a wide range of services:

RADIO/TV BROADCASTING DELIVERED IN NEW WAYS VIA MULTIPLE DEVICES:

- Localised delivery
- Customised content production and distribution
- Live TV casting to connected cars, trains, etc. (mobile TV)
- Augment Unicast content delivery
- Guided tour in museums, airports, venues, etc.
- Electronic newspapers/magazines
- Data feeds and notifications

NEW USE CASES TO ENHANCE USER EXPERIENCE:

- Multi-angle views of an event
- Voice over commentary of a live event
- Access to multiple events taking place in different locations
- 360-degree video views of remote areas
- Delivery to large screens in major events

NEW USE CASES TO INFORM AND PROTECT (SAFETY):

- Supporting recovery in disaster areas e.g. coordinating first responders
- Public announcements, emergency alerts and alarms
- Over the air information download for maps, traffic info, etc.
- Instructions and guidance in critical situations

Multiple applications on the same infrastructure

Media/entertainment distribution of live media events

Video delivery to large screens

5G radio/ TV in cars

Over air maps and traffic info

Synchronise and update maps and traffic info

Public information updates

Vehicle casting and automotive broadcasting

Enhanced car positioning without satellites

On-demand content for cars

Public transport, airports, cruise ships

Natural disaster resilience

5G Broadcast / Multicast

Live sports and music events

In highly crowded places such as football matches and large music concerts, the primary challenge is to keep up with the ever-increasing demands of mobile multimedia consumption by large volumes of people at any one given time.

5G Broadcast/Multicast alleviates such challenges and offers the potential of new, value-added services that appeal to attendees of live events, including*:

- Live super high-definition (SHD) video from the pitch or the stage, with fans able to choose from multiple camera angles in real time
- Show data overlays and stats about musicians or players on the audience's mobile or wearable devices
- Sell merchandise or additional services on the fly to customers using mobile devices
- Support pop-up retailers with secure wireless connections for payment processing
- Extend market reach, by offering the same live video and information feeds to fans who couldn't get to the venue

* GWS Research Debrief, "Evaluating the 5G VISTA concept", Apr 2021

5G Broadcast / Multicast Implementation

5G BROADCAST/MULTICAST SERVICES CAN BE DEPLOYED IN TWO WAYS:

OPTION A

By upgrading existing cellular sites using supplementary downlink transmitters

OPTION B

By deploying an overlay network, a computer network which is built on top of another network, using a high-power transmitter

The VISTA implementation

VISTA has focused on deployment option A as the most optimum method for using pre-existing infrastructure in stadiums across the UK.

This method will utilise FeMBMS to enable the simultaneous delivery of a single video stream to multiple users (Multicast/Broadcast). The technology overcomes the problem of a lack of bandwidth at live events by delivering the content from a single source to many users, rather than one to one, meaning that quality of service is maintained, regardless of the number of users.

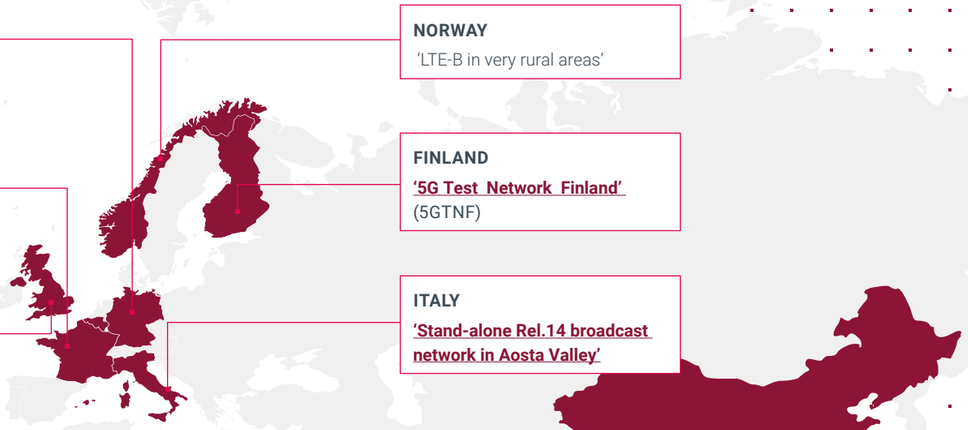
5G Broadcast

Current state of the industry

Across the globe there is significant interest in 5G Broadcast deployment and a high level of activity in 4G/5G Broadcast trials, with traction building across all regions.

Many use cases are being developed and trialed, with more emerging. This will lead to extensive commercial rollouts worldwide.

SOME SIGNIFICANT TRIALS AND TESTBEDS IN EUROPE INCLUDE:



GERMANY
'5G-TODAY'

FRANCE
'Tower Overlay'

UK
'5G RuralFirst'

NORWAY
'LTE-B in very rural areas'

FINLAND
'5G Test Network Finland' (5GTNF)

ITALY
'Stand-alone Rel.14 broadcast network in Aosta Valley'

NEW STANDARDISATION ACTIVITIES ARE ALSO TAKING PLACE IN EUROPE AND CHINA:

5G Media Action Group, formed in 2021 to create common reference tools and support implementation and interoperability

CHINA
The chinese technical standards organisations are preparing a new mobile Broadcast-Multicast standard named aib: advanced interactive broadcast, that will be considered as the future industry standard

5G BROADCAST CASE STUDIES

5G BROADCAST CASE STUDY

Samsung 5G and Nexus NFL Dallas Cowboys Augmented Reality (US)

The AT&T stadium, home to the Dallas Cowboys, was the first stadium venue to harness the 'Augmented Reality Cloud' in 2019.

The collaboration with Samsung and Nexus Studios saw stadium attendees using Samsung, 5G-enabled mobile phones to view AR renditions of the Cowboy players, showing their performance statistics during gameplay.

AR technology was also deployed at half time to stream holograms that fans could take photos with, as well as gamified robot battles with the players. Working with technology developed by Scape, the whole stadium was scanned to ensure that AR features were accurately placed.

To find out more, visit:
A Forbes article about the experience
Information about Nexus Studios' immersive tool, GILDA

5G BROADCAST CASE STUDY

Ericsson/Ooredoo (Qatar)

Ericsson has partnered with a number of global stadiums to develop 5G connectivity to enhance experiences at a number of football tournaments.

Ericsson is preparing to collaborate with Qatari telecom company Ooredoo to roll out 5G connectivity for a football tournament taking place in Qatar in November/December 2022. This connectivity will span across 8 stadiums in 6 different cities. The infrastructure uses 5G radio access network (RAN) and will also be installed to enable different experiences across local airports, fan zones and major tourist attractions.

To find out more, visit:
Ericsson news release about the experience

5G BROADCAST CASE STUDY

SK Telecom and in-stadia AR (South Korea)

In 2019, South Korean telecom company SK launched an Augmented Reality (AR) application powered via a 5GX smartphone app to show the South Korean baseball team SK Wyverns' mascot flying through the stadium. Following the impact of the COVID-19 pandemic, SK developed a 5G streaming service on its platform 'Wavve'. The application allowed viewers to access 12 different angles of various baseball games and additional detailed analysis of the game in real-time. They estimated that viewership on the app was 20% higher than those watching the game on broadcast TV.

In addition to camera angles, the app offers:

- Fan chat service
- Statistics and analytics
- Ability to watch up to 5 different games at the same time

Read more about the partnership

5G Broadcast
Case studies

VERIZON'S GO90 SERVICE

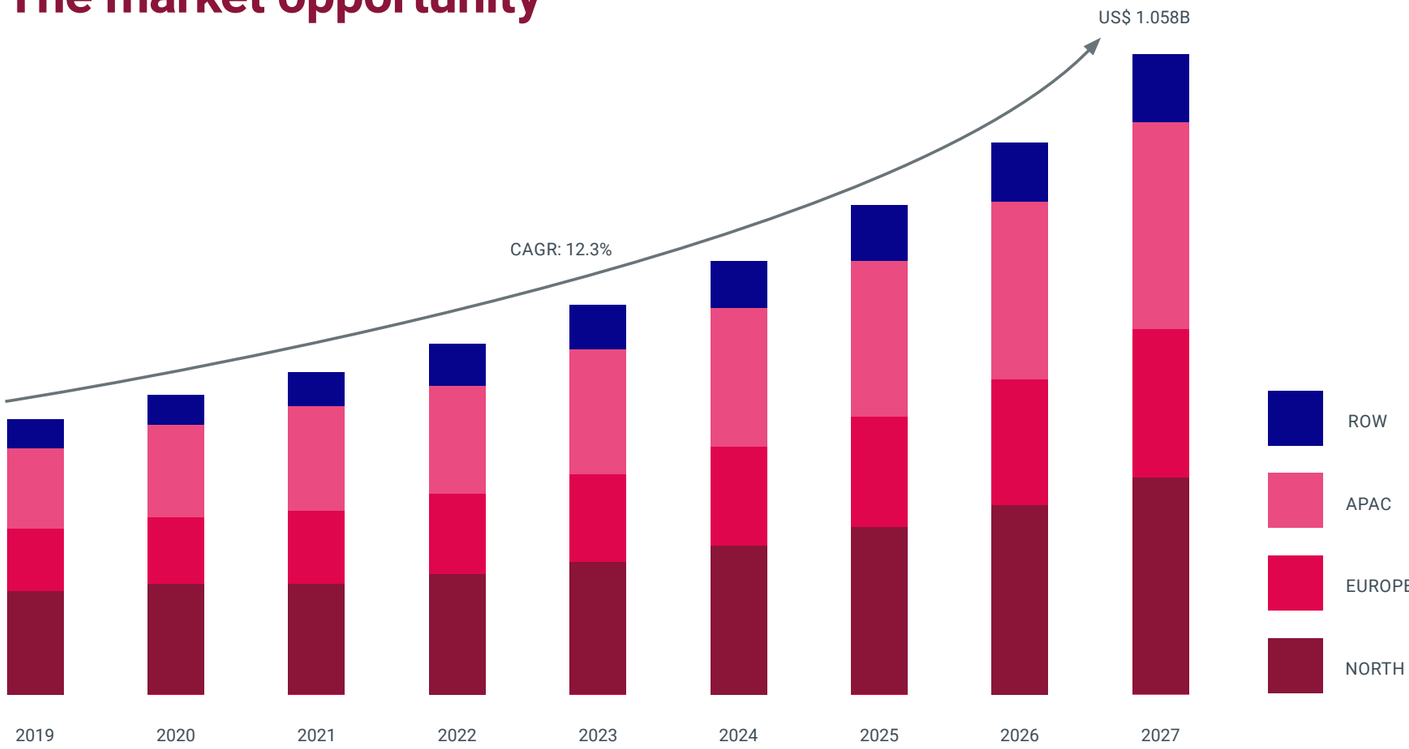
Verizon's Go90 app launched in Autumn 2015 exclusively for Verizon customers. Samsung and Verizon reached an agreement to pre-load the service on Samsung Galaxy S9 smartphones. This was a direct response to the overwhelming success of streaming services such as Netflix and other media companies creating original content. Go90 was geared towards Millennials, Generation Z, and gamers. The Go90 app streams ad-supported video content in the form of scripted shows, movies, short clips, and news. Similar to YouTube, users (the majority of them, teens) were able to like and comment on any of its content; it offered a mix of in-house, exclusive, and licensed classic series, and let users build their own shelf of favourites.

The service was meant to be ad-supported, but not even a quarter of the videos had any ads attached, and of those that did, more than half were for other Go90 content. Without big-name (and budget) series, networks or talent attached to most of the content, the ambitions for the service seemed entirely unsustainable. Verizon had acquired content from a range of partners including premium content from NFL, SuperBowl, La Liga and NBA games and even won an Oscar in 2018 for Kobe Bryant's animated short film "Dear Basketball."

According to Verizon, the problem with Go90 was its inability to achieve scaled distribution, lack of advertising dollars coming in, the massive expense creating and maintaining the service and **"overhype"** through its marketing. At its highest point the total audience for Go90 reached an average of more than 17 million unique viewers per month in early 2018 compared to YouTube's 1.5 billion. Go90 also has had difficulty with advertisers, as many companies are put off by the service's weak user numbers. Partners also became frustrated by the lack of promotional push behind their shows, and talent complained that the app-only experience didn't give them a way to share their work with their large fan bases. Finally, Go90 was also beset by turmoil on the technical-development front (from Intel's OTT OnCue division that built the original Go90 platform) and poor user interface that made it difficult to find content.

Go90 was supposed to combine the revenue model of Facebook with the content style of Snapchat and the social features of a messaging platform, but in reality, it never had the content or user base to make it work. So, after spending well over $200million (some say $1.2B) the service was terminated in July 2018.

The market opportunity



OVERALL MARKET OPPORTUNITY

The market size of Long Term Evolution (LTE) and 5G Broadcast is expected to grow at a steady compound annual growth rate (CAGR) of 12.3% in the next five years, and reach over 1 billion USD by 2028*.

The market is primarily driven by the increasing 5G and LTE mobile user base, the penetrating sales of smartphones and the rising popularity of on-demand content. Moreover, growing need for increased connectivity of devices due to the Internet of Things (IoT) revolution is likely to further promote the market growth.

IMPACT OF COVID-19

The COVID-19 pandemic caused major disruptions in the global economy, with the entertainment industry - a key target market for 5G Broadcast - being amongst the hardest hit with the closure of all major venues and events. Whilst the broadcast market is currently showing signs of recovery, the financial outlook remains uncertain with high-levels of inflation which can hinder consumer spending and limit new investments. The impact of COVID-19 on the supply chain (e.g. integrated circuit IC availability) will also delay the introduction of new devices in the market at least until the end of 2022.

PRIVATE 5G BROADCAST NETWORKS

Private 5G Broadcast currently appears to have more immediate content distribution opportunities than generic public networks for the immediate future. However, given the dependencies on 3GPP Rel.17 and the enormous investment in Digital Terrestrial Television (DTT) infrastructure and user-base, this is unlikely to happen quickly.

* Source: Market Research Future, “Lte and 5g Broadcast Market Report”, April (2021)

The rise of LTE/5G private networks

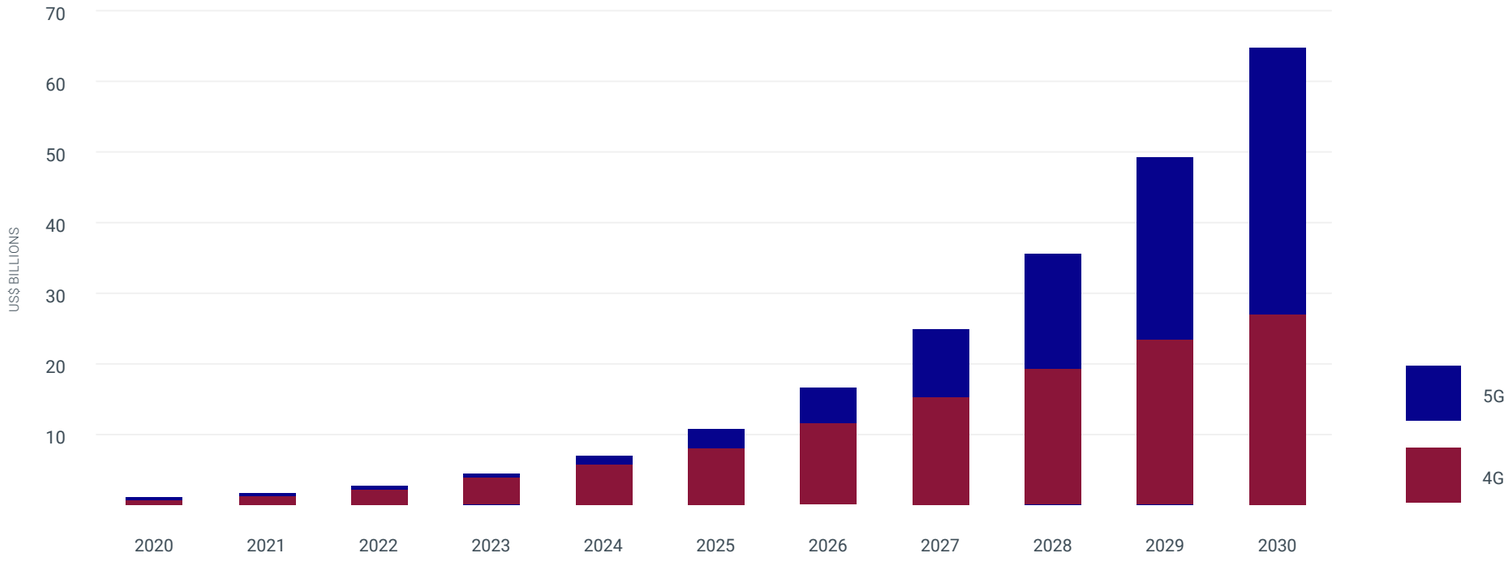


Image: ABI Research, "Private Cellular Networks to Generate Over US$64 Billion by 2030", Oct. 2020

In order to deliver content at a specific venue to attendees of that particular venue only, 5G VISTA relies on private 5G networks.

These networks allow enterprises to bring a custom-tailored 5G experiences to their indoor or outdoor facilities where high-speed, high-capacity, low-latency connectivity is crucial, regardless of whether the premises is within a public 5G coverage area.

There are an increasing number of enterprises that are leveraging 5G technology to launch private 5G networks,* and adding private 4G/5G is now the top priority of IT decision makers in medium sized enterprises.**

The private LTE/5G market is expected to grow rapidly and reach $64 billion by 2030.***

All of the **outlined 5G Broadcast use cases** can be implemented by using a private 5G network fully controlled by the broadcaster or by a third party as a managed service****. Private 5G Broadcast has more immediate content distribution opportunities than generic public networks for the immediate future.

See Vodafone's private 5G pilot with the Deutscher Fussball-Bund (DFL – the German Football Association) and the Bundesliga (German Premier League) club VfL Wolfsburg.

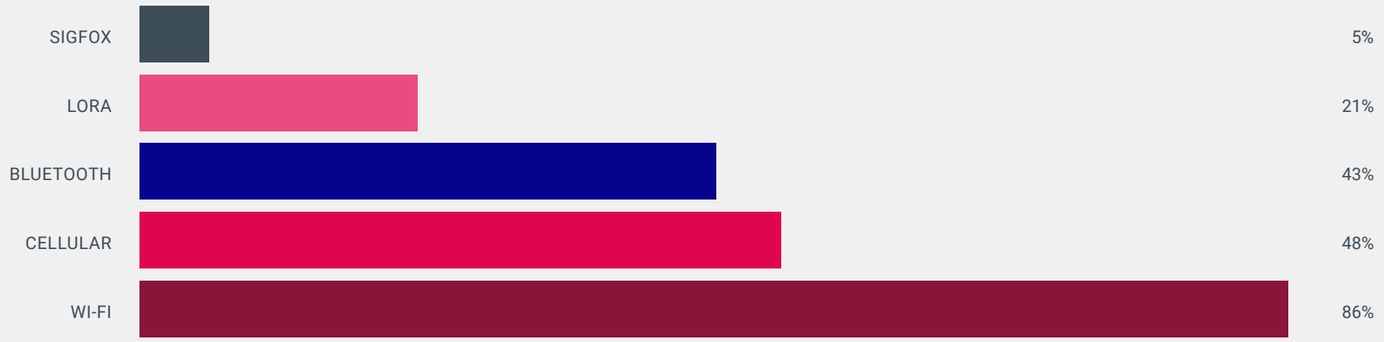
* Morning Consult, "Verizon 5G Business Report", Dec. 2020
** Technalysis Research, 2020, Based on a survey of 600 US-based IT decision makers at medium and large enterprises (100-999 employees)
*** ABI Research, "Private Cellular Networks to Generate Over US$64 Billion by 2030", Oct. 2020
**** Arthur D Little, "Broadcasters' 5G evolvement within a hybrid environment", Oct. 2020

The role of Wi-Fi

Wi-Fi is by far the most dominant wireless networking technology for enterprise networks* and it is likely that in enterprise networks, Wi-Fi can be complemented by private 5G networks to support mission-critical applications.

- Wi-Fi is expected to continue to dominate enterprise networking in the next five years
- Wi-Fi has new enhanced features that make it very competitive against private cellular networks
- Private cellular networks offer key benefits compared to Wi-Fi for sports venues and distributed events:
  - **Improved area coverage** (suitable for outdoors)
  - **Reliability and availability**
  - **Accurate synchronisation**
  - **Support low-latency applications** (e.g. telemetry)
  - **Mobile coverage** (roaming)
  - **Enhanced security** (SIM-based vs password)

ENTERPRISE CONNECTIVITY TECHNOLOGIES*



Beecham Research, "Deploying Private Cellular Networks", Feb 2022

CAPABILITIES OF WIRELESS NETWORKING SOLUTIONS**

	SECURITY	MOBILITY AND OFF SITE	BANDWIDTH	ABILITY TO SYNC.	OUTDOOR SUSTAINABILITY	LATENCY	LAYOUT FLEXIBILITY	RELIABLE COVERAGE
WI-FI			■				■ ■	■
PRIVATE LTE	■	■ ■	■	■	■ ■	■	■ ■	■ ■
PRIVATE 5G	■	■ ■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■

STL Partners, Private 5G vs Wi-Fi vs Private LTE, 2021

* Beecham Research, "Deploying Private Cellular Networks", Feb 2022
** STL Partners, Private 5G vs Wi-Fi vs Private LTE, 2021

5G services

Key takeaways and summary

- VISTA is a DCMS backed project that aims to demonstrate the potential of 5G Broadcast/Multicast to support new use cases to spectators at live events using FeMBMS technology
- 5G Broadcast can be deployed as an upgrade to existing cellular base stations using supplementary downlink transmitters and support a wide range of use cases and services including:
  - **Delivery of live radio and/or TV programmes** in new ways and with various different devices
  - **Enhancing user experience** of live events through features such as multi-camera 360-degree video views
  - **Improving the safety and security** of public places and audiences
- 5G Broadcast is particularly suited for live sports and music events where the connectivity demand is higher, and the mobile network can be overloaded and congested
- The 5G Broadcast market will reach over US$1B by 2028 which is reflected in the high level of activity in trials globally
- The main competition to 5G Broadcast is from on-demand streaming services which have attracted massive audiences particularly amongst the younger demographic. However, Unicast streaming remains a wasteful method for video distribution, with up to ten times the environmental impact of 5G Broadcast
- It is most likely that commercial deployments in the next 5 years will be over private 5G networks in areas such as within elite football leagues, car racing (e.g. Formula 1), golf tournaments and music concerts

03. MARKET OPPORTUNITIES

MARKET OPPORTUNITIES

Building upon the key learnings from Chapter 2, namely that 5G Broadcast is particularly suited to live sports and music events, Chapter 3 focuses on market opportunities in these areas and summarises additional market research undertaken.

Beginning with an outline of the research conducted by consortium partner Global Wireless Solutions Inc. (GWS) on the wider consumer base for 5G Broadcast services, this chapter further explores the key market opportunity areas including: large stadium sports; distributed venue sports; large music and live events; fan areas and associated events, and outside the stadium.

The chapter concludes with a summary of the key consumer base and predicted end-users of the services, based on research commissioned by the European Club Association (ECA), Formula 1 and Nielson.

GWS consumer research

INTRODUCTION

In June 2021, **GWS** conducted a nationwide qualitative research study to gather and understand consumers' (sports and music fans) response to the 5G VISTA concept, and identify potential use cases. In particular, GWS's task was to assist in determining the potential business opportunities to enable 5G-powered live streaming at sports and music events across the UK.

Live events are special to people and create strong emotions. There is some resistance across age groups to applications which might distract attention away from the main event. Yet, phones have a regular role in most people's experience of attending live events. There is an opportunity, therefore, to consider times when the use of mobiles phones are both useful to people, and permissible.

GWS consumer research
Findings

The data collected as part of the study illustrated the following:

- There is a **stronger case for the use of 5G Broadcast/Multicast applications at slower-pace sports** (e.g. cricket), events and where the spectator can't see everything e.g. F1, golf, music festivals with multiple stages
- Outside stadia and other event venues, there is a strong opportunity to **provide access to missed live events from home.** In this case the (shared) experience is required to be TV-based
- VISTA can **enhance small but important components** of the experience in football and rugby matches incl. highlights, key moments, commentary, etc.
- Possible **fringe benefits** from collateral information about the venue and where applications could be used, for example: queues in bars/toilets; special promotions; travel and local food

The most appealing commercial opportunities centre around:

- **Event related activities:** Formula 1, golf, cricket, festivals
- **Season ticket/membership related activities:** 'Privileged access' content

Industry workshops

Digital Catapult used key findings from the GWS customer research report to help shape the design of two workshops which aimed to establish industry appetite and explore potential business opportunities for a commercially viable VISTA product offering.

As such, the two workshops organised were held in alignment with the 5G VISTA objectives. They were attended by invited stakeholders from identified groups, including those of: broadcasters; sports teams, and venue management.

Each workshop provided the opportunity for attendees to share their experiences and perspectives on business models, as well as their feedback on the project and how it could benefit industry sectors.

Workshop attendees

WORKSHOP 1: BROADCASTERS AND SPORTS TEAMS

BBC, BT, SCEENIC, Fraunhofer

WORKSHOP 2: VENUE MANAGEMENT

LIVE NATION ENTERTAINMENT, AEG EUROPE, Arsenal, Netskrt

Industry workshops

Design and methodology

Each workshop lasted for 2.5 hours and included the following:

- 1 facilitator and 1 scribe from Digital Catapult
- 1 Senior 5G Technologist from Digital Catapult
- 4-5 external participants

The Technology Q&A session was an important opportunity for the Digital Catapult Senior 5G Technologist to give a high level overview of the technical capabilities that FeMBMS has to offer and answer questions from the attendees.

Industry workshops
Use cases

The following five use cases were presented to all attendees at both workshops.

Semi-structured conversations were carried out, and due to time constraints, focus was maintained on use cases that were pertinent to the areas of interest/expertise of the attendees in the room.

USE CASE 1:

Large Stadium Sports (football, rugby, cricket)

Description: An app designed for passionate sports fans; this product augments the match day experience with additional broadcast content and coverage of key moments.

USE CASE 2:

Distributed Venue Sports (motor racing, golf, Olympics)

Description: An app designed to expand the live experience beyond your single viewing location. Follow your favourite driver around the track; watch other competitions as you follow one; follow other events and get close up views of the athletes in action.

USE CASE 3:

Large Music and Live Events (stadium concerts and large experiences)

Description: An app designed to expand the live experience, enabling users to get close up views of the stage from distant seats and view additional visual content during the event.

USE CASE 4:

Fan Areas and Associated Events (stadium concerts and large experiences - B2B)

Description: A B2B product offering that uses 5G technology to broadcast the event to fan areas and sites away from the direct action.

USE CASE 5:

Outside the Stadium (stadium concerts and large experiences - B2B)

Description: A B2B product offering that uses 5G technology to carry the broadcast signal to native broadcaster applications.

Industry workshop Key features

The key findings from the workshops are broken down into the following sections. These factors have played an important part in developing the shape and structure of this report and its key areas of focus.

Targeted Approach

Throughout the course of the workshops, it was found that VISTA's application is very broad and technology-focussed.

Customer Focus

Adopting a customer centred approach will be critical in the successful adoption of the FeMBMS technology.

Use Cases

The 5 identified use cases help set some of the parameters around technology deployment.

Distributed Sports Venues

Sports such as Motor Racing, golf and the Olympics were the most attractive use cases for the VISTA product offering.

Technology

Key information needs to be addressed regarding FeMBMS' key value proposition - why use it over Unicast? Define the technical requirements for a successful product.

Rights Ownership

Need to establish the role of key stakeholders, particularly the ones who will own the technology and manage the metadata/streams.

Primary Use Cases

Based on the consumer research and industry workshops, two use cases have been identified as most promising for commercialisation.

USE CASE 1:

Large Stadiums Sports (football, rugby, cricket)

An app designed for passionate sports fans, this product augments the match day experience with additional broadcast content and coverage of key moments.

USE CASE 2:

Distributed Venue Sports (motor racing, golf, Olympics)

An app designed to expand the live experience beyond your single viewing location. Follow your favourite driver around the track, watch other golf pairs as you follow one, follow other events and get close-up views of the athletes in action.

End-users research

In addition to the workshop findings, when shortlisting the use cases most suitable for commercialisation, focus had to also be placed upon end-users.

Having established the two most promising use cases, both of which depend on the attendance of fans and large fan bases, research was explored to further identify needs and expectations of end-users to ensure that these use cases were fit for purpose.

The findings of the **"Fan of the Future"** report, commissioned by the European Club Association (ECA) in 2020 and the **"Formula 1 in 2021"** report published by Motorsports Network in 2021 were referred to in order to better understand the end-users for each of the two most commercially viable use cases.

‘Fan of the Future’
End-users*

The ECA *Fan of the Future* report indicates that the following groups are key end-users of football applications:

FOOTBALL FOR… THEIR LOVED ONES

- Typically, older segment (65% over 35) and more likely to be female (59%)
- Lightest football fans, with low emotional and intellectual engagement
- Interest prompted by friends/family, or national team performance
- Despite lower football interest, most have heard of UCL and UEL and generally become more engaged around big tournaments

FOOTBALL FOR… THE OCCASION

- Typically, older (64% over 35) and more likely female (52%)
- Moderate fans – keep up to date with news and watch on TV
- Low engagement frequency which increases around big matches / tournaments
- Less bothered about the result, more interested in the event

FOOTBALL FOR… THEIR FRIENDS

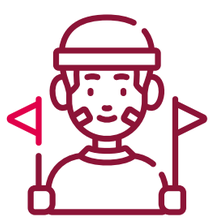
- Relatively young (52% under 35), predominantly male (54%)
- Moderate fans – claim to follow the sport closely, but don’t identify as “huge” fans
- Follow football for social currency – something to talk about
- Frequently engage with football (news, illegal streaming, sharing stories/memes) but less emotionally engaged
- Prefer to follow big teams, and prefer European football over domestic for the perceived higher quality of entertainment

FOOTBALL FOR… THE GAME

- Follow football in its entirety, with strong emotional engagement – football provides a sense of community which is key to their enjoyment
- Slightly younger than average (37% are under 35), and the most male group (69%)
- Follow a range of sports, and highly engaged with football
- Prefer to go to the stadium to really experience this feeling of “togetherness”
- Attached to their club but engage widely beyond this, including lower league football

FOOTBALL FOR… THEIR CLUB

- Oldest segment (70% 35+) and predominantly male (66%)
- Highly engaged, long-term football fans
- Find football interesting/entertaining and follow their club closely
- Emotionally invested in their club, which helps provide their identity
- Watch football regularly and keep fully up to date with news



FOOTBALL FOR… THE PLAYER

- Youngest segment (53% 13-34) and 57% male
- Moderate to strong football interest, which is increasing
- Interest in football because they play regularly – generally prefer playing to watching
- Follow specific players and find them relatable
- Not as competition focused, but enjoy big games featuring the world’s celebrity footballers

* Source: “Fan of the Future”, ECA, Aug. 2020

‘Fan of the Future’
Key findings

- The most popular sports are **Football and Motorsports**
- **Watching live games on the TV** at home remains the most common way to engage with football
- **Digital interaction with football is extremely popular:** browsing football news, social media, live streaming, gaming and shopping
- **Younger fans are markedly different consumers** compared to their older peers, sparking fears of a ‘missing generation’ of fans
- **Digital forms of engagement are much stronger among younger fans** focused on gaming and social media
- **Price of viewing subscriptions and match tickets is a barrier** to fans and “validates” illegal streaming activity for 56% of football fans
- There is only a **moderate level of interest in monthly TV** (47%) or ‘pay per match’ (44%) subscription options
- **Fans in the UK** are the most sensitive to prices
- **42% of fans of all age groups spend less money on football** today than they did five years ago (30% same)
- 63% of fans think **technological advances are good for football**

Source: “Fan of the Future”, ECA, Aug. 2020

‘Fan of the Future’

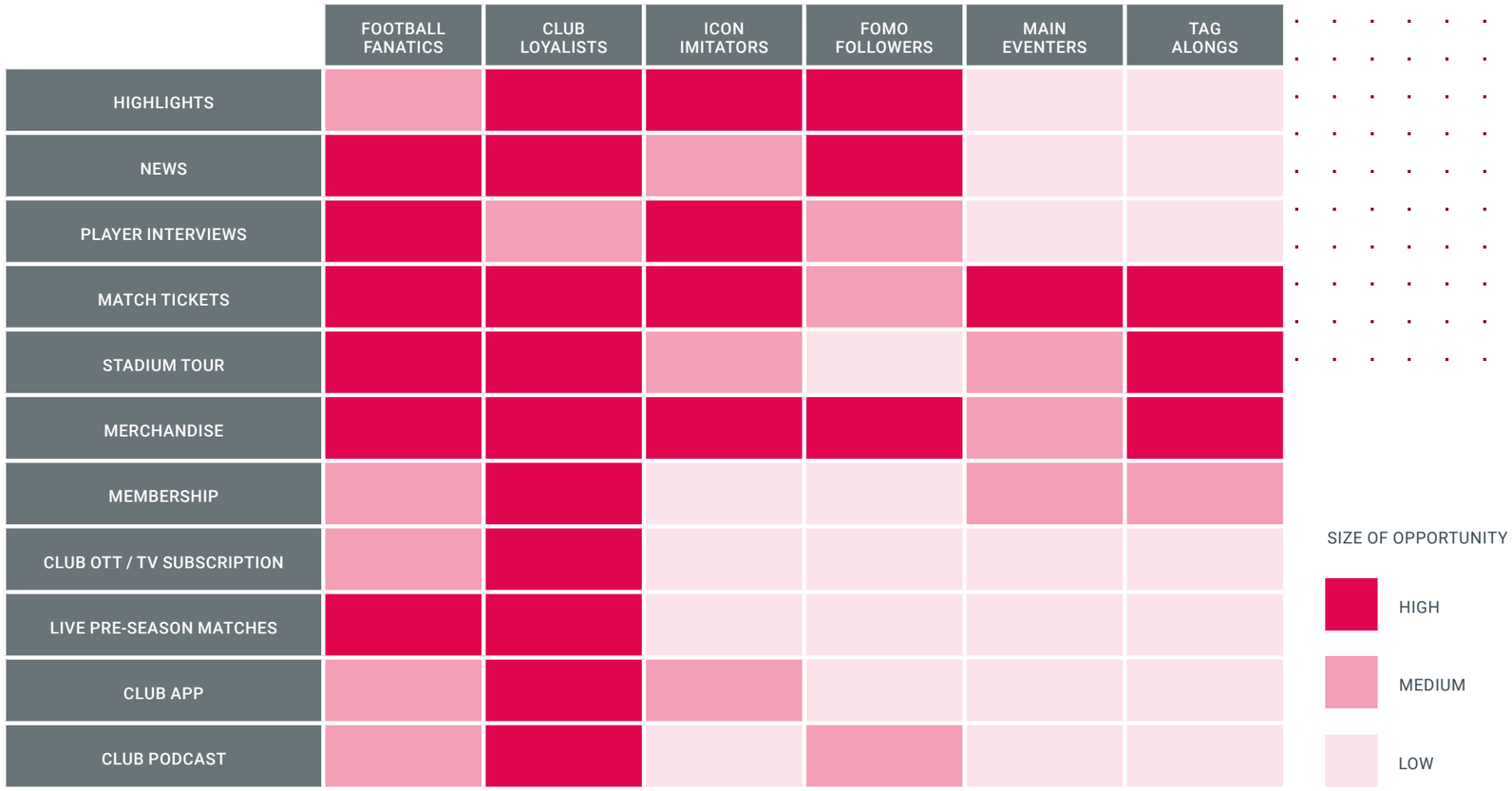
Tailoring the user experience

The ‘Fan of the Future’ report also highlights the fact that different clubs attract different types of fans and as such, they must tailor their approach to engagement* accordingly.

The figure illustrates different types of engagement based on sub-sections of club fan bases. Evidence suggests that ‘Football Fanatics’ and ‘Club Loyalists’, thus more passionate sports fans, are most likely to interact with the most engagement platforms, from reading news through to applications and podcasts.

“For sports to stand out from other entertainment businesses, in and outside of game-days, they need to develop the right engagement strategy for the right fan.

Sport’s global appeal is rooted in its unpredictability. No two plays are the same and leagues must recognise that the same is true of their fans**”



* Fan of the Future”, ECA, Aug. 2020
** https://www.sportbusiness.com/2021/08/cutting-through-the-noise-why-sports-need-to-own-the-fan-engagement-journey/

'2021 F1 Global Fan Survey'
Key findings

The '2021 Global F1 Fan Survey' was conducted in 15 languages across the Motorsport Network platform in collaboration with Formula 1 and Nielsen and received feedback from 167,000 fans in 187 countries.

- 90% of fans surveyed consider **F1 as *'the pinnacle of motorsport'***
- **Fans are prepared to commit significant time** engaging with the sport: over 90% of fans currently watch an entire race from lights to flag, with 60% of those also watching the pre-race and post-race analysis
- The most important media platforms for Formula 1 are **TV (both paid and free-to-air) and specialist websites**
- **Fewer than 20% of fans** have attended a Grand Prix in person
- The **key Grand Prix features** are: ease of travel, ease of parking, good vantage spots, a strong support race package and Pit Lane Tours
- **Fans willing to pay up to $195** for a 3-day ticket
- **Usage of social media continues to increase** amongst F1 fans; Twitter is the most used platform while Instagram is the fastest-growing. Facebook and traditional media platforms (i.e. newspapers and radio) suffered from sharp declines
- **Online gaming grows in appeal** with over 50% of survey respondents regularly engaging in motorsport gaming

Key takeaways
Chapter 3 summary

- GWS workshop feedback indicated that the most appealing commercial opportunities that the VISTA project should consider would be those that are event related or season ticket/membership related
- 5 potential use cases were established from workshops undertaken by Digital Catapult with key stakeholders:
  - Large stadium sports
  - Distributed venue sports
  - Large music and live events
  - Fan areas and associated events
  - Outside the stadium
- Further shortlisting led to the 2 key use cases chosen for the 5G VISTA project:
  Large Sports Stadiums: an app designed for passionate sports fans
  Distributed Venue Sports: An app to expand the live experience beyond a single viewing location
- Consumer research revealed that committed and loyal fans, across both football and F1, are the most likely to engage with multiple engagement platforms
- The VISTA project has the potential to build an app that all event attendees can engage with, regardless of loyalty. The next chapter will establish key business considerations in order to make the project's ambitions a reality

04. KEY FACTORS IN GO-TO MARKET

KEY FACTORS IN GO-TO-MARKET

Based on the stakeholder workshop feedback and end-user research, this chapter focuses on key factors that need to be considered in order for the proposed use cases to be realised.

Key deployment and business considerations will be outlined to assess the market-readiness of the proposed products. The chapter will then draw on a number of in-stadia and “widespread” event case studies to illustrate their successes, any gaps as well as consumer feedback.

With these considerations, the chapter presents a comprehensive stakeholder map and engagement model.

5G deployment considerations

In large stadia and “widespread” events

Connectivity

First and foremost, any 5G solution needs to deliver **true high-density broadband**. This allows fans to access their favourite applications for social media, betting, etc.

Deployment costs

Likely to require large investment to create and maintain the app, marketing, support infrastructure, content creation, rights management, installation, etc.

The solution must be **cost competitive with Wi-Fi** (e.g. Distributed Antenna Systems (DAS) failed because it is up to ten times more expensive HD Wi-Fi)

Who is in control?

Solution provider should be independent from individual stakeholders.

Independent model is most attractive to maximise commercial benefit (e.g. the app should be made available across all Mobile Network Operators (MNOs), clubs, Original Equipment Manufacturers (OEMs) and rights owners)

Expected functionality

- Easy access (download and install) via a **single app** (likely to be the ticket-/season-holder app)
- **Intuitive, user-friendly** graphical user interface (GUI)
- Able to **support data-heavy apps** (e.g. streaming video)
- Scalable with **guaranteed QoS**
- Retail/concessions/travelling/parking
- **Engaging social media features** (more like Snapchat, TikTok and Substack rather than WhatsApp)
- Enable user-generated content

User data control and privacy

Who owns and controls user data is critical. Venue owners and rights holders want to decide **what content fans can access,** capture user data, track usage and target content.

In today’s big data and precision marketing world, this kind of control is not only essential, but highly valuable.

Fans trust clubs more than MNOs or social media companies.

Applications and features

Currently, the most used applications during a live event come under the banner of **social media** (inc. photos, messaging, voice calls). For sports events, **live betting** is also very popular. Key features for a new app:

- Live-streaming video
- Real-time game and player statistics
- Live Multiview (choosing camera angle) and replays of goals and key moments

New revenues vs cost saving

Ad-based revenues require rapid distribution growth which are difficult to achieve for most clubs.

5G is a key technology solution for **boosting revenues** and **fan engagement** by allowing customisation and personalisation of various experiences.

However, it is far easier for Chief Experience Officers (CXOs) to approve a technology investment that reduces risks and costs and increases the venue’s operating efficiency.

Other relevant 5G features

- Improve the operations of the club with **better connectivity, support electronic points of sale, training, asset tracking, etc**.
- Support **social responsibility** projects
- TV production using **5G cameras**

Business considerations

- A consistent theme across all of the use cases established following the workshops is a clear preference for an **Independent Model** for a commercially viable VISTA product offering
- Such a model will **avoid consumer confusion** in terms of where to go to view the content e.g., BBC iPlayer vs VISTA app vs other sports broadcaster apps vs third-party app
- Attendees also highlighted the need for simplicity in accessing and using the app (e.g. one-time download)
- However, **commercial deployments to-date are driven by Mobile Network Operators** (MNOs) - e.g. Telefonica, DT, Vodafone, EE, Verizon, etc. Many of these are developed on the back of sponsorship or advertising deals
- This is partly due to the **large investment** (on top of network costs) that is required to develop, roll-out and support an engaging app (e.g. **"Pepsi Super Bowl LVI Halftime Show ULTRA PASS Powered by Verizon 5G Ultra Wideband"**)

OTHER CONSIDERATIONS HIGHLIGHTED WERE:

- Consumers are **indifferent to the underlying technology,** and they will not pay extra for a VISTA service unless they see a clear benefit for them
- An overarching concern was the need for more clarification around content dissemination and exclusivity in relation to **rights management**
- Sports clubs and event organisers want to "own the fans" and have **access to their user data.** This requires some linkage with ticketing and/or club membership
- **Sports clubs and brands are more trusted** than MNOs or social media companies
- Feeds and management of feeds can be offloaded, but more clarification is needed regarding **the management of metadata and streams,** and the overall end-to-end service

5G IN-STADIA CASE STUDIES

5G IN-STADIA CASE STUDY

Pepsi Super Bowl LVI

The "Pepsi Super Bowl LVI Halftime Show Ultra Pass Powered by Verizon 5G Ultra Wideband" is a first-of-its-kind second screen mobile experience, offering many new features via the NFL Ticketholder app:

- **Verizon 5G Multi-View:** Gives fans the opportunity to engage with up to seven different camera angles, project AR overlays of NFL's Next Gen Stats for players, and access instant replays
- **NFL Ultra Toss:** An interactive mobile game, that enables players to view scores and compete directly with other fans playing in real-time
- **5G Connected Lens:** Fans can use Snapchat to join a shared, simultaneous AR experience where teams of users battle against other groups of fans to take control of a giant virtual airship
- **Tailgating App:** Tailgate parties take place in stadium or concert venue parking lots, with food and drink served from the back of a parked car or truck. This mobile app allows fans to create events, invite friends, and track who's attending, where to meet, and what's being served

Verizon also explores practical use cases for 5G-enabled AR such as assessing concessions, crowd management, and public safety.

Yahoo! Sport article about the Verizon and NFL partnership

The $119 million investment includes 169 new small cells, 4 new macro cell sites, and 24 new in-building systems.
According to Hans Vestberg, Verizon Chairman and CEO:

"...our work with the NFL will continue to enhance and transform not only the fan viewing experience, but also has the potential to improve player training and overall venue operations."

5G IN-STADIA CASE STUDY

Pepsi Super Bowl LVI

Reviews of the Pepsi Super Bowl LVI Halftime Show are split into two camps and provide useful insights into customer experience of app-based engagement during a live event:

Those who were able to launch the app were very pleased with the experience:

“I was on stage shaking my booty with my homies 😎”
“Cool experience! I hope they do this again in 2023”
“Great app! Brings me the spirit of the Super Bowl.”

The main complaint in this group was about the lag between the app and the big screen TV. Also, privacy concerns (phone’s camera, End-User License Agreement (EULA)), no access to other services (no sound, no access to sweepstakes, no value pre-event) and poor Quality of Service (QoS, e.g. freezing video).

Those who were not able to make the application work were very disappointed.

“Kept wanting me to scan a QR code from my phone”
“It kept giving me an error and telling me to refresh…”
“This app never left the black screen. Super disappointed”

App reviews

“App was not in sync with halftime show on TV. Camera angles were bad, even when moving around.”

“What a waste of time. You couldn’t control the way that the 360 view was pointing, except by moving the phone, and it thought the stage was behind me. Also, wasn’t sync’d with what was on the TV.“

“A cool addition to watching the halftime coverage on TV. Basically a 360° perspective as I moved my phone to the left, right and behind me.”

“I was never able to load any of the special features during the show. I kept getting an error message even though I have 5G and Verizon”

“This halftime show was epic! Pepsi really did it big this year. Being from California, I really enjoyed the line up. The virtual experience was unforgettable. For it being live the video quality was amazing. Good job you guys.”

“The virtual app experience was 60 seconds sooner than the Peacock stream of the show on T.V. It was not a good addition to the halftime show.”

“App would NOT connect at all. Missed entire halftime show dealing with this app. Very upset and disappointed.”

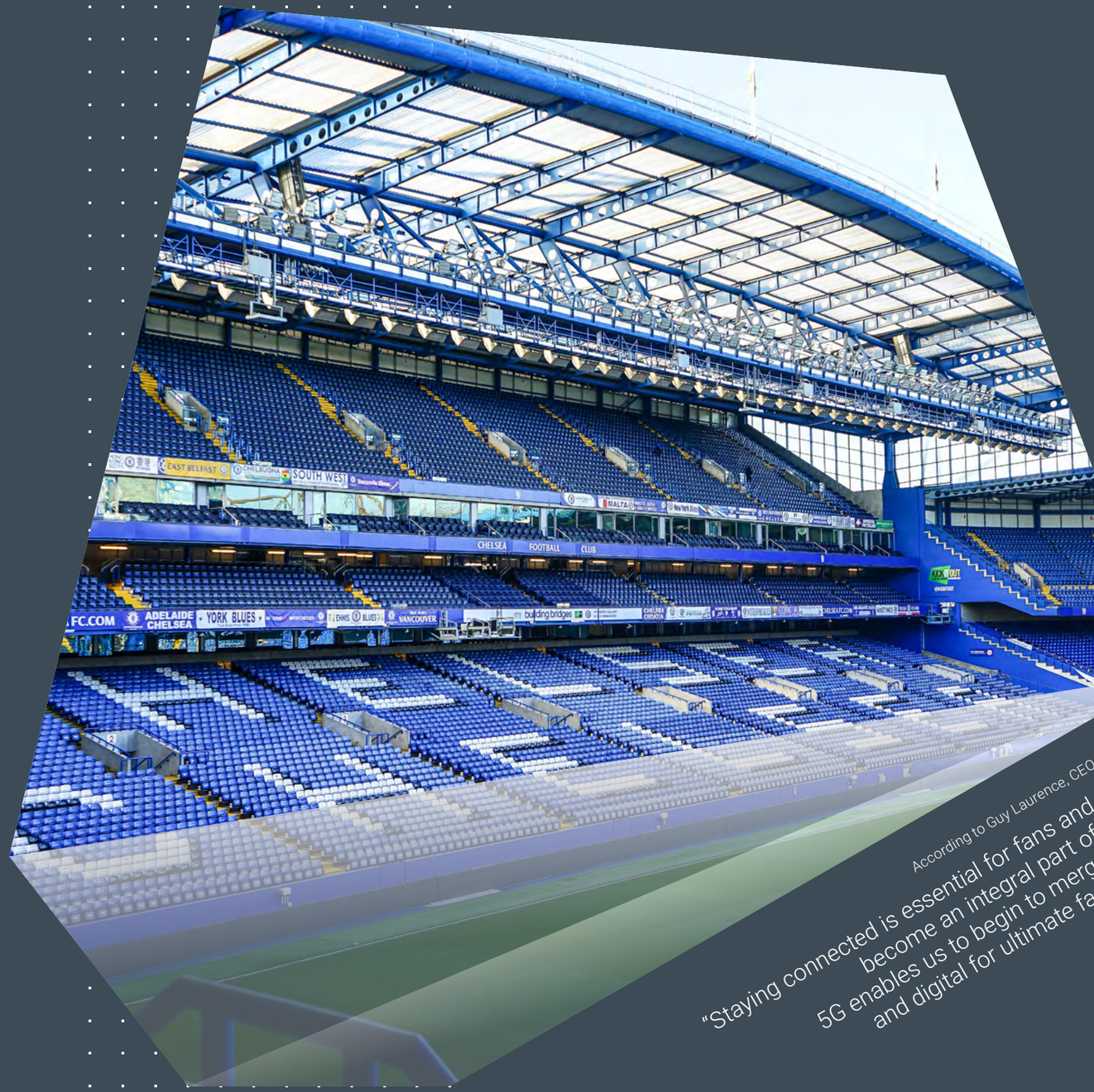
“Why does it need control of my camera? I just want to see the different angles of the halftime show.”

“Didn’t work. The 5G icon just kept spinning while saying tap to ground. Using a Samsung S21 Ultra so shouldn’t be a device issue”

“It started out ok, could pan across each stage. But it quickly became useless. You couldn’t zoom in to see the singers and then the app got 3-4 seconds ahead of the live show on TV. When you went to the main stage the view was sideways and in back of the singer. After that the whole show was sideways. In order to see the show on the app I had to put my phone completely perpendicular to the TV and turn myself sideways as well. At this point I put the phone away and watched it on the TV.”

“What a letdown. the app kept glitching out right at the start of the show. Good job Verizon and Pepsi. The actual show was awesome though.”

“Would have given 5 stars if it was in sync with the broadcast. The lag on the stadium’s TV made it hard to follow.”



5G IN-STADIA CASE STUDY

Chelsea FC Stadium

Stamford Bridge stadium (Chelsea FC) became the first Premier League stadium in the UK to convert its grounds fully to 5G accessible in February 2022.

The 5G network is provided by Three, who has signed a 3-year sponsorship deal with Chelsea worth £40m. The provider will enable the delivery of 5G download speeds of up to 250Mbps.

The main benefit promoted as part of Chelsea's 5G commitment is that with improved bandwidth and latency, the fan won't suffer from slowdowns or a lack of connectivity when tens of thousands of people are all trying to get online at once in a small area.

According to Guy Laurence, CEO at **Chelsea FC:**

"Staying connected is essential for fans and mobile has become an integral part of matchdays. 5G enables us to begin to merge the physical and digital for ultimate fan experiences".

5G AT WIDESPREAD EVENT CASE STUDY

Formula 1

Formula 1 already offers an app that presents data relating to specific drivers and the overall action, while an Over The Top (OTT) platform launched in 2018 offers video content highlights.

5G enhances these offers by unlocking new experiences to bring fans closer to the action:

- Puts the **curation of the experience into the hands of the viewers** - they can choose the cameras, the angles, the drivers they want to follow
- Provides **live driver and vehicle statistics** (e.g. **F1 Insights by AWS**)
- Users can **choose any point of view** with no compromise on image quality
- **Instant replays** of key moments of the race
- Deliver **4K quality video** from mobile cameras and drones
- **Leverage AR** to provide information about the venue, hospitality services and facilities

As part of the country's **Vision 2030** project, Saudi Arabia has constructed the first Formula 1 circuit using 5G to boost fan experience.

Earlier in the year, **Digital Catapult announced an agreement with Formula 1** to explore new fan engagement opportunities alongside start-ups and scaleups, as part of the **5PRING** Live Events programme.

Stakeholders Map

The outlined business and deployment considerations will be key factors when engaging with key stakeholder groups. A cohesive structure will have to be implemented to ensure a strategy is developed that can focus on rights management, ownership and data streams. Based on the key areas outlined, alongside market research and workshop feedback, the following groups have been identified as potential stakeholders:

SPORTS TEAMS AND OWNERS

- Interested in building stronger fan relationships
- Offering new services and improving customer engagement and experience
- Concerns around required investment

VENUE MANAGEMENT

- Interested in building fan relationships; however fans are more interested in developing relationships with the artists

BROADCASTERS

- Curate the existing broadcast feed
- Interested in FeMBMS being simpler to use than eMBMS and that it will be transparent to the handset
- Is there a toolkit or service kit that can be picked up from any broadcaster?

MOBILE NETWORK OPERATORS (MNOS)

- Does FeMBMS work across all MNOs or is it tied to one single network?
- Concerns around handset capability

RIGHTS OWNERS AND SERVICE DELIVERY OWNERS

- Interested in Deeds of License and establishing appropriate relationships around rights ownership
- Concerns around rights management and who would manage the metadata / streams

SPONSORS

- Interested in monetisation of content i.e. advertising within and around the stadium, digital imagery, static ad articles, paid and free social media posts etc.
- FeMBMS technology would need to be built into that partnership

NETWORK HARDWARE PROVIDERS

- Would supply the network infrastructure.
- How would this investment be financed?

SPORTS AND MUSIC FANS

- Interested in developing closer relationships with athletes and artists
- Concerns regarding user engagement in certain use cases - most applicable use case is in distributed venue sports

Stakeholders

Co-operation framework

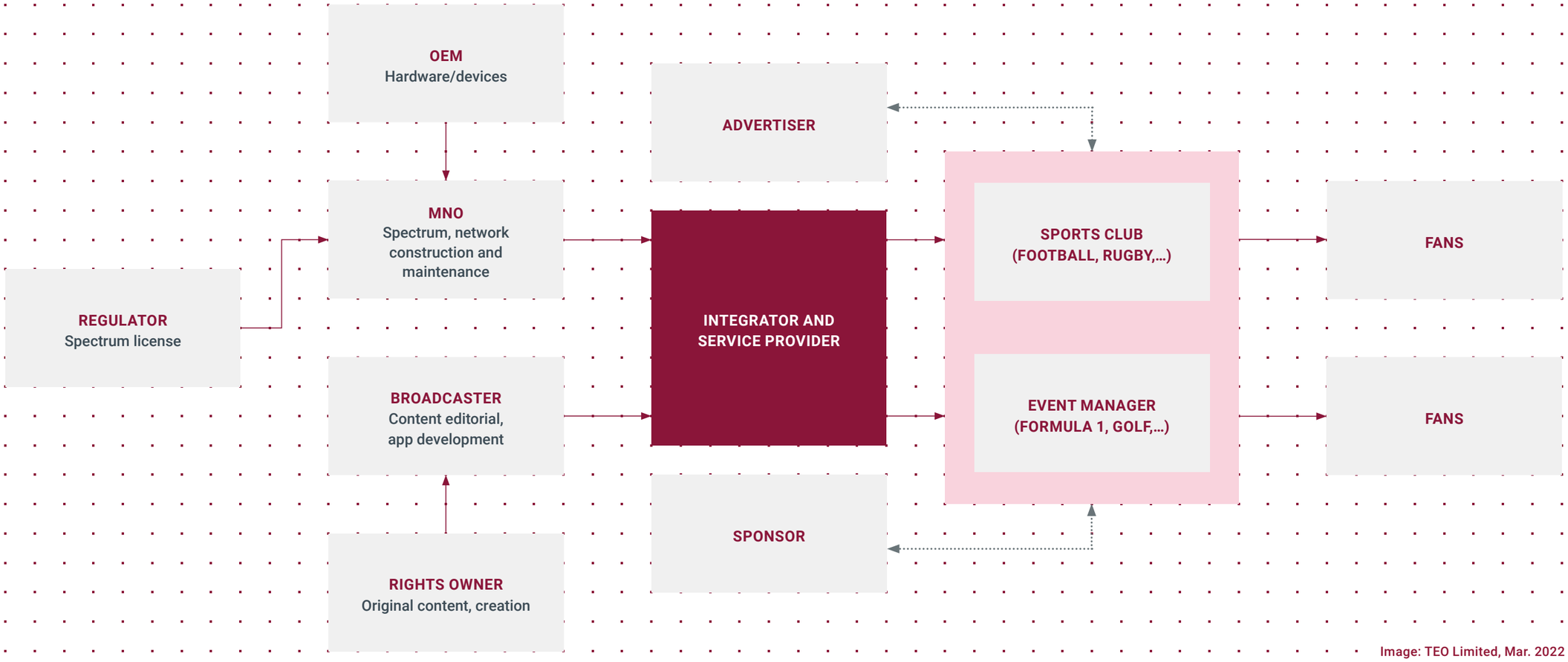


Image: TEO Limited, Mar. 2022

Key takeaways

- This chapter has validated consumer demand and confirmed that 5G broadcast can offer a better experience
- Commercial deployments to-date are driven by Mobile Network Operators (MNOs) on the back of sponsorship or advertising deals and demand large budgets
- Technology solutions are not fully ready for the market:
  - No compatible handsets
  - Limited or no integration with other applications (e.g. ticketing)
  - Rights management
  - Poor user interface design
  - Lack of synchronisation with other services (audio)
- A key benefit is the ability to guarantee Quality of Service (QoS) in a congested mobile network
- Sport clubs and brands want to have access to user data and are trusted by fans and consumers
- A business model with a clear return on investment is required and should mainly be focused on cost savings rather than new revenue opportunities

05. BUSINESS PROPOSITIONS

BUSINESS PROPOSITIONS

This chapter is dedicated to propositions based on the two shortlisted products: **an application for large stadium events** and **an application for distributed venue sports**. In preparing these product propositions, we have taken into consideration the findings from the research outlined in Chapter 3. Focus has also been maintained on the established stakeholders and end-users.

Key elements of the proposed use cases will be outlined, including: concept outline; main features; extended features; business models; SWOT analysis and financial modeling. This chapter indicates the key factors that determine the sustainability of the products proposed, both as part of the VISTA project, but also looking beyond the scope of the project.

Following outlines of the proposed products, key competitor applications are referred to in order to illustrate key areas of convergence and divergence in the consumer offerings.

Products

INTRODUCTION

As outlined in Chapter 3, two use cases have been identified in this report as most promising for commercialisation:

LARGE SPORTS STADIUMS

DISTRIBUTED VENUE SPORTS

In this section, we define the possible commercial product offerings that can address those use cases in the form of smartphone apps that enhance the user experience:

Football stadium
An app that augments the match experience with additional live broadcast content and coverage of key moments

Motor racing
An app that expands the live experience beyond the single viewing location in a circuit

Football product
Concept

The football mobile app would allow access to live broadcast content pre, during and post-game to season ticket holders and priority guests, throughout the football season.

The ambition would be to augment the match day experience with additional content and allow customers to get closer to the action at key moments, where their initial view may not have been sufficient.

The app would enable a contact point for sponsors and partners to interact with these customers. It could be promoted as a standalone app to smaller clubs or as a value-added extension to Premier League clubs who already have an established fan engagement app.

THREE KEY POINTS ARE FUNDAMENTAL FOR THE APP'S COMMERCIAL SUCCESS:

- The club must have a **direct relationship with the fans** ("own the customer") and have unrestricted access to their user data
- **The integrator role** is important in coordinating the development, deployment and operating the application. The role can be taken by the club, MNO or an independent company
- **Broadened availability of compatible devices** to receive the service

Football product
Features

The app content could include pre-game news and information, post-match analysis and broadcast of significant incidents during the match (e.g. goals, offside decisions, VAR etc.). It would allow fans to directly view incidents that they would normally view on the big screen. It would not, however, allow for sharing outside of the match environment and users could not pause or rewind content, but it could show replays.

INFRASTRUCTURE/ TECH AND INTEGRATION

- The app should be made available for both Android and iOS
- Options for either a standalone app or integration with club app depending on club's digital/IT capabilities
- Considerations on scalability, security and data sharing

STRATEGY TO DRIVE TECHNOLOGY ADOPTION AND DEVICE AVAILABILITY

- Leverage club's brand recognition to stimulate device availability
- Consider co-promotions and joint marketing with major Original Equipment Manufacturers (OEMs)

ENGAGING THE FANS

- User friendly experience (Graphical User Interface design)
- Engaging and regularly-updated content (stale content kills the app!)
- Incentivise supporters with special features

Football match app
Extended features

WHEN	IMPORTANCE	FEATURES
PRE-MATCH	MUST HAVE	■ Latest news (inc. travelling info, interviews, recorded podcasts) ■ News of team's preparations (e.g. videos from training, performance analytics, etc.) ■ Interviews with players/managers/club officials ■ Highlights from previous games
	NICE TO HAVE	■ Integration with ticketing system (may include special offers for any unsold tickets) ■ Merchandise special offers in the club shop ■ Last minute hospitality offers
DURING THE MATCH	MUST HAVE	■ Instant replay of multi-view for "SwipeVideo" experience (needs 180MB/min on receiver) ■ Find your way around the stadium (e.g. concessions, toilets, first aid etc.) ■ Order food and drink from your seat to avoid queues
	NICE TO HAVE	■ Volumetric video with player information and commentary ■ Online shopping (order now and collect on your way home) ■ Take a virtual tour around the stadium ■ View queues in concessions and toilets ■ Live games in the stadium between groups of fans
POST-MATCH	MUST HAVE	■ Video recordings of the highlights of today's game (e.g. goals, offside decisions, VAR, etc.) ■ Analysis of the match with statistics
	NICE TO HAVE	■ Social media aspects TikTok-style (i.e. record your own video) ■ Quizzes and polls around the match (Man of the Match, select/vote for next highlight etc.)

Football match app
Business model

Key partners

- Integrator
- Broadcasters
- Technology vendors / Original Equipment Manufacturers (OEMs)
- Mobile Network Operators (MNOs)
- Football club
- Sponsors
- Advertisers

Key resources

- Relevant and up-to-date content
- Fidelity of the production
- Audio and commentary
- Player and match statistics
- Post and pre-game content
- Hardware and software technologies
- Tools for easy creating, editing and repurposing the content

Customer segments

- Target Customers (priority order)
  - Football fanatics
  - Club loyalists
  - Icon imitators
  - Fear of missing out (FOMO) Followers
  - Tag alongs
  - Main eventers
- Season ticket holders
- Hospitality hosts and guests

Channels

- B2C - through FeMBMS broadcast to consumers
- Delivery of non-linear content via broadband
- Access through app
  - Integrated with club's own app (preferred)
  - Standalone app (especially suitable for smaller clubs)

Business structure

- The role of the Integrator is vital for commercial success
- It is also possible for the Integrator to be formed as the club, MNO or an independent company. Also possible to be formed as a joint venture by the club and an MNO
- The club must always front the app, leveraging its established relationship and trust with the fans

Cost structure

- Fans are willing to pay only for quality and relevant content
- Large investment is required to acquire and curate the right content
- Infrastructure costs in setting up the broadcasting system (CAPEX Capital expense)
- Content acquisition, preparation and broadcasting (OPEX Operating expense)
- Maintain app on various platforms iOS/Android/Cloud etc. (OPEX)

Revenue streams

- Subscription model works best in terms of cash flow
- Other possibilities include:
  - Part of season ticket
  - Add-on to season ticket
- Additional revenues possible via ads and sponsorships, but fans dislike mixed models (e.g. ads on top of subscription)

Target market

- Live to attendees of the match
- Season ticket holders
- Premium VIP members
- Hospitality guests
- Fans with a consistent presence at the game

Football product Business model canvas

KEY PARTNERS

Strategic partners needed to maintain the business model:

- Integrator
- Football club
- Broadcasters
- Mobile Network Operator
- Equipment vendors
- Smartphone OEMs
- App developers
- Sponsors
- Advertisers
- Rights owners

KEY ACTIVITIES

Key activities necessary to build the business:

- Market/commercial analysis
- Build 5G-Broadscast solution
- Technology proof-of-concept
- Develop minimum viable product/demo app
- Pilot trials with early adopter
- Business development to validate customers
- Develop commercial app
- Sales and business development to market

KEY RESOURCES

What resources required to maintain the business model?

- Core FeMBMS technology
- App development
- Relevant/up-to-date content
- Content management tools
- Smartphone availability
- Spectrum licenses
- Human resources

VALUE PROPOSITIONS

How does VISTA help customers achieve their mission, do their job and improve their position?

- Enhanced end-user experience to increase “stickiness” to the club
- Engage new segments of audiences
- Improve efficiency in cellular network (traffic off-loading)
- Reduce OPEX (“one to many technology”)
- Create new business models
- New revenue generation opportunities through value added products and services

CUSTOMER RELATIONSHIPS

What are the customer acquisition, retaining and switching costs? What is the lifetime value?

- **Spectators** are acquired via the unique event organiser’s app
- **Event organiser** is a long-term co-creation partner who plays the role of the Integrator
- **Network operator** maintains the network platform

CHANNELS

How do you contact the customer, deliver the value and promote the value?

- Club retains relationship with the fans directly via the app
  - Part of club’s own app
  - Standalone app
- Co-promotions and joint marketing with major OEMs

CUSTOMER SEGMENTS

Who are they? What are their pain points?

- Football fans / hospitality hosts and guests
  - Football fanatics
  - Club loyalists
  - Icon imitators
  - FOMO followers
  - Tag alongs
  - Main eventers

Enhance the entertainment value with a more engaging user experience

- **Football club**
  Increase revenues, reduce costs, maintain fan loyalty
- **Network operator**
  Lower network OPEX and improve efficiency

COST STRUCTURE (HOW DOES MUCH IT COST?)

What are the main components of the product costs?

- Content production and/or acquisition
- Personnel (software development and content curation)
- App maintenance on different platforms (e.g. iOS and Android)
- Infrastructure costs (hosting app in Cloud)
- Customer support teams in each geographical market
- Marketing, sales and business development

REVENUE STREAMS

Why and how does the customer pay, and what’s the average price? How many customers?

- App is promoted on a subscription basis (annual or monthly)
- Price can be incorporated in season ticket as an option
- Additional revenues possible via ads and sponsorships
- Basic monthly subscription of around £3
- Premium subscription option for an additional £60/year
- Business plan is viable with 40% gross margin with at least 30% of fans subscribing to the basic service, and 15% to the premium service

Football Product
SWOT

S
Strengths

- Live broadcast content
- Enhance user experience
- Enable fans to curate their own experience
- Increase stickiness and engagement with the club
- Convert new fans (especially younger audiences)

W
Weaknesses

- Availability of receivers with FeMBMS capability
- Limited interactivity unless augmented with broadband
- Up to 20% additional capital expenditures to support the 5G Broadcast system
- Additional large investment to create an appealing proposition and keep it fresh and relevant
- Lack of tools to curate and synchronise content across multiple platforms

O
Opportunities

- Replace wired content screen around stadium
- Expand live broadcast to venues away from the main event to remote fan gatherings and parks
- Integrate with broadcast apps (e.g. Sky Sports) to customers not attending the event
- Broadcast outside the live setting

T
Threats

- Unicast streaming via broadband
- New services (SwipeVideo, Spiideo) delivered over Wi-Fi
- Fans unwilling to pay additional costs
- Ability of clubs to support the service (cost/technology-wise)
- Lack of interest from the clubs to adopt the solution

Football app
Financial modelling

- Financial modelling assumptions:
  - 30% of fans subscribe to the basic service and 15% to the premium service
  - Basic TV service is priced at £3 per month while Premium TV service priced at £5 per month (both comparable to other similar apps in the market)
  - Capital expenditures (CAPEX) of £150K is amortised over 5 years and does not include costs (CAPEX/ Operating expenses- OPEX) of the private 5G network
  - Hosting cost in public cloud is £5/month/server
  - Apple and Google platform hosting costs at 30%
- Financial model run for clubs with 15K, 30K, 50K and 100K total number of fans
- The model indicates that the business is viable even for small size clubs (down to around 20K) which produces a modest 26% gross margin. Anything smaller, is not commercially viable as it barely covers its costs
- For club sizes of over 30K, the model produces a reasonable gross margin of 40% which increases to a healthy 60% for larger clubs with over 100k fans

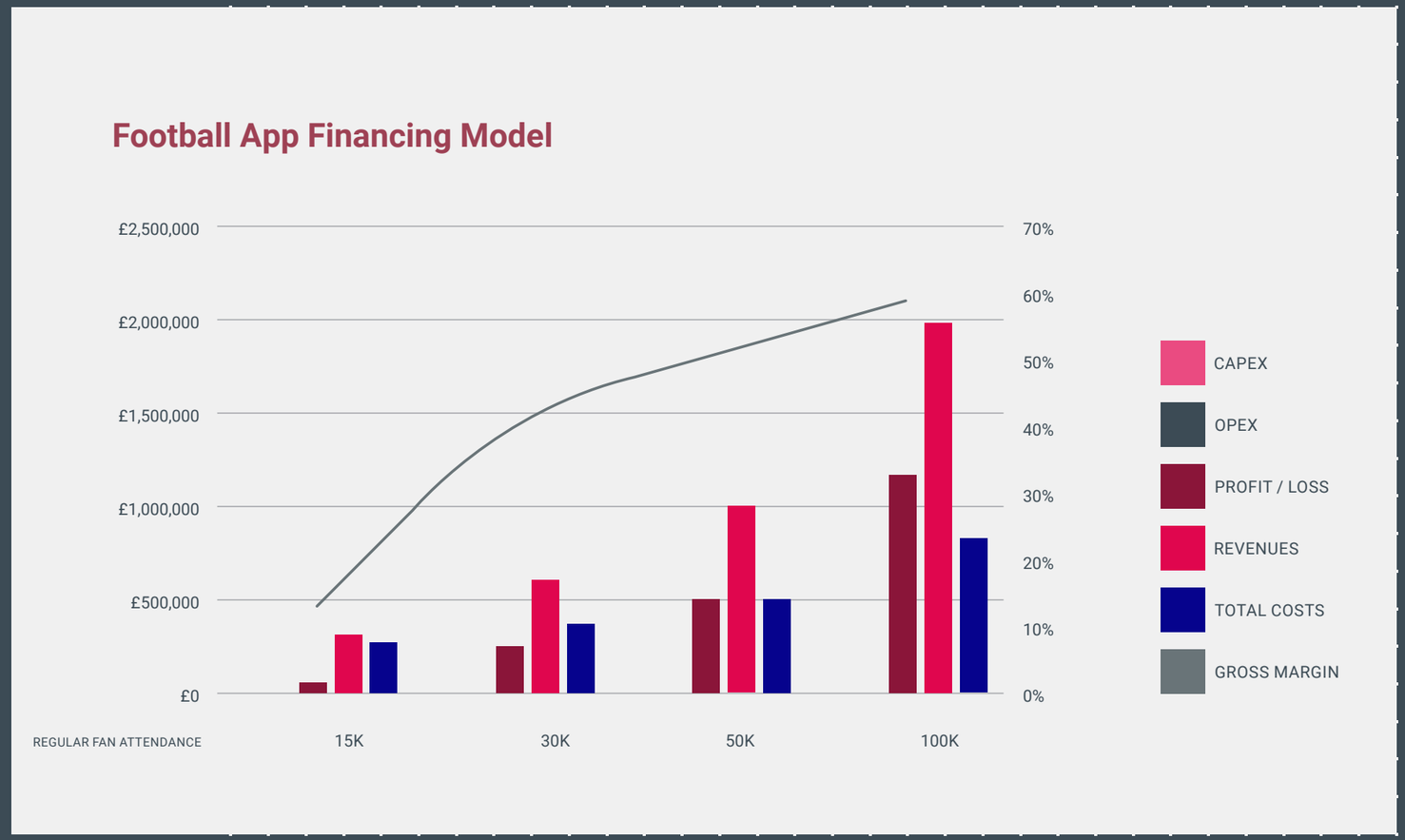


Image: TEO Limited, “Financial Modelling of VISTA apps”, Mar. 2022

Motor racing product
Concept

The motor racing mobile app would enable access to additional live broadcast content during the Grand Prix weekend.

This new content could include: pre-race news and information; post-race analysis and broadcast of different streams during races (pit stops, the opportunity to follow specific drivers, incidents/ overtakes and general race stream).

The app could provide a contact point for sponsors and partners to interact with these customers.

Formula 1 already has **a very successful app** that provides much of the desirable functionality. The motor racing app should be promoted as a value-added extension to F1 app. The aim of the motor racing app is to leverage 5G Broadcast technology to:

- Improve the viewing experience of the Grand Prix with better quality video feeds (i.e. guaranteed QoS) and;
- Reduce the cost of deployment and bring the same “F1 experience” to other motor sports that lack the popularity and budgets available in Formula 1

Motor racing

Features

The app contents could include pre-race news and information, post-race analysis and broadcast of different streams during races e.g. pit stops, the opportunity to follow specific drivers, incidents/overtakes and general race stream.

It would allow the supporter/user to watch incidents directly that they would perhaps otherwise view on the big screen, as well as being able to see areas of the track that are not visible from their position in the venue.

Playback trick modes (pause, rewind and replays in slow-motion) are very appealing and are possible by means of a relatively small memory cache (180MB/min) in the receiver device.

INFRASTRUCTURE/ TECH AND INTEGRATION

- The app should be made available for both Android and iOS
- Integration with the F1 app and with live telemetry data platform
- Push notifications and social media (focus on Twitter and Instagram)

STRATEGY TO DRIVE TECHNOLOGY ADOPTION AND DEVICE AVAILABILITY

- Leverage F1's brand recognition to stimulate device availability
- Consider co-promotions and joint marketing with major sponsors/car teams

ENGAGING THE FANS

- Watch the action from the best viewing positions around the track
- Live telemetry data and easy-to-use driver tracker over interactive maps

Motor racing app
Extended features

WHEN	IMPORTANCE	FEATURES
PRE-MATCH	MUST HAVE	■ Grand Prix schedules and results to date ■ Latest news and analysis (inc. travelling info, parking assist, car team interviews) ■ News of teams' preparations (e.g. videos from trial runs, performance analytics, etc.) ■ Video highlights from previous Grands Prix
	NICE TO HAVE	■ Interviews with drivers, team managers and event officials ■ Promotions of special offers on merchandise in shops around the event ■ Last minute hospitality offers
DURING THE MATCH	MUST HAVE	■ Broadcast video streams from best vantage locations (pit stops, on cars, bird's-eye view) ■ Instant replay of video broadcasts (needs 180MB/min memory cache on receiver device) ■ Live leader board and lap-by-lap expert race commentary ■ Live telemetry data (speed, throttle, gear, brake, etc.) and easy-to-use driver tracker
	NICE TO HAVE	■ Watch live 360-degree videos from other activity areas around the event ■ Find nearest facilities areas (bars, restaurants, shopping, toilets, etc.) ■ Share most popular Twitter and Instagram social media feeds
POST-MATCH	MUST HAVE	■ Video recordings of the highlights of today's Grand Prix ■ In-depth technical analysis from experts
	NICE TO HAVE	■ Quizzes and polls around the match (winner of the race, best incident/overtake, etc.) ■ Gaming: compete with the winner of the race on the same course ■ Interactive driver tracking maps with sector times and pitstop info

Motor racing
Business model

Key partners

- Integrator
- Broadcasters
- Technology vendors / original equipment manufacturers
- MNOs
- Formula 1 / event organiser
- Sponsors
- Advertisers
- Rights owners
- Car teams

Key resources

- Relevant and up-to-date content, including telemetry data
- Video/production Quality of Service (QoS)
- Audio and commentary
- Driver and Grand Prix statistics
- Post and pre-game content
- Hardware and software technologies
- Tools for easy creating, editing and repurposing the content

Customer segments

- Target customers (priority order)
  - ‘Never miss a race’ (9%)
  - Regular viewers (27%)
  - Occasional viewers (15%)
  - Basic interest (12%)
  - Excitables, purists, sociables, habituals, peripherals, incidentals
- Season ticket holders
- Hospitality hosts and guests

Channels

- B2C - through FeMBMS broadcast to consumers
- Delivery of non-linear content via broadband
- Access through app integrated with event organiser’s app

Business structure

- The role of the Integrator is vital for commercial success
- The event organiser (e.g. F1) , or an independent company operating as a service provider to F1 should deploy the app leveraging established relationship and trust with the fans

Cost structure

- Fans are willing to pay for quality and relevant content (e.g. telemetry)
- Integration with existing app
- Infrastructure costs in setting up the broadcasting system (Capital expense - CAPEX)
- Content acquisition, preparation and broadcasting (Operating expense - OPEX)
- OPEX for maintaining app on iOS, Android and Cloud

Revenue streams

- Subscription model works best in terms of cash flow
- Additional revenues possible via ads and sponsorships, but fans dislike mixed models (e.g. ads on top of subscription)

Target market

- Attendees of the Grand Prix
- Season/bulk ticket purchasers
- Premium VIP members
- Hospitality guests

Motor racing Business model canvas

KEY PARTNERS

Strategic partners needed to maintain the business model:

- Integrator
- Event organiser
- Broadcasters
- Mobile Network Operator
- Equipment vendors
- Smartphone OEMs
- App developers
- Sponsors
- Advertisers
- Rights owners
- Car teams

KEY ACTIVITIES

Key activities necessary to build the business:

- Market/commercial analysis
- Build 5G-Broadcast solution
- Technology proof-of-concept
- Develop minimum viable product/demo app
- Pilot trials with early adopter
- Business development to validate customers
- Develop commercial app
- Sales and business development to market
- Formula One app integration

KEY RESOURCES

What resources required to maintain the business model?

- Core FeMBMS technology
- App development
- Relevant/up-to-date content
- Content management tools
- Smartphone availability
- Spectrum licenses
- Human resources

VALUE PROPOSITIONS

How does VISTA help customers achieve their mission, do their job and improve their position?

- Enhanced end-user experience (QoS)
- Improve hospitality offering
- Off-load traffic from cellular network to improve efficiency
- Reduce OPEX (“one to many technology”)
- Create new business models
- New revenue generation opportunities through value added products and services

CUSTOMER RELATIONSHIPS

What are the customer acquisition, retaining and switching costs? What is the lifetime value?

- **Spectators** are acquired via the unique event organiser’s app
- **Event organiser** is a long-term co-creation partner who plays the role of the Integrator
- **Network operator** maintains the network platform

CHANNELS

How do you contact the customer, deliver the value and promote the value?

- Club retains relationship with the fans directly via the app
  - Part of club’s own app
  - Standalone app
- Co-promotions and joint marketing with major OEMs

CUSTOMER SEGMENTS

Who are they? What are their pain points?

- Spectators / fans / hospitality hosts and guests
  - ‘Never miss a race’
  - Regular viewers
  - Occasional viewers
  - Basic interest
  - Excitables, purists, sociables, habituals, peripherals, incidentals

Enhance the entertainment value with a more engaging user experience

- **Football club**
  Increase revenues, reduce costs, maintain fan loyalty
- **Network operator**
  Lower network OPEX and improve efficiency

COST STRUCTURE (HOW MUCH DOES IT COST?)

What are the main components of the product costs?

- Content production and/or acquisition
- Personnel (software development and content curation)
- App maintenance on different platforms (e.g. iOS and Android)
- Infrastructure costs (hosting app in Cloud)
- Customer support teams in each geographical market
- Marketing, sales and business development

REVENUE STREAMS

Why and how does the customer pay, and what’s the average price? How many customers?

- App is promoted on a subscription basis (annual or monthly)
- Price can be incorporated in season ticket as an option
- Additional revenues possible via ads and sponsorships
- Basic monthly subscription of around £3
- Premium subscription option for an additional £60/year
- Business plan is viable with 40% gross margin with at least 30% of fans subscribing to the basic service and 15% to the premium service

Motor Racing
SWOT

S
Strengths

- Live broadcast content
- All areas of the track visible
- Enhance user experience
- Enable fans to curate their own experience
- Increase “stickiness” and engagement with the event
- Convert new fans (especially younger audiences)
- Hospitality opportunities

W
Weaknesses

- Lack of FeMBMS in the handsets
- Limited interactivity unless augmented with broadband and receiver cache memory
- Up to 20% additional capital expense (CAPEX) to support the 5G Broadcast system
- Additional large investment to create an appealing proposition and keep it fresh and relevant
- Lack of tools to curate and synchronise content across multiple platforms (e.g. telemetry)

O
Opportunities

- Replace the large wired screen with a more appealing experience
- Provide live video feed to venues away from the event
- Integrate with broadcast apps (Sky Sports) to customers not attending the event
- Broadcast video highlights outside the live setting

T
Threats

- Unicast streaming via broadband
- New services (SwipeVideo, Spiideo) delivered over Wi-Fi
- Fans unwilling to pay additional costs
- Ability of the organisers to support the service
- Event organisers and car teams not willing to adopt and support the solution
- Difficulty in standardising the solution across different events

Motor racing app
Financial modelling

- Financial modelling assumptions:
  - 20% of the Grand Prix spectators purchase the VISTA app as top-up to their ticket price
  - 20 Grand Prix events per season
  - Average daily ticket price of £250 (F1 2021 figures)
  - CAPEX of £550k is amortised over 5 years and does not include costs (CAPEX/OPEX) of the private 5G network
  - Hosting cost in public cloud is £5/month/server
  - Apple and Google platform hosting costs at 30%
- Financial model runs for different top-up prices of £10, £20, £38 and £63 representing 4%, 8%, 15% and 25% of the ticket price respectively
- The model indicates that the business is viable even for a moderate top-up price of 4% (£10) which produces a modest 32% gross margin. Anything smaller, is not commercially viable as it barely covers its costs
- For top-up fees of over 8% of ticket price, the model yields a reasonable gross margin of 51%, which increases to a marginally better 60% for nearly double the amount (15%)

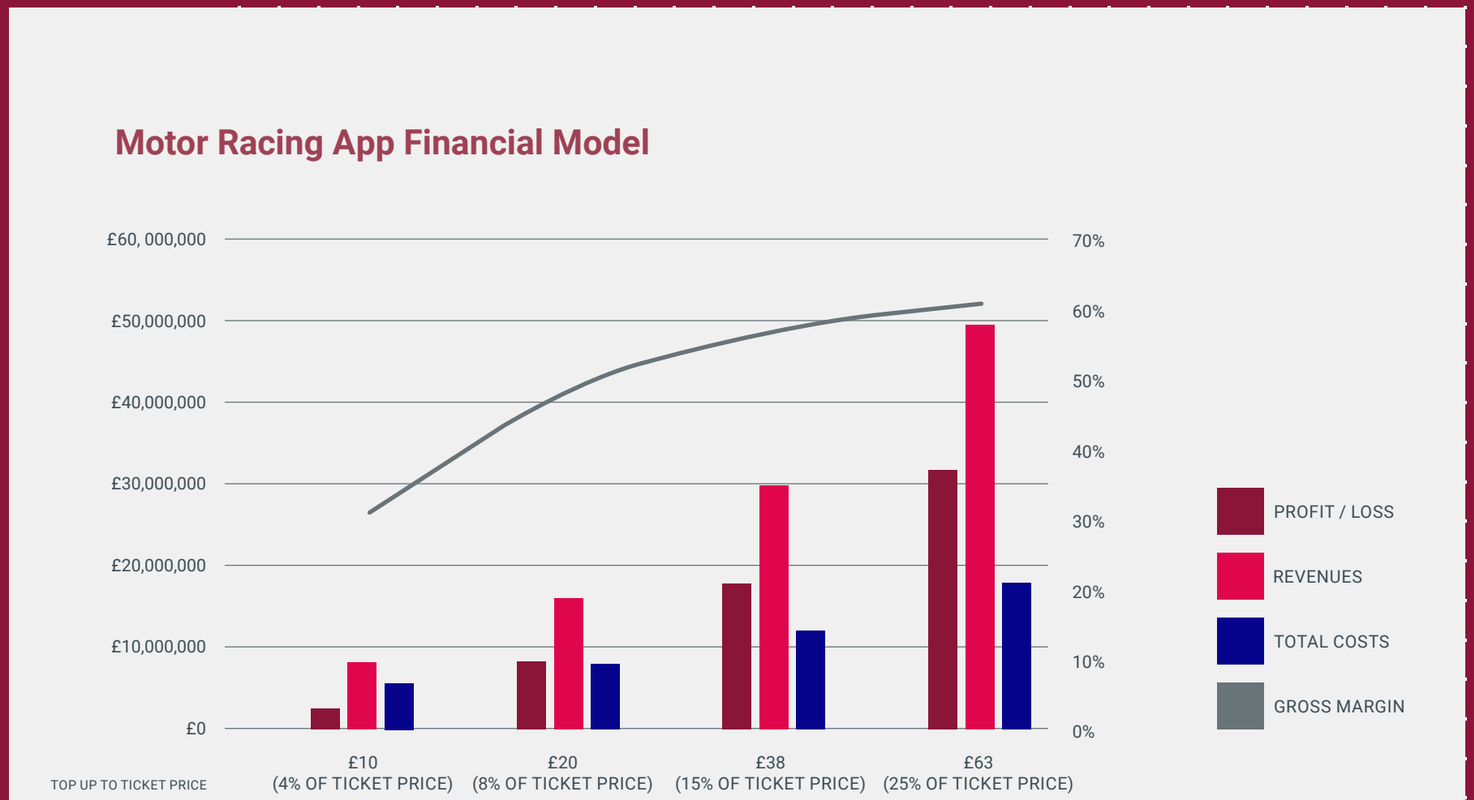


Image: TEO Limited, "Financial Modelling of VISTA apps", Mar. 2022

Competitor analysis

True View

Intel's True View is a volumetric video platform for data capture, processing and production. Using volumetric video technology, footage is recorded from dozens of ultra-HD cameras to create a virtual environment and enables fans to watch 360-degree replays and views from a player's perspective, as though they were in the game.

DEPLOYMENTS:

True View has been installed in more than 30 NFL and NBA stadia/arenas in the USA and in several top clubs in the **UK**, **Spain** and France. The **cost** per deployment has been estimated to around EUR 1 million (paid by the French Football League (LFP) in France).

LATEST STATUS:

Intel sold its True View technology to Verizon, and it now forms Verizon's key technology offering in the **Volumetric Format Association** (VFA) which aims to standardise the capture, processing, encoding, delivery, and playback of volumetric video.

ANALYSIS:

Volumetric video is an impressive technology which could become the ideal companion to 5G Broadcast.

"As a result of TrueView Arsenal has seen a 90% uplift in supporters revisiting the content when compared with other match highlights*"

* https://insidersport.com/2020/07/29/arsenal-boosts-fan-engagement-with-intel-sports-extension/

Competitor analysis
SwipeVideo

SwipeVideo is a proprietary patented software that allows live or archive streaming of multi-angle video over any web browser. It gives the viewer full control over the direction of the content and increases engagement by providing a totally **new video viewing experience**.

DEPLOYMENTS:

Amatelus, the company behind SwipeVideo, has partnerships with **Dentsu** and **NTT Docomo Business**. It works with Dentsu in defining use cases in sports, entertainment, education and e-commerce, and uses the mobile phone operator, NTT Docomo, as a channel partner.

LATEST STATUS:

Amatelus collaborates with **Jetro** (Japan's Department for International Trade) to expand internationally, starting with North America.

ANALYSIS:

SwipeVideo is a cheaper alternative to True View that uses commodity camera hardware (i.e. smartphones) and specialist software to keep the costs down. The result is still impressive. In a **recent interview**, Amatelus conceded that its main challenge is to define a suitable business model for its technology.

USE CASE	PRICING	COMMENTS
Single event shooting	£2K (¥300K)	Free delivery of up to 4 minutes
On-premises plan For events and local viewing	Set up cost: £20K–130K (¥3M–20M) Monthly subscription: £325 (¥50K)	Everything required for shooting, data storage and viewing
Turnkey solution (Shooting to distribution)	8% of ticket cost	Includes, platform, payment system and various options e.g. chat
Live video distribution over cloud (SaaS)	From £1K per month based on data storage and distribution requirements	Custom-made quotes for a dedicated delivery system

Competitor analysis

Spiideo

Spiideo is an advanced video recording platform for sports teams that gives them the ability to stream games online automatically without the need for a camera crew. It is a sports performance analytics software that helps coaches to turn on-field gameplay videos into actionable data insights that improve team performance.

DEPLOYMENTS:

- Many deployments in Europe, North America and Asia
- Targeting medium and smaller clubs with limited budgets
- Live streaming **pricing** starts at **€2,500 per year**

LATEST STATUS:

- Extending its performance analytics platform to a video streaming platform directly to fans for a better engagement and participation

ANALYSIS:

- COVID-19 opened the eyes of even the smallest sports clubs and fans to the benefits of streaming and its ability to enhance the fan experience and reach bigger audiences
- If fans couldn't be there in person because of lockdown restrictions, they could instead watch online

Competitor analysis

Formula 1 TV Access

The **F1 app** offers fans access to all the F1 news, results, timings and in-depth analysis - as well as real-time telemetry, or the collection of data through receiving equipment, around 300 sensors on the F1 cars - thanks to Amazon's (AWS) IoT platform.

DEPLOYMENTS:

- The data is streamed to F1's own TV platform and app
- While the basic app is free (with ads), access to real-time telemetry and exclusive content requires **F1 TV Access** subscription at £19.99/year
- The premium **F1 TV Pro** (not in the UK) is $79.99/year. In the UK, Sky Sports F1 costs £18/month*

LATEST STATUS:

- **Formula 1** is the fastest-growing major sport with ~50M followers. It outperforms all other major sports in digital distribution and had the highest engagement rate on social media compared to any other major sport in 2021

ANALYSIS:

- F1 has a strong fan base and loyal followers. For them, the basic cost of £2.29 per month (UK) is an affordable way to gain full access to all live features and on-demand content from the F1 archive
- In 2021, total video views (web, app, social) increased to over 7 billion (up 44% from 2020) with 113 million unique users**

* Prices correct at time of publishing

** https://www.formula1.com/en/latest/article.formula-1-announces-tv-race-attendance-and-digital-audience-figures-for-2021.1YDpVJIOHGNuok907sWcKW.html

Key takeaways

- Two possible commercial product offerings have been defined, targeting the use cases that have been identified as most promising for commercialisation:
  - **Football stadium: An app that augments the match experience with additional live broadcast content and coverage of key moments**
  - **Motor racing: An app that expands the live experience beyond the single viewing location in a circuit**
- Each product has been defined conceptually, listing their desired features with reference to competitive products targeting the same market
- The value proposition and market fit were further validated using SWOT and Business Model Canvas tools, and a simple financial model was used to quantify the market conditions for the commercial viability of the products in the current competitive environment
- It is illustrated that both the football app and motor racing app are commercially viable under the assumptions of the model when adopted by a relatively small number of fans of (~30K) and at prices of £3-£5/month subscription (football) or ~8% top-up to ticket price (motor racing)

06. CONCLUSION AND RECOMMENDATIONS

Conclusion

Opportunities enabled by FeMBMS

This report has given a comprehensive overview of the sustainability and competitiveness of the products outlined as part of the DCMS-funded 5G VISTA project. Based on extensive market and consumer research, stakeholder and end-user mapping as well as specialist workshops, the project has proposed two commercially viable products that have the potential to transform experiences of live sporting events.

Of particular significance is the broader application potential of the 5G services outlined. 'Further-evolved multimedia broadcast and multicast service', also referred to as FeMBMS, enables a "one-to-many" distribution model that has the potential to transform the delivery of broadcast and multicast services. It is the most advanced service to combine terrestrial broadcasting with mobile communications through the power of 5G.

There is a consumer need at in-stadia live events to enhance network coverage and allow large audiences to access a seamless network stream, given the significant rise in social media and smartphone usage across all demographics. FeMBMS will enable the key stakeholders outlined in this report to provide their customers this service within the geographic boundaries of their venues.

As outlined in the **report recommendations**, further exploration of the topic could determine the broader potentials of FeMBMS. The consortia partners of the 5G VISTA project have tested and demonstrated the technical feasibility of this technology in the specific context of live in-stadia events and music concerts. Further business models could be developed to consider options outside these areas; additional research would help to assess potential solutions for driving ubiquitous handset compatibility.

Where FeMBMS fits in the network provision

FeMBMS has multiple benefits that have the potential to drive the development of further use cases and leverage network capacity.

The cost of sending a single packet using Unicast is increasing linearly with the network size (nodes) and number of receivers that need to be reached (see Figure 1).

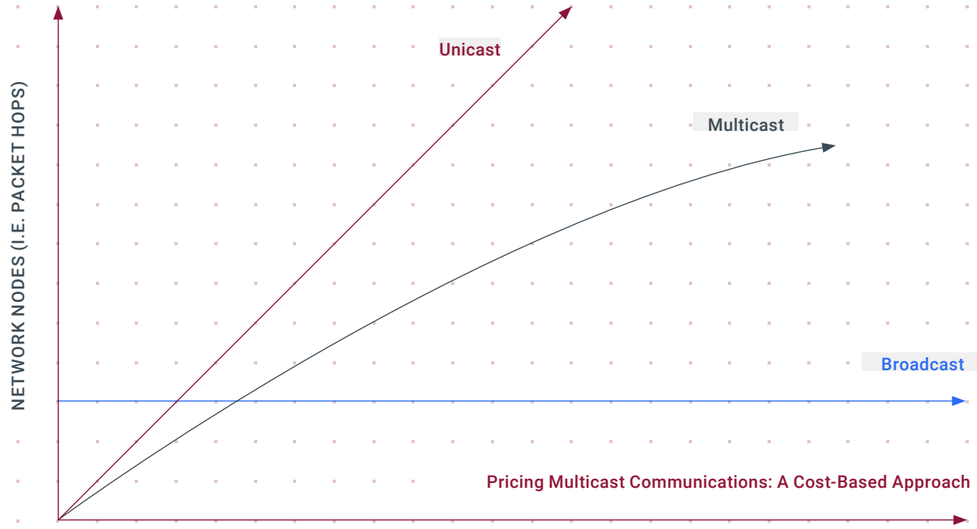
Broadcast transmission, on the other hand, has a fixed cost irrespective of the number of receivers. This is not economical for a small number of receivers, however it becomes more efficient once a minimum number of receivers require the same service (see Figure 2).

It is estimated that broadcast is superior to Unicast once more than eight receivers require the same content over the network.

Multicast transmission performs somewhere in-between Unicast and broadcast. For a small number of receivers, it performs like Unicast, but its performance improves against Unicast for larger receiver numbers by adopting clever streaming strategies.

These economics can be used to develop a practical planning tool that can help with the design and dimensioning of each delivery method to support the network performance targets for a specific event.

Cost of sending a single packet



Pricing Multicast Communications: A Cost-Based Approach

Figure 1

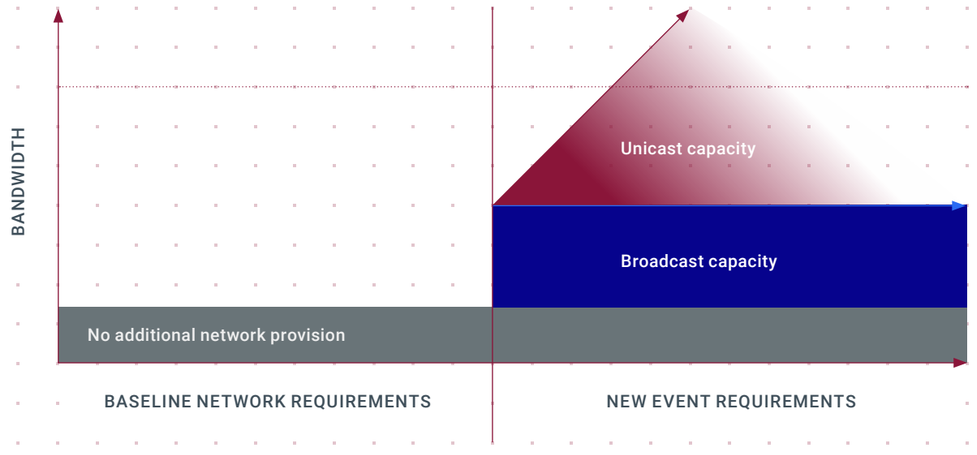


Figure 2

Images: TEO Limited, Mar. 2022

Summary of recommendations

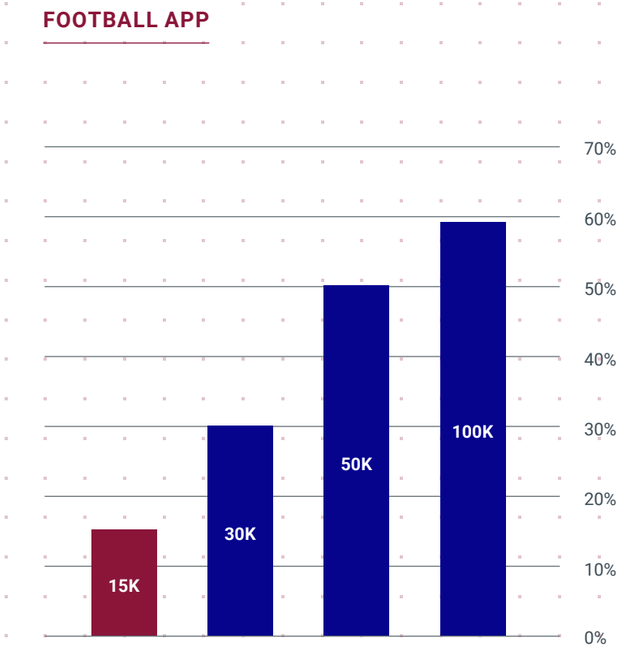
5G Broadcast/Multicast is an efficient and environmentally low-impact solution that augments the capability of heavily-congested cellular and Wi-Fi networks such as those found in sports events and music concerts.

This sustainability report validates the consumer demand and commercial viability of the solution in two exemplar markets: **football** and **motor racing**.

The report has illustrated that both products are commercially viable even with relatively low audiences (~30K) and less than £5/monthly subscription for the football app, or around 8% top-up to ticket price for the motor racing app.

Moving forward, a more detailed business plan could be prepared with the aim to clarify and resolve key challenges raised in this report including:

- Larger field trials in real operating environment
- Availability of compliant receivers
- Content rights management
- Suitable deployment scenarios
- Exploration of alternative business models
- Price sensitivity analysis



For the football app, the business opportunity becomes viable for any number of subscribers above 30K as shown in the graph where the profit margin increases in line with the number of subscribers.

Profit margin for various top-up prices (% of ticket price)

For the motor racing app, there is a window of pricing around the £20 (representing 8% of the average Formula 1 ticket price) which produces healthy profit margin (i.e. over 50%). Anything higher than that (i.e. >15% of the ticket price) represents a hard-to-justify portion of the total ticket price

TEO Limited, “Financial Modelling of VISTA apps”, Mar. 2022

Customer demand

In order for the two products proposed in this report (football stadium and motor sport applications) to be a success, it is crucial that they respond to the established valid customer needs:

- **The product should augment and improve the live experience:**

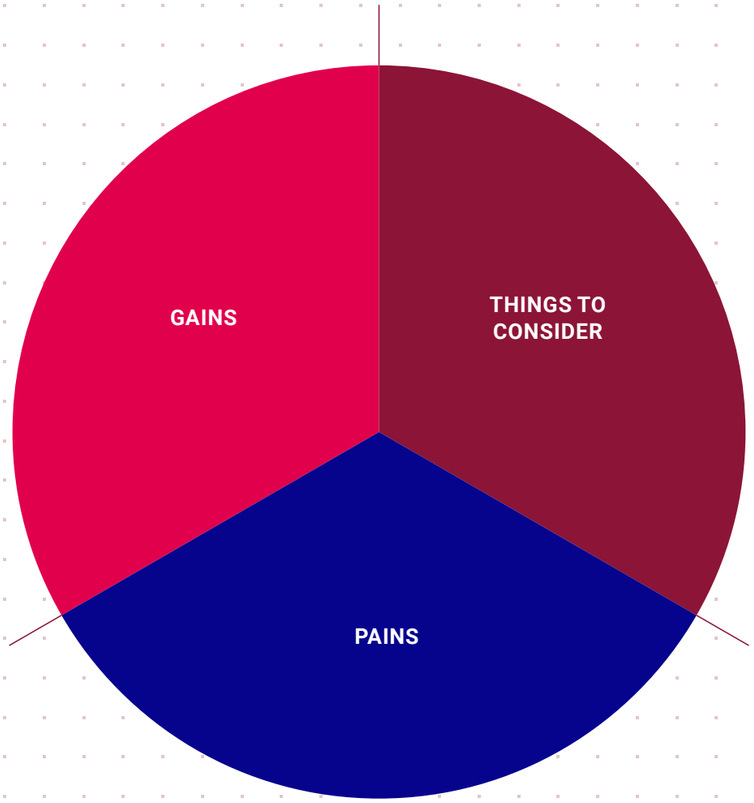
  The key draw for attendees is being there in person, if they wanted to watch on TV they could stay home. The application must ensure that it feeds directly into the real-time experience, immersing the audience in exclusive content that complements the environment.

- **The product should allow further access to the action:**

  Sports and events where you cannot see all the action from one position have a more obvious appeal for the outlined use cases. Allowing the attendee to both experience what is in front of them, and better follow the action elsewhere, expands the experience beyond the parameters of one viewpoint.

Feedback from the workshops undertaken make it clear that VISTA's application is broad and has high demand variability across multiple use cases, as well as potential fringe opportunities in other locations accessed by fans during their journey on the day of the event (food stalls; queues etc.).

Value Map



GAINS

- Potential to generate revenue across use cases, either directly or through partnerships deals and additional sales channels (live sports and music events)
- Can encourage spectators to return to live events following the COVID-19 pandemic
- FeMBMS allows broadcast servicing operate on a cellular network, supporting the delivery of multiangle HD video streams to thousands of viewers
- Relatively low capital expenditure when compared to 5G Unicast solutions

THINGS TO CONSIDER

- Multiple camera angle broadcast needs to be produced in order to provide relevant and engaging content
- This requires additional investment in the broadcast production
- Following COVID-19 the climate for capital investment in sport and live events is challenging and organisations are wary of making large scale investment in new innovations
- A new broadcast service should work in tandem with existing business partners and commercial agreements

PAINS

- Experience should augment the live match experience and nature of the event; adoption etc. is reliant on positive consumer engagement
- FeMBMS needs to demonstrate benefits over Unicast and other technology solutions
- Rights ownership is complex due to existing business agreements

Future plans

Product roadmap

In order to maximise return-on-investment (ROI), both target markets (i.e. sports events and motor racing) need to be addressed with the same core software platform technology. This will require an initial phase of a "Core Technology Development" which will split into two paths, each targeting a specific vertical.

Initially the "must-have" features of the products must be supported and the "nice to have" features should be developed as a product roadmap strategy. Additional client-customisation should be offered for different clients as illustrated below.

This is a scalable approach to business development which allows the product offering to be extended to other use cases beyond football and motor racing in phase 2 and would be able to leverage the network capacity outside match day event in phase 4, depending on the available funding.

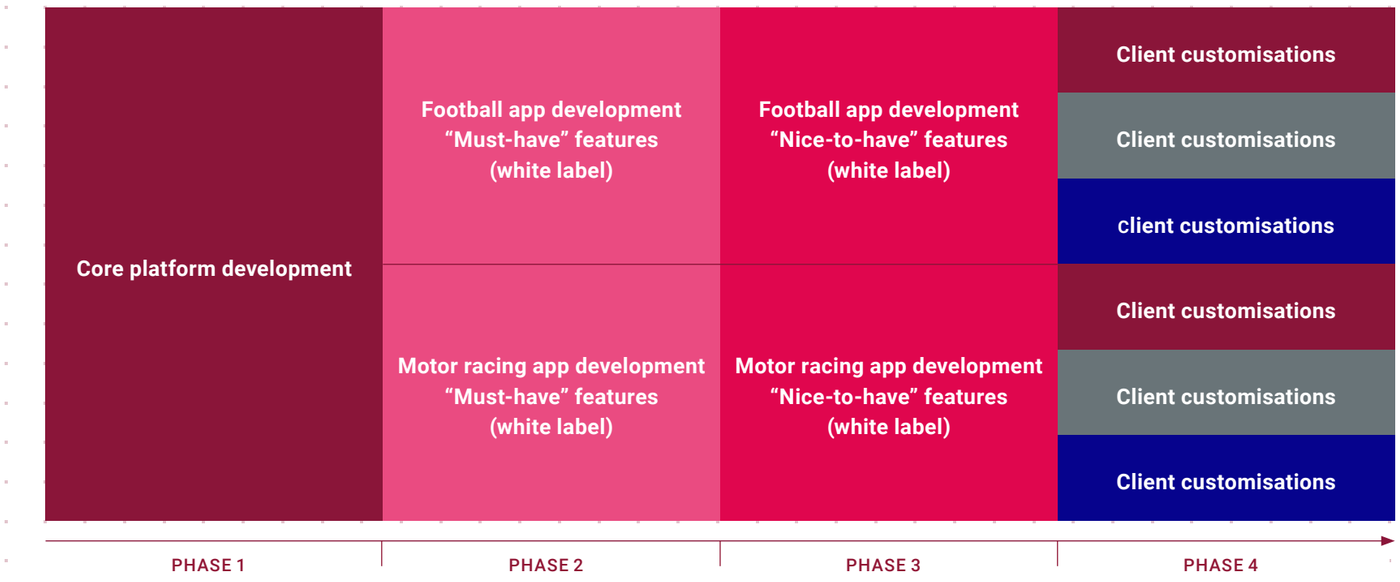


Image: TEO Limited, Mar. 2022

5G: other possibilities

Beyond the VISTA project, the **5G Festival** project applies 5G to the creative sector and live music events. Leading organisations from across the UK's arts, entertainment and technology industries collaborated to create the first 5G-powered music festival, a showcase of creative talent – both technical and artistic – and the power of digital technologies.

The 5G Festival is where artists can gather and connect both in person and online. Using 5G and its ability to transmit with low latency (delay) and in ultra-high bandwidth, the 5G Festival has transformed the ability of physically separate artists to perform in an immersive live, collaborative environment from different locations. The 5G Festival showcase in March 2022 was broadcast live directly to audiences at leading UK venues, and will include immersive in-venue experiences.

Digital Catapult continues to support the acceleration, expansion and commercialisation of 5G services, working with government to drive technology adoption and transform key sectors in the UK economy. Working closely with the Department for Digital, Culture, Media and Sport (DCMS), Digital Catapult supports a number of initiatives on the 5G Testbeds and Trials Programme (5GTT) to harness areas where the UK has a competitive advantage.

Glossary

5G

The 5th generation of mobile network telecommunications - represents a step change in network performance capability, providing business grade service levels, reliability and availability incomparable with earlier generations. 5G can deliver speeds up to 100 times faster than 4G, ultra-low latency, high reliability, and increased capacity. It will eventually allow up to one million devices per square kilometre to connect without interference – 4G can only manage 2,000. 5G will also provide a stable and reliable connection, even for fast moving objects. In coming years, its capabilities will support innovative use cases from smart cities to connected ports, new ways to experience live entertainment, remote collaboration and industrial training, quality inspection, and much more.*

VISTA (VIDEO IN-STADIA TECHNICAL ARCHITECTURE)

This name was selected to reflect the project's use cases and ambition to provide an enhanced 'in-stadia' viewing experience of national sporting events. "Technical Architecture" refers to the technological infrastructure enabled by 5G Multicast, which will allow customers seamless connection from within chosen locations. Project VISTA has been developed to provide a solution to the architectural shortfalls of Unicast whilst further enhancing the experience through live 5G Multicast.

FeMBMS

FeMBMS (Further-evolved multimedia broadcast and multicast service, 2010) is a point-to-multipoint interface designed to improve the delivery of broadcast and multicast services. FeMBMS (2017) enhanced the capabilities of eMBMS, allowing for 100% broadcasting capacity.** It marks the most developed stage of the convergence of terrestrial broadcasting and mobile communications through the power of 5G.*** The FeMBMS technology has the potential to provide broadcasting services to an unlimited number of customers within a desired coverage area.

MULTICAST

5G Multicast services extend the capabilities of Unicast services; where Unicast functions to broadcast from one source to another, Multicast enables traffic to exist between the boundaries of Unicast – thus allowing one source to be broadcast to many destinations.**** This will enable broadcasts to reach broad audiences, minimising delay and enhancing the overall on-site experience. Within stadia, in the context of the VISTA project, Multicast enables the capacity to take control of the viewing experience, through zooming in on multiple angles, repeating footage, slo-mo playback and synchronised commentary.

* Definition taken from the Verizon 'Journey to 5G Report' by Digital Catapult
** https://www.progira.com/embms-FeMBMS-5g-cutting-through-the-technical-jargon/
*** https://www.rohde-schwarz.coâm/uk/about/technical-stories/5g-broadcast_251259.html
**** Rohde and Schwarz 5G Broadcast Multicast report

Acknowledgements

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With special thanks to **Alex Buchan, Project Lead at DTG**.

Special thanks also go to partner company Global Wireless Solutions Inc (GWS), who undertook extensive consumer research as part of the VISTA project.

Our thanks are also extended to all of the consortium partners:

- Ateme
- Digital TV Group (DTG)
- Global Wireless Solutions Inc (GWS)
- Imaginary Pictures
- Ori Industries
- Rohde and Schwarz
- The University of Surrey
- Virgin Media O2

This project has been funded by the UK Government's Department for Digital, Culture, Media and Sport (DCMS) as part of the 5G Testbeds and Trials programme.

About Digital Catapult

Digital Catapult is the UK authority on advanced digital technology. Through collaboration and innovation, we accelerate industry adoption to drive growth and opportunity across the economy.

We bring together an expert and enterprising community of researchers, startups, scaleups and industry leaders to discover new ways to solve the big challenges limiting the UK's future potential. Through our specialist programmes and experimental facilities, we make sure that innovation thrives and the right solutions make it to the real world.

Our goal is to accelerate new possibilities in everything we do and for every business we partner with the journey – breaking down barriers, de-risking innovation, opening up markets and responsibly shaping the products, services and experiences of the future.

Digital Catapult is part of the Catapult Network that supports businesses in transforming great ideas into valuable products and services. We are a network of world-leading technology and innovation centres established by Innovate UK.

Visit www.digicatapult.org.uk for more information.

5G VISTA

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