

5G Early Access Program

RESEARCH REPORT



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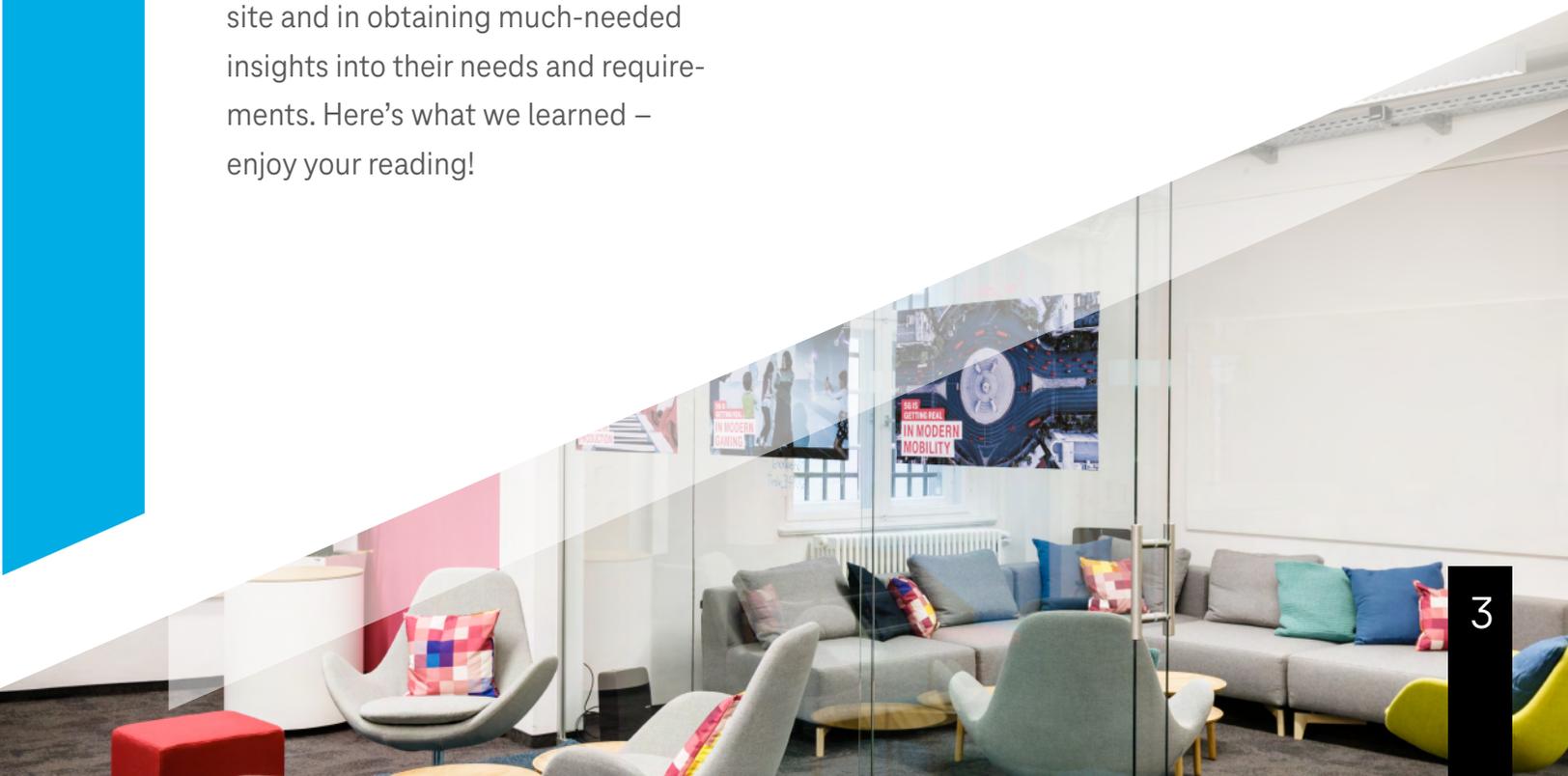
WELCOME!



Axel Menneking
Vice President of Startup
Incubation & Venturing,
Managing Director of hubraum

Digital developer ecosystems are driving the ongoing transformation of businesses worldwide. Deutsche Telekom offers extremely valuable resources for developers in our network. Our challenge is making our Application Programming Interfaces (API) simple to use, despite the complexity of the telco network.

We are incredibly proud of the results achieved so far in our 5G Early Access Program. Participants used their access to our unparalleled indoor and outdoor 5G testbed to configure key functions of 5G networks like throughput and latency. Our team did a great job, both in terms of supporting developers on site and in obtaining much-needed insights into their needs and requirements. Here's what we learned – enjoy your reading!



KEY RESULTS

Insights: Developer Culture

When developing API products, developer needs should be at the heart of this process.

Insights: Perception of Telcos versus Aggregators

Telco APIs' attractiveness rockets when they are supported by other telcos — especially when those same companies are thinking of operating internationally.

Insights: 5G – Education and Expectations

The 5G Early Access Program helps participants to better understand what specific benefits and advantages 5G can deliver to different industries, and to identify the technological requirements for specific use cases to operate on it.

Insights: Key Requirements for Telco APIs

Excellent, robust documentation is one of the key requirements developers have when choosing the right API. There is no such thing as too much documentation.

Insights: Key Requirements for 5G Quality-on-Demand APIs

Our tests have confirmed that the 5G Quality-on-Demand API is simple, standardized, and improves the performance of the use cases we tested when the network is congested.

Telco Made Easy

Telecommunication companies such as Deutsche Telekom operate via high performance networks which are increasingly becoming software-based. Networks thus transform into platforms which can grant access to services via formalized interfaces without demanding any knowledge of inner workings on the part of the user. Consequently, the new Telco as a Platform requires the ability to provide interfaces to the platform to any type of user.

We grant external consumers access to the platform via Application Programming Interfaces (APIs). These APIs, used by external and partner developers, enable completely new and innovative use cases. The fifth generation of cellular networks (5G) will enable completely new use-cases and enhance customer experiences of existing ones. In the future, network capabilities will be exposed through 5G APIs.

But many developers struggle to integrate telco microservices into their applications, which may be attributed to poor documentation, limited support, or a lack of clarity when it comes to telco specifics. Another barrier is access to telecommunications expertise. While everyone has heard about 5G networks, most developers will likely only have a fairly generic level of knowledge about this topic at this time.



We take a developer-centric perspective and aim to develop our products and services based on a nuanced understanding of the developer ecosystem. Using our own and third-party research, we listen to the developer community to identify both the good and the bad when it comes to dealing with telco APIs.

Anna Piwowarczyk,
Program Manager, hubraum

We set up our 5G Early Access Program to give developers a first look at the technology and to simultaneously learn what their requirements are. Our research approach assumes that only if developers can test out our APIs themselves, even at an early stage of their development, will they be able to provide solid feedback and help us improve them.

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5G Early Access Program

As such, on designing the 5G Early Access Program, we had two overarching goals in mind. The first was to receive feedback on our 5G APIs and learn how to improve them. The second was to understand developers and adapt our offerings to cater to their specific requirements. The program kicked off in May 2022 at our Berlin campus and continues to this day — it's a one-month program which culminates in startups performing a demo of their product and which we have held with four different batches of startups so far.



With this program we are focused on figuring out what's interesting to developers, regardless of if they work in startups or corporates.

Noel Wirzius,
Product Lead Network APIs,
Deutsche Telekom



When we launched the program, hubraum's campus was the only place in the world where Deutsche Telekom was offering an indoor and outdoor 5G testbed — an environment where developers, startups, corporates, and hyperscalers could test 5G APIs directly on a fully functional 5G standalone core network. The fourth batch of startups on the program in January 2023 carried out testing simultaneously in Berlin and at T-Mobile US in Seattle.

This enabled developers to test our APIs before the public launch of the new abilities that 5G offers, and to generally get to grips with the value 5G standalone networks will bring to coders and businesses alike. Our research team conducted interviews with the participants to evaluate the insights gleaned from each of the batches and suggest improvements for the respective next steps of the program and the APIs.

Insights: Developer Culture

Developers are a unique target group who both stand out from the crowd and change swiftly. Individuals active as developers are often described as people who are solution oriented, who place their trust in communities, but who mistrust marketing communication. Most of them are fighting a constant battle to stay up to date with latest developments in software. Therefore, it's common for this group to learn by carrying out projects, trying out new tools, and exchanging information with their communities (see box).

Work organization	Communities and staying up-to-date
<ul style="list-style-type: none"> ▪ Solution-oriented ▪ Focused style of working ▪ Use agile methods, scrum, mind maps ▪ High team-orientation ▪ High degree of predictable tasks ▪ "We google everything" ▪ Copy and paste code ▪ Open-source ▪ Likely to outsource tasks to low-wage countries ▪ Likely to work remotely ▪ High fluctuation, changing employers frequently ▪ Thinking in hierarchies and logical relations ▪ Believe in multiple ways to achieve a goal ▪ "Someone says: 'build this', but for us it means hundred questions" 	<p>Participation in communities</p> <ul style="list-style-type: none"> ▪ High trust in communities and colleagues ▪ Following social channels, reading blogs, forums, browsing tutorials (Reddit, Stack Overflow, Slack, GitHub, Twitter, YouTube, LinkedIn) ▪ The majority of participants were passive, but in total more active participation (sharing knowledge, answering questions) than found in other professions ▪ Attending meetups, conferences and hackathons <p>Staying up-to-date</p> <ul style="list-style-type: none"> ▪ "This is a constant battle" ▪ Intrinsic motivation to stay up to date, often using time outside of work to do so ▪ Learning by carrying out projects, trying out tools ▪ Communities are most important source ▪ Common to have side projects

Source: Prof. Franke + Gussenberg GmbH, Telecommunication APIs - Market Research Results, 2022



To target this particular group, it is essential to place their needs and requirements at the center of the product development of our APIs.

As we developers know, it's challenging when people create something without considering us. But here we make the difference – we focus on you, the developers. We ask you what your developer use case is, without developing away from you.

Mario Bodemann

Developer Evangelist, hubraum

Insights: Perceptions of Telcos versus Aggregators

Since not many core telcos offer APIs themselves yet, the market currently is dominated by third party aggregators. These companies buy API capacities and market them to developers. Experiences with APIs obtained directly from a telco are limited. As such, evaluating the appeal of APIs offered by telcos means analyzing expectations rather than real life experiences.

Overall, it seems challenging for telcos to be taken seriously by customers as API providers. Nevertheless, there is an opportunity for network operators to become the source of services to be accessed directly via APIs.

The way developers view telcos

PRO	CON
<ul style="list-style-type: none"> ■ Telcos are established companies ■ Less risk of getting fined for violating regulations of a specific country ■ Trust: "We do trust telcos more than we trust aggregators" ■ High brand awareness 	<ul style="list-style-type: none"> ■ Old-fashioned (sometimes even outdated) code design / technology / data formats / protocols ■ APIs are not telco's core business ■ Inflexible ■ Some participants feel unable to influence telcos to resolve the matter when problems with their API services arise (mostly due to their experience with a specific carrier)

Source: Prof. Franke + Gussenberg

Our research shows that what matters most about the APIs provided by telcos is how the service works and whether it is available when roaming and supported by other operators, rather than where the APIs are provided, be it an operator's platform or an aggregator's platform.



And the most important disadvantage of using telco providers is that you need to **do the same things** for three different providers and if two of them fail for the implementation phase, you need to search for different solutions for different providers. So that makes it very complex.

**Developer,
Full Stack**

However, for new, innovative APIs such as the 5G Quality-on-Demand API, telcos appear to be the preferred vendors. After all, they are the experts for their networks, and developers expect better, more substantial technical support. Using such APIs via an aggregator would unnecessarily extend the distance between customer and supplier.

Insights: 5G – Education and Expectations

5G networks will become the next platforms which enable new use-cases and enhance customers' experiences of existing ones. 5G is now delivering on this promise and evolving from a static network into a dynamic one. In the future, network capabilities will be experienced through 5G APIs.

Since no fully functional stand-alone 5G networks are in operation yet, it is unsurprising that most developers only have a very general understanding of the technology. There is a lack of nuanced and in-depth understanding of how 5G works and how a stand-alone network differs from what is available today.

Incentives to participate in the 5G Early Access Program included achieving market readiness and scoring an advantage over competitors once 5G stand-alone networks are rolled out. The 5G Early Access Program helps participants to better understand what specific benefits and advantages 5G can give different industries, and to identify the technological requirements for specific use cases to operate on it.

Telekom is perceived as a partner whose brand stands for an innovative approach to 5G. The aim for participants here is understanding what Deutsche Telekom's plans are for a 5G rollout, and what business and partnership opportunities may



Gergely Ellenrieder,
CEO, AeriU



I had some ideas about 5G networks, but it was good to see that we are going forward and not just non-standalone but standalone 5G is starting to roll out.

Insights: Key Requirements for Telco APIs

Choosing an API, or switching from one API to another, is more than a programming task — it is a decision-making process that reflects how API users evaluate and use multiple APIs in different situations. Some factors to be taken into account include how well an API corresponds to the nature of the project, how useful and easy to use it is, plus how much it costs to switch from one to another. The number of factors to consider is high. Understanding the decision-making process of API selection was just one of the goals of our research project.

The decision-making process can be divided into four stages – **defining, discovery, evaluation, and planning.**

- **Defining** refers to the process of identifying a problem that needs to be solved, such as reducing latency to improve the user's streaming experience.
- **Discovery** describes the process of uncovering existing solutions to a problem — at this stage, solutions can take various forms and include different APIs available on the market.
- **Evaluation** refers to the initial process of learning about and testing candidate solutions, including APIs, before reaching a final decision. Developers play a key role at this stage.
- **Planning** describes the process of the business stakeholder, product owner or company considering the implications of committing to a particular API.

Each of these stages involves different actors, including business stakeholders, product owners and developers. Developers play a key role in the evaluation stage, where they must determine to what extent an API allows to quickly write error-free programs that solve the design challenge they have been set. Since developers test many competing products at the same time, it is worth considering the key requirements that have a decisive impact on their decisions. **For this report we focus on the three most critical aspects of developers' requirements. Documentation** is a crucial aspect in the decision-making process for many developers.



The most important thing for me to use actually one API.

When I see a documentation is good, I will just use this API because it seems like you could easily implement it.

Developer,
Full Stack

Source: Prof. Franke + Gussenberg

Insights: Key Requirements for Telco APIs

Texts outlining the APIs do not just need to describe the technical specifications of the API but also need to be well written and easy to understand by those without any telecommunications training, and include

- Documentation for various programming languages
- Information addressing country-specific differences
- Maintenance after API updates (refer to specific versions)
- Explanations for every single parameter, endpoint and response

Code examples / implementation

Various code examples and best practices for as many use cases as possible (including real-world examples) should be provided.



My main pain point is getting to grips with these APIs, understanding what they mean. And later, if I want to change something, I want to easily understand what I did at that point, what my settings are, what they mean.

Source: Prof. Franke + Gussenberg

Developer,
Full Stack

Sample applications for various platforms and sample projects should be offered on GitHub or as downloadable code

- Keys, credentials, endpoints must be easily provided
- Easy implementation for international use

Introducing APIs externally

For developers, it is important that the API is easy to access and is respected by the community

- Registration and verification processes should be simple and fast (no key account manager)
- The API provider or platform should be easy to find on Google
- It's helpful when there's already an existing vibrant community supporting the API on GitHub, Reddit, etc.
- Ideally, the API provider would be respected and well-liked by the developer community



I always check the API online, I google APIs first. And when I come across an interesting API, I check what other developers have written about it. If there are no comments about an API, that's always concerning.

Source: Prof. Franke + Gussenberg

Developer,
Full Stack

Insights: Key Requirements for 5G Quality-on-Demand APIs

The Quality-on-Demand (QoD) API outlined in the CAMARA project provides an interface for developers to request stable latency or throughput managed by telco networks without the necessity to have an in-depth understanding of the 5G system or the overall complexity of the telecom systems.

Our tests across a wide range of use cases have confirmed that the 5G QoD API is simple, standard and works as expected. The description of the parameters (E, S, M, L) was clear and understandable for the participating developers.



I think the API itself is well written and is relatively easy to use. It's a very standard REST API that most developers are familiar with.

Adam Kirk,
CEO, Forma Vision

The tests also show that several requirements must be met to successfully deploy QoD APIs. One use case - different priorities: For specific use cases various QoD API parameters (E, S, M, L) may need to be deployed for different types of data. For example, in the case of drones equipped with cameras, low latency is required for navigation, while high throughput is required for video transmission.



We have two types of data: One is telemetry data, which gives the drone commands accepting where the drone is, drone position; the other is the video payload. Ideally, we would like to split these two data and prioritize the telemetry data, which is a few bytes, but ensures that it communicates the most recent parameters of the drone and its the location to us.

Gontran Reboud,
EMEA Sales Director, H3 Dynamics

Insights: Key Requirements for 5G Quality-on-Demand APIs

QoD profile labels	Network Service Description
QOS_E	Latency stays stable under congestion (throughput up to a certain limit, e.g. 500kbps). The application bitrate should not exceed the limit. (LATENCY)
QOS_L	The 5G system throughput is prioritized up to certain higher limit (e.g. 20Mbps), or without an explicit limit. At a high load, the throughput may be capped at the limit and can be degraded to lower effective throughput (without a minimum level).
QOS_M	The 5G system throughput is prioritized up to certain medium limit (e.g. 8Mbps). At a high load, the throughput may be capped at the limit and can be degraded to lower effective throughput (without a minimum level).
QOS_S	The 5G system throughput is prioritized up to certain lower limit (e.g. 4Mbps). At high load, the throughput may be capped at the limit and can be degraded to lower effective throughput (without a minimum level).



Imagine being at a festival, and someone in the audience has been injured and needs assistance. The positioning data of where AR objects are placed are important to the AR experience, but are they as important as the position of someone who has an emergency? The rescue team needs to use positioning data to establish where this person's at. Some types of data are more crucial than others. The position of an AR object is not as important as someone's life and well-being.

Johannes Davidsson,
Head of Business Development, Auki Labs

Insights: Key Requirements for 5G Quality-on-Demand APIs

Taking priority over priority: There should be an API which always takes the top priority, even over QoD API users. Such an API should be dedicated to critical services related to health AND safety, such as fire departments or ambulances.

Priority on demand / access to network information: The key advantage of QoD APIs is prioritizing the user connection when the network is congested. Therefore, the mechanism predicts the level of congestion and the state of the network is essential, in order to call and/or stop the API only when it's needed. The way that this mechanism which detects congestions works depends on a business case. Thanks to this, optimization of the QoD API will be possible.

Stability on demand: There is a need not only for low latency, but also for stable latency - this is especially true for use cases in which jitter variations (and associated packet loss) are a threat to the usability of the solution, such as with cyber security or for a solution dealing with autonomous traffic surveillance.

Lowest, stable latency on demand: There is a growing demand to minimize latency, which can be seen across various verticals. Fast-moving objects require the lowest possible latency to be able to slash the response time in fast changing environments. It plays a crucial role in the automotive industry, especially with the introduction of autonomous or semi-autonomous vehicles.



In a live volumetric meeting users can see each other from any angle at any distance, so the experience is better with high resolution data. 5G unlocks the ability to use high resolution data for every participant in a group call without compression artifacts.

Adam Kirk,
CEO, Forma Vision Labs

QoD API across different providers: : The most important aspect determining how attractive QoD APIs are is the standardization of 5G Network APIs. For the cross-border, international use cases, guaranteeing the same standard for different telecommunications networks is a key element in terms of providing a stable, uninterrupted service. This is what the CAMARA Alliance is all about.

CAMARA – Telco Global API Alliance

To ensure a seamless experience across different networks and countries when using APIs, telco operators need to work together to build bridges between their various networks. To tackle this challenge, a number of telco operators joined forces with the Linux Foundation and the GSMA association to create CAMARA – Telco Global API Alliance.

“CAMARA is set up as an open-source project to define, develop and test the APIs. Harmonization of APIs is achieved through fast and agile working code with developer-friendly documentation. API definitions and reference implementations are free to use under an Apache 2.0 license.



Nathan Rader
VP Service and Capability Exposure,
Deutsche Telekom

CAMARA has set itself an ambitious goal: to enable seamless access to 5G network capabilities. Deutsche Telekom 5G APIs are the first APIs designed according to CAMARA specifications. Within CAMARA, dedicated working groups focus on various APIs and develop guidelines for the source code, documentation and CAMARA-specific terms.

“Learnability”: We define “learnability” as the time and effort needed to master the new API. The standardization (e.g., structure of the documentation) can noticeably boost the “learnability”. This is even more crucial for developers outside of the telecommunications industry as they don't need to invest time in mastering new APIs.

Network Neutrality: This is the principle that Internet service providers (ISPs) must treat all Internet communications equally, and not charge users different rates based on content, website, platform, application, type of equipment, source address, destination address, or method of communication. It's important to provide information about QoD APIs in the context of its compliance with the Network Neutrality standards.

At the current stage of market development, the 5G QoD API is still a niche product. We differentiate two categories of use cases. In the first, the QoD API works as an enabler, in the second it rather functions as a booster.

5G QoD API as a Booster

All use cases in this group are working and bring value to their end users through existing connectivity options such as 4G or Wi-Fi. Companies are interested in 5G connectivity to create use cases for the future. So far, their use cases are not compromised by congested or unstable networks. There is not a hard stop because they have certain ways to cope with. It is not something that their use cases are facing frequently.

However, the 5G QoD API can stabilize their latency, or provide higher throughput which might translate to a better user experience (this works mainly for AR/VR), which is rather a nice to have than a must have feature.

5G QoD API as an Enabler

Use cases in this category depend on the 5G QoD API and consist of two groups. One group is designed to operate in congested networks (i.e., big concerts, festivals, fairs), and the second when stable connectivity is crucial for user safety. In these use cases, the alternative to using the 5G QoD API is either expensive (like fiber), or not sufficient, or does not exist at all.

The following use cases are from this category.



Use Cases

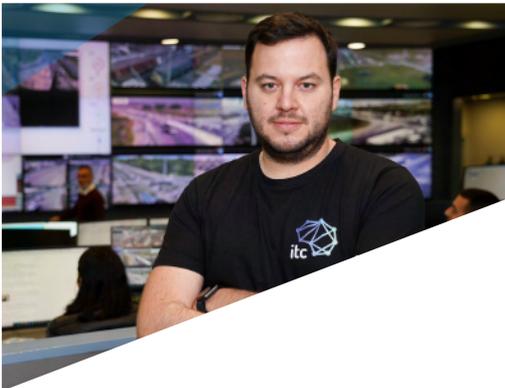
ITC

API as an Enabler / Traffic Control

ITC develops software which solves traffic jams based by using on hardware such as traffic cameras and traffic light infrastructure. Managing volatile traffic flows requires real-time information even in situations with high utilization of the 5G infrastructure.

Impact

ITC successfully used the QoS E profile to prioritize its traffic. Since the API (S, M, L) provides superior quality of the data streamed from traffic cameras, it can significantly reduce the price of traffic control.



“ The tests showed the synergy between our software and the Telekom API, and we learned more about 5G cellular demand peaks.

Dvir Kenig,
Co-Founder & CTO

MATSUKO

API as an Enabler / Holography

MATSUKO is a holographic presence app that enables people and business meetings and calls in Extended Reality (XR).

Impact

Using 5G APIs leads to an improved holographic experience in hologram resolution, framerate, latency, and bandwidth recorded during real-time holographic calls.



“ It is a unique chance to utilize Deutsche Telekom's and Orange's APIs and 5G infrastructure to automatically select the most suitable server which ensures the best quality of holographic calls for our customers and partners, even in case of congested network.

Michal Szakala,
DevOps Engineer

T-Labs Quantum Computing API as an Enabler / Security

API as an Enabler / Security

T-Labs is the R&D department of Deutsche Telekom focusing on translating new technology trends and delivering tangible results into Deutsche Telekom's innovation portfolio.

Impact

For the security use case “Digital Quantum Key Distribution over 5G Networks”, T-Labs used the 5G QoD API to acquire a desired low latency flow between its quantum key management server and its devices. By doing so, it was able to measure the efficiency of the secure application.



“The test fully met my expectation, since I know now how my use case can benefit from the network QoD API.

Ming Yin,
R&D Expert

Enfore/ MagentaPOS API as an Enabler / Commerce

Enfore provides cash register solutions which offer everything from a single source – hardware, software, and business services – are synchronized in real time with the cloud.

Impact

The impact of the QoD APIs on the Enfore/Magenta POS use case would be immediate, primarily in terms of cutting costs and time saving. While Enfore currently needs to bury up to 70 km of wire to connect their cash registers, introducing QoD APIs would not only save money, but also a lot of time, as the digging and set-up process usually takes 2–3 weeks.



“We wanted to data prioritization in a 5G network with a cloud connected enforePos device in a crowded cell. In the test, the lowest level of prioritization was enough to run our solution with almost no delay in the behavior of our client: neither for our merchant, nor for the customer who wants to order and pay!

Volker Stöger,
VP Business Development
and Partner Management

Research Methodology

Here at hubraum, we have been researching developers since 2019. Our goal is to understand the nuances of the developer community, with a particular focus on the needs and requirements when it comes to APIs provided by telecommunication network operators.

This study is based on qualitative research conducted in the 2022 and 2023 5G Early Access Program and Developer Centricity Research. The 5G Early Access Program research involved a total of 22 individual and group interviews with company representatives who participated in the QoD API testing in both Berlin and Seattle. The study also included ethnographic observations of the testing process and a questionnaire.

Objectives of the research:

- Evaluation of the provided 5G APIs - their usefulness, documentation, attractiveness.
- Identification of specific problems, errors, bugs and impediments.
- Ideation on potential new 5G APIs to be developed.
- Evaluation of business value and market readiness of 5G APIs.

Research methods:

- Focus and individual interviews with Early Access Program participants.
- Interviews with people responsible for technical support of the program.
- Ethnographic observation of the testing process.
- Evaluation survey.



Researching developers is certainly not a simple task, as it requires the research team to have a solid, in-depth understanding of many different technologies and the specifics of developers' work. So, the Early Access Program was a learning-in-action process for our team as well.

Katarzyna Wala

Qualitative Design Researcher, hubraum

Complementing the 5G Early Access Program research was the Developer Centricity project (Prof. Franke + Gussenberg GmbH, Telecommunication APIs - Market Research Results, 2022). The main goals of this project were to reconstruct the decision-making process of selecting and purchasing Telecommunications APIs, and to identify key requirements for API use (such as market expectations for specific API components). The study involved 20 in-depth interviews with developers representing companies of all sizes — from startups to hyperscalers from Europe and North America.

5G EARLY ACCESS PROGRAM – PARTICIPANTS



Aeriu helps warehouses speed up and reduce costs in their inventory management with a drone-based solution.
<http://aeriu.co>



Enfore provides cash register solutions which offer everything from a single source – hardware, software and business services – and are synchronized in real time with the cloud.
<https://enfore.com>



Arloopa is an augmented reality app allowing users to see AR content in their environment.
<https://arloopa.com>



flyXdrive provides 3D mobility solutions with fully integrated unmanned aerial systems.
<https://www.flyxdrive.com/>



Auki Labs offers a decentralized protocol for collaborative spatial computing.
<https://aukilabs.com/>



Forma Vision is a holographic meeting platform which offers face-to-face remote meeting experiences.
<https://www.formavision.io/>



CTHINGS.CO develops hardware and software for 5G IoT solutions.
<https://cthings.co>



GoCharly provides On-Demand Delivery in urban environments and uses teleoperated delivery robots instead of traditional human couriers.
<https://gocharly.ai>



DriveU.auto enables operators of remote-controlled and autonomous fleets to deploy robots and vehicles with confidence.
<https://DriveU.auto>



H3 Dynamics ensures digital transformation in various industries as well as round-the-clock surveillance and security patrol services through area protection systems.
<https://www.h3dynamics.com/>

5G EARLY ACCESS PROGRAM – PARTICIPANTS



ImmersiveCast provides solutions and services to help experience high-quality XR content that offers true immersion.

<https://immersivecast.com/en/>



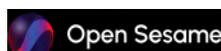
ITC - Intelligent Traffic Control develops software which solves traffic jams based on hardware such as traffic cameras and traffic light infrastructure.

<https://www.itc.city/>



MATSUKO is a holographic presence app that enables people and business meetings and calls in Extended Reality (XR).

<https://matsuko.com>



Open Sesame is a B2B application and tools developer pioneering the future of 'social audio' experiences such as online karaoke.

<https://opensesame.media/>



T-Labs is the R&D department of Deutsche Telekom. Its security use case “Digital Quantum Key Distribution over 5G Networks” used the 5G Quality-on-Demand of Service API. <https://laboratories.telekom.com/>



Sinfosy wants to employ its technology SINTRA reverse to avoid rear-end collisions on the highway.

<https://www.sinfosy.com>



VIEWAR is an augmented reality ecosystem, allowing non-AR-experts to create AR experiences for indoor navigation, remote assistance, and more.

<https://www.viewar.com/>



Volucap captures things and people both spatially and in motion with a system consisting of 36 cameras. People and objects are scanned in 3D, ensuring a lifelike effect.

<https://volucap.de>



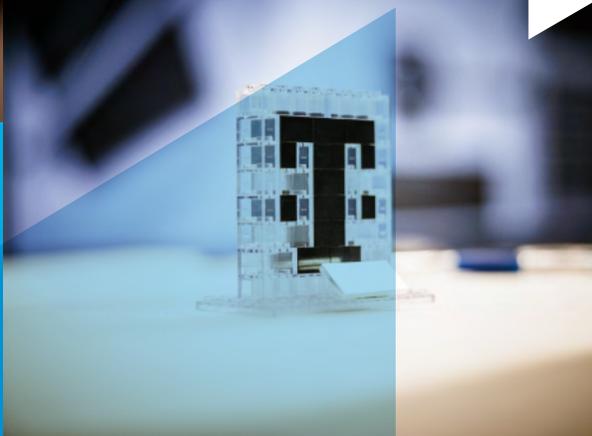
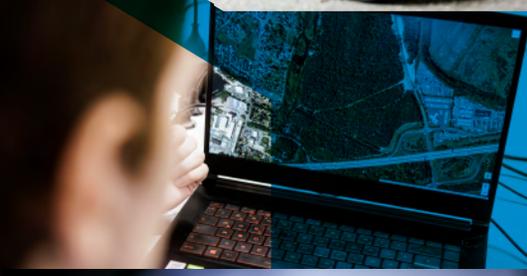
Polyptic has created VROMBR, the first Remote Reality Racing Game for smartphone. Real players from all over the world compete against each other with real cars on real tracks.

<https://vrombr.games>



World of VR is a virtual and augmented reality software startup with a major focus on meaningful B2B solutions.

<https://worldofvr.de>







5G EARLY ACCESS PROGRAM TEAM

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Anna Piwowarczyk, Program Manager

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Managing Director of hubraum

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