ITU POLICY PAPER

TECHNICAL SPECIFICATIONS FOR THE IMPLEMENTATION OF BROADBAND MAPPING SYSTEMS IN BOSNIA AND HERZEGOVINA

Table of Contents

Introduction

This report outlines the technical specifications required to establish a broadband mapping system in Bosnia and Herzegovina, while considering all aspects of tendering and legal procedures that would be required for a successful bid by the Communication Regulatory Authority of Bosnia and Herzegovina (CRA). This report continues and adds new additional information produced during the first phase of this technical assistance delivered by ITU to CRA in 2021, which resulted in the publication of the policy paper "Enabling Environment for Broadband Mapping in Bosnia and Herzegovina."

The following technical specifications are based on the ITU Guidelines "Establishing or Strengthening National Broadband Mapping Systems" and the ITU experts' recorded work experience in this field. It is important to note, nonetheless, that the following technical specifications produced in this report are the translation effort of the ITU Guidelines, as these are the ITU's operational Guidelines designed to be used as a baseline tool for non-EU NRAs and other institutions in charge of broadband mapping systems at the national level to assist them in the establishment or strengthening of broadband mapping tools. The guidelines address both strategic and regulatory issues and project setup and technical requirements, which are inextricably linked. As already mentioned in the first policy paper, the body of knowledge on broadband mapping produced by the European Union have positioned this region of the world at the forefront, and as a result, the ITU Guidelines consequently drew on the experience of this region, including not only the European Union but also the European NRAs, BEREC, and the European Commission, addressing the critical questions that all stakeholders face in this field.

This report is produced by the ITU Office for Europe under the supervision of Mr. Jaroslaw Ponder, Head ITU Office for Europe, Mr. Elind Sulmina, Project Officer ITU Office for Europe, Mr. Vladimir Daigele, Program Officer ITU Digital Networks and Society Department (ITU/DNS), ITU broadband mapping systems Experts Mr. Marko Simončič and Mr. Primož Uršič, who worked together on the drafting and writing of this report in response

Background, Context and purpose of the technical specifications

After the first phase of technical assistance delivered with the policy paper on Enabling environment for broadband mapping in Bosnia and Herzegovina, in its second phase, this new report aims at further continuing ITU's support offered to CRA by drafting a technical specification document that defines the technical and legal framework under which CRA shall pursue the bid to establish a broadband mapping system. The technical specification document will cover areas pertaining to IT resources, compliance with common tech standards, accessibility requirements, state registers integration, IT environment scalability, strict data formats and validation, accountability and data collection timelines. As per the first phase, this second phase also aims to foster the deployment and uptake of connectivity throughout Bosnia and Herzegovina.

Following completion of the first phase of the technical assistance, RAK expressed interest in proceeding with the second phase. Currently, the country has received its first policy assessment, which included recommendations for enabling the environment for broadband mapping in the country, ranging from general proposals to proposals for collaboration with relevant institutions, as well as proposals for data format and technical specifications. With the second phase of this technical

assistance, the proposals produced in the first report would be translated into precise technical specifications.

Overall, the proposals of the policy paper emphasized that for the country to succeed in this endeavour, it would be important to create a positive environment among all political and technical institutions concerned, thus allowing RAK to have the right mandate to access, exchange, and (re)use the data collected for its broadband map. To achieve this, RAK was advised to consider the opportunity of creating a single information point (SIP) database to organize its work. Additionally, advice on strengthening the role and mandate of RAK was also given, as this would positively impact on the quality of the data collected. In other words, the long-term proposed solution for Bosnia and Herzegovina presented in the first paper calls for swift actions to allow the establishment of an efficient regulatory environment, thus allowing RAK to be correctly positioned to directly request and obtain data from all owners and operators of the telecommunications infrastructure in the country.

Another crucial factor taken into account and suggested was the establishment of communication protocols or memorandums (whether formal or informal agreements) with data gathering and exchange agencies, which is closely related to enhancing the role of RAK. Bosnia and Herzegovina should lay out the guidelines and precisely define the data exchange format in order to obtain pertinent and unified information from the owners of telecom infrastructure, including all information on existing (and planned) infrastructure via georeferenced data.

Parallel project: Information System for electronic monitoring of network resources and licenses in telecommunications in the competent institutions through the Geographic Information System (GIS).

So far CRA has showed strong interest in developing its national broadband mapping system by benefitting of ITU's technical assistance and therefore also receiving technical specifications for its implementation. However, CRA recently communicated to ITU that parallel work had taken place with the signing of legal agreement between CRA and a potential private supplier to develop the project: "Information System for electronic monitoring of network resources and licenses in telecommunications in the competent institutions through the Geographic Information System (GIS)".

Under this framework and the technical specification document that was provided to ITU, a series of requirements were presented to the contractor for the implementation of this project. While not describing in detail the content of the document, as the details will be covered in another section of this work, it is still worth mentioning that the technical specifications included general requirements (i); type of data to be processed in the system (ii); system functionality(iii), software modules (iv) other features (v).

In light of what has been mentioned above and following CRA's direct request for ITU's support with its opinion in this situation, it was convened and agreed by both ITU and CRA, that, to fully deliver on ITU's previous commitment to support Bosnia and Herzegovina in implementing a broadband mapping system through the delivery of the ITU technical assistance to CRA with the three-phase approach, ITU would provide as a primary deliverable the ITU's technical specifications based on the ITU Guidelines, but would also produce a concise, informative and not-binding informal opinion on the current ongoing

project titled “Information system for electronic monitoring of network resources and licensees in telecommunications in the competent institutions through the Geographic Information System (GIS)”. To clearly define and distinct the two products ITU will produce with this intervention, this concise informative and non-binding informal opinion will be delivered as a stand-alone annex to the actual report, once more demonstrating that ITU’s commitment to support CRA is achieved by primarily providing its technical expertise based on its body of knowledge and on previously established framework of cooperation, thus not exceeding ITU’s mandate.

Based on all items mentioned above, the following report will be divided into four chapters: Introduction (i); The European Experience and the ITU Guidelines (ii); ITU Proposed technical specifications (iii), conclusions (iv); Concise, informative, not-binding and informal opinion on the current ongoing project “Information system for electronic monitoring of network resources and licensees in telecommunications in the competent institutions through the Geographic Information System (GIS) (Annex 1).

The European Experience and the ITU Guidelines

The European Experience

As mentioned in the introduction, the ITU Guidelines Establishing or strengthening national broadband mapping systems have significantly looked at the European experience, as this region of the world has showed over the past years the greatest effort of harmonization in the field of broadband mapping systems. Far from being as exhaustive as what three ITU reports offer, namely the ITU Guidelines “Establishing or strengthening national broadband mapping systems” (2022), the policy paper “Broadband Mapping Systems in Europe and Regional Harmonization Initiatives” (2021) and the policy paper “Enabling environment for broadband mapping in Bosnia and Herzegovina” (2021), this brief recap of the European experience appears to be nonetheless necessary to introduce the technical specifications designed for CRA to describe and give a glimpse to the main drivers that have provided the European legislators and regulators with a distinct mandate to promote harmonization in this field. In the following paragraphs, attention will be given to the most important instruments produced by the European Union, i.e. the EU Guidelines on State Aid for Broadband (2013) (i); The Broadband Cost Reduction Directive (2014) (ii) and The European Electronic Communications Code (2018) (iii).

The first policy driver, the EU Guidelines for the application of State aid rules in relation to the rapid deployment of broadband networks” were published in 2013. The objective of these guidelines was to support member states in defining clear ways to unlock investment opportunities to deliver on the goals assigned by the EU to the member states with the Digital Agenda for Europe (DAE). It is worth mentioning, however, that these guidelines would nonetheless ensure market competition, which is one distinctive aspect of the EU legislation as such approach ensures that State aid does not distort the market.

Among the different provisions described in the guidelines, the compatibility principles, i.e Art 2.5 is essential as it gives the framework for the establishment of broadband mapping system. It goes without saying that for every project, efficiency, not only in terms of work but also in financial terms, is essential for the sustainability of any action. And this is the same that happened in the context of

broadband mapping systems. Indeed, the establishment of the Single Information Point (SIP) was a direct response to this challenge. By creating one individual database collecting all the necessary information of the physical infrastructure, with any given specific parameters one would need, this would lower down the costs while also achieving transparency as the data would be available at the national level.

Without detailing all the conditions for the compatibility principles to be fulfilled, the decision for opting to "facilitate the use of existing infrastructure" allows us to move to the next important policy drive, i.e the Broadband Cost Reduction Directive. Published in 2014, this directive had as its cardinal point on the co-deployment and infrastructure sharing. The guidelines also provide with a various array of options that would then result in how complex or detailed the broadband mapping systems could be, correlating the number of data points gathered with the complexity of the system. As an example, location and quality of networks are essential elements to be considered when collecting data relevant for the broadband map. However, such information could appear at first potentially damaging the operators as considered business secrets. Without going into the details and explaining the differences between the level of granularity that can be adopted by the competent regulatory authority to collect and aggregate the data, it is nonetheless important to highlight how good quality data is essential for the regulation and how, once more, the European experience has paved the way for the definition of what the right data are needed to establish a functioning and relevant broadband mapping system.

When considering the Broadband Cost-Reduction Directive's objective to "facilitate and incentives the roll-out of high-speed electronic communications network by promoting the joint use of existing physical infrastructure and by enabling a more efficient deployment of new physical infrastructure so that such networks can be rolled out at lower cost", this same directive also advised on the establishment of a dispute settlement body (DSB), defined as of equally of vital importance as the SIP, as it not only increases the clarity of rules by ensuring that these are enforced under the obligations established by the BCRD, but also capable of setting the general reference for any NRA that may lack the pre-existing legislative framework under which it would operate.

The third and final policy instrument is the European Electronic Communications Code, which is a European directive issued in 2018. This directive consists of the reform of the regulatory framework for electronic communications. The most important aspect of this code is that BEREC was tasked with further additional responsibilities by allowing the Regulatory body to set regulatory standards for the implementation of the EECC across the entire Union, among which one requirement would request European NRAs to conduct geographical survey of the electronic communications systems at the country level.

To conclude, in light of the has been described so far, Europe has a demonstrated significant effort and willingness to push the boundaries of what harmonization means in the field of connectivity with pioneering work that has been developed over the past 15 years. Europe is today, more than ever, positioned at the forefront of the knowledge, the capacity and the implementation-related measures pertaining to broadband mapping.

The ITU Guidelines for Establishing or Strengthening National Broadband Mapping Systems

Broadband maps are key to inform decision on new ICT network deployment. Under the ITU geospatial activities (Figure 1. global app), the Union has conducted national experiences on ICT infrastructure maps and produced the ITU Guidelines Establishing or Strengthening National Mapping Systems (NMS), based on international best practices.

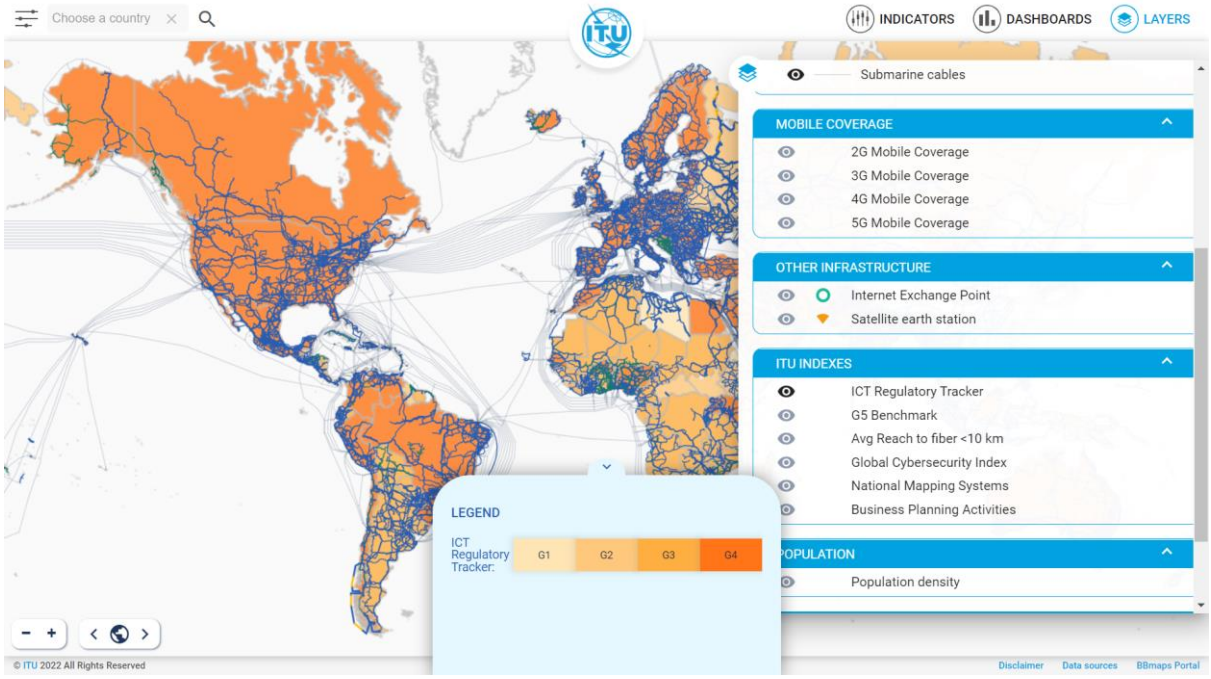

Figure 1. ITU broadband maps (https://bbmaps.itu.int)

Two pillars are at the foundation of The ITU Guidelines Establishing or Strengthening National Broadband Mapping Systems: the first one pertains to policy-related aspects, whereas the second pillar addresses the project setup and technical requirements, together with the strategies for correct project management. The second pillar is elaborated in chapter three and four of the Guidelines. These two chapters on the technical components of the ITU Guidelines are the result of a concerted effort achieved at the European level.

This work, developed under the expertise of three ITU Experts on broadband mapping, benefitted from relevant inputs from various stakeholders, including European NRAs, EaPeReg, BEREC, EIB, European Commission, and from an external actor from the Europe Region, i.e. World Bank. All these actors have contributed extensively by providing their experience on broadband mapping through a series of bilateral calls as well as by commenting and suggesting inputs during the draft of the Guidelines. The first technical chapter, chapter three, addresses the aspects on the project setup and technical requirements, under which guidance is provided to the reader for what concerns the project framework and objectives (i), as well as the project design (ii); whereas the chapter four deals with all management-related aspects, with relevant input from the different stakeholders who have contributed to the drafting of the guidelines focusing on common challenges and solutions(i) on data quality (a), data confidentiality (b), data sources (c), reporting types (e) and regulations (f). Also, the project management outlined the general success factors (ii) considering the stakeholder involvement (a), the definition (b) and type of mapping (c) and ultimately the long-term sustainability (d) with examples such as the actions to be done in the field of reporting.

The complexity of the development of broadband mapping systems was discussed in chapter three, touching on a variety of topics. These recommendations were presented as to limit the scope of the digital map and precisely make it in accordance with the real needs of the NRA. As an example, questions are submitted to the reader whether the desired broadband map should consider fixed broadband to be considered or whether it may allow for an integration with mobile networks. It is also important to reiterate the significance of selecting the data transfer form, the type of interface, the level of detail, and the way in which the system gathers, arranges, and validates the data. Additional desirable features include the use of a mobile application for citizen's convenience and a helpdesk for support in case the users experience technical issues.

Finally, an easy-to-use cost estimator for creating the broadband mapping system was also created as part of the work on these guidelines. The cost calculator was developed following a comparison of data on the adoption of the broadband mapping system in European nations. The ITU Guidelines highlight that developing a broadband mapping system does not mean just selecting what one would want and pay for that price tag; or the country area, which correlates with the number of system elements or the number of system users, the more expensive the broadband mapping system would be. Developing a broadband mapping system is a multivariate challenge that considers many parameters. However, this does not mean that it may not be possible to have a close estimation of the actual cost, regardless of the small error probability assigned to the externality that always exists in every equation. Indeed, there are certain aspects, mostly related to the organization, management and implementation of the broadband map – e.g the number of days required and assessing the NRA's capacity for hiring IT personnel - that all NRAs face in the same way when designing the project proposal. Those are just two examples that show how such common challenges have an impact on complex work like developing a broadband map. By trying to standardize these series of commonly experienced via the creation of a simple cost calculator, the guidelines offer a simple solution to swiftly advance on such decisions.

To put it in other words, the project setup and technical requirements together with the project management have been designed in such a way that the reader would perceive them as a set of precise helpful measures for any NRA to be followed and implemented to successfully develop a broadband mapping system fit for purpose.

ITU proposed project and technical considerations to set-up a bidding procedure for CRA to implement, own and operate the national broadband mapping systems in Bosnia and Herzegovina

Project framework and objectives

To facilitate investment in broadband networks, reliable and up-to-date data on existing infrastructure and existing broadband services is essential. When starting broadband mapping initiative, there are some crucial decisions that have to be made at the preliminary stage. Bosnia and Herzegovina, as the target country of this report, can gain significant time over the implementation of the necessary mapping steps by applying good practices and anticipating the challenges already identified. The objective for Bosnia and Herzegovina, which still has a long way to go in developing and harmonizing its regulatory framework, should be to leapfrog EU countries and reach state-of-the-art systems that are simple enough and are thought to directly support the implementation. Setting up a broadband mapping exercise is not a simple undertaking as it must balance many factors and variables which concur to what can be implemented and with what scope.

It should be noted at the beginning that there are several broadband mapping systems for any category, including infrastructure, services, investments, and demand. It is necessary to decide what kind of mapping has the biggest relevance and it is highly recommended to start with first question.

In case of Bosnia and Herzegovina, infrastructure mapping would be the best choice to start with. ITU defines the infrastructure mapping systems as a broadband map capable of gathering, structuring and representing georeferenced data on passive physical infrastructure (e.g., pipes, ducts, poles, manholes, base stations, mobile towers, etc.), information about the type of infrastructure deployed (fiber, copper, water pipes, electricity) as well as information about the owners of that infrastructure (fixed/mobile telecommunications, other network operators, national and local government, etc.).

On a later stage, service mapping could also be considered. Service mapping is defined as the activity entailing the gathering, structuring and representing data about service availability (including bandwidth and or type of technology used to offer the service), the number of broadband service offers from operators and/or the estimated quality of service available for a specific address and/or a specifically defined geographical area (e.g. 100m x 100m grid).

On a third point, though not in scope with what appears to be requested by RAK at the moment of this writing, investment mapping is defined as the activity entailing the gathering, structuring and representing data about planned investments aimed at developing broadband infrastructure and services in a defined geographical area (e.g. region, municipality) should be also entitled. Investment mapping should include relevant information about publicly and/or privately funded projects. Investment maps may include reports about areas characterized by market failure or sub optimal outcomes.

Finally, demand mapping relates to the activity entailing the gathering, structuring and representing data about the quantity and quality of broadband demand for bandwidth desired by the end user and the level of financial allocation foreseen in association with that given broadband fixed service.

Data sources

Relevant data sources for broadband mapping should include infrastructure owners (i), telecommunication operators (ii), public utility entrepreneurs (iii) and local government authorities (iv). With the data provided by the main group of data sources, the challenging aspects are mainly low willingness to provide data and a tendency to present the situation better than it is or hide some important data which hamper the state aid interventions. To deal with these, two solutions may be considered: the first one pertaining to the use of legal reporting obligations to be imposed and the second one would aim for a voluntary basis approach. Data quality checks should be implemented in the broadband system. Additionally, administrative rules on penalties including financial penalties should be laid down in the national telecommunication law in case when decision is taken to go for mandatory reporting obligations.

Information to be collected

The information that can be collected from operators within broadband mapping can be divided into three levels. The first level is the type of information, i.e., nodes, lines, services.
The second level of information might relate to the master description which is added to the basic information about the very existence of the infrastructure or the availability of broadband service. This type of information is called attributes. The third layer should contain defined values or terms for the second level attributes.

In order to achieve broadband objectives, it is fundamentally important that there are reliable and valid data on existing broadband infrastructures and services offered. Data on broadband infrastructure and services are crucial to identify gaps of broadband coverage and quality of service level and identify suitable areas of investment. Gathering infrastructure data will be particularly useful to avoid duplication of financing, as subsidies should be allocated to areas truly affected by market failure. To avoid negative consequences of broadband data shortage the mapping platform has to collect data sets concerning broadband infrastructure and services. Data collection on the investment and demand can be performed on voluntary basis.

Data formats

The two most commonly used data formats for providing data within the broadband mapping process are DSV (mainly CSV) and XML.

DSV (mainly CSV)

Delimiter-separated values (DSV) is a text file that stores two-dimensional data, where values are separated by specific delimiter characters. In the .DSV file, each row is one database record. Any value can be used as delimiter character that separates the values. Most popular delimiter characters are comma (CSV, – Comma-separated values) and tab (TSV, - Tab-separated values). Colon, semicolon, pipe and space are also sometimes being used as delimiters.It is very important to choose a delimiter that is not being used in the data in order to avoid later issues with data read. It is possible to use

double quotes for string values. All records should have the same number of fields and the same value order. This format is easy to read by databases and spreadsheet applications. It is also very easy to create.

XML

Extensible Markup Language (XML) is a universal mark-up language designed to represent various data in a structured way. It contains textual data. It is platform- independent, which enables easy document exchange between different systems. Using XML also means that the user may easily design a data hierarchy. This format is appropriate for large amounts of data and when one wants to emphasize the hierarchy of data. XML also supports data validation, especially structure validation. XSD (XML Schema Definition) is a file, where the user specifies the structure and description of an XML file. It is used for verification of the main XML file. The XML file is more complex than the CSV file, but it also gives more possibilities.

GIS data

There are a few different types of GIS data:

- vector spatial data,
- spatial raster data (e.g., orthophoto map) and
- attribute tables that are represented in tabular format.

The location of point features is determined by the coordinates of the point locating the feature. In the case of linear and area objects that are defined by a larger number of points, apart from their coordinates, it is important to arrange them properly, which is determined by the shape of the object.

Vector data

The most common vector data formats used are:

- DGN is the name used for CAD file formats supported by Bentley Systems' MicroStation and Intergraph's Interactive Graphics Design System CAD programs.
- AutoCAD DWG is the proprietary native file format for AutoCAD, one of the most popular computer-assisted design (CAD) packages.
- DWG is a compact binary format that stores and describes the content of 2D and 3D design data and metadata.
- Shapefile - Esri vector data storage format for storing the location, shape, and attributes of geographic features. It is stored as a set of related files and contains one feature class. Shapefiles often contain large features with many associated data and historically have been used in GIS desktop applications.
- GeoJSON - a format for encoding a variety of geographic data structures. GeoJSON supports the following geometry types: Point, LineString, Polygon, MultiPoint, MultiLineString, and MultiPolygon. Geometric objects with additional properties are Feature objects. Sets of features are contained by FeatureCollection objects.
- Keyhole Markup Language (KML) - an XML-based markup language designed to annotate and overlay visualizations on various two-dimensional, Web-based online maps or three-dimensional Earth browsers (such as Google Earth).

• Extensible Markup Language (XML) - a file format used to create common information formats and share both the format and the data on the World Wide Web, intranets, and elsewhere using standard ASCII text.
• A comma separated values (CSV) - contains different values separated by a delimiter, which acts as a database table or an intermediate form of a database table. In other words, a CSV file is a set of database rows and columns stored in a text file such that the rows are separated by a new line while the columns are separated by a semicolon or a comma.

Raster data

Raster consists of a matrix of cells (or pixels) organized into rows and columns (or a grid) where each cell contains a value representing information, such as temperature. Rasters are digital aerial photographs, imagery from satellites, digital pictures, or even scanned maps.

The most popular raster data formats are:
• Tagged Image File Format (TIFF) - the extensible feature of this format allows storage of multiple bitmap images having different pixel depths, which makes it advantageous for image storage needs. Since it introduces no compression artifacts, the file format is preferred over others for archiving intermediate files.
• Joint Photographic Experts Group (JPEG) - it is commonly used for storing digital photos and used by most digital cameras to save images.

Tabular format data

Tabular format data is represented by data organized into columns and rows. It can be said that it is the simplest data format, but it can be considered the easiest for operators to handle. An example of software that allows you to process tabular data is Excel.

Data supply process

To ensure the most efficient data provision within the broadband mapping process, the collecting body, probably CRA, should elaborate a designated platform for data transfer. This is a core component of a mapping project and a key determinant of its success within a given country. The platform has to fulfil rigid safety and security criteria for data transfer, but also balance the user experience to facilitate compliance by operators, particularly in contexts where the voluntary approach is adopted.

On the entity validation aspect, one basic method is using a logging-in system, which may be significantly strengthened by a separate procedure of obtaining usernames and passwords by the reporting entities. Importantly, only logged-in users should be able to report data. Simultaneously, the reporting system should give the possibility to log-in only to entities that report data. The platform should allow access to view data, as well as to edit them and update for reporting entities.

The platform should enable to transfer data in two basic ways – manual and automated. The first way should allow reporting data manually by a browser. It would be dedicated to entities that have a small amount of data to report and to those, whose data changes only a little between reporting periods.

The second, automated method should allow transferring data by entities via pre-prepared files. These files should have an appropriate structure, which has to be determined in advance. These data files could be for example CSV or XML files, or both. The precise reporting set up regarding the way of reporting in an automated way via files would be determined by the specific design of the reporting platform. This method should be dedicated to entities that have large amounts of data to report.

Data conversion

The platform should support and assist with the data reporting. It should make it possible to report data manually by hand and to automatically import prepared data files. The first way ensures functionalities that allow entering data manually through the browser. The second way can be a dedicated tool that helps to prepare data files for reporting. This tool should not be complicated to use and should allow generating files with large data volumes. This tool could represent a mix of manual and automatic data preparation. The third way can be a dedicated tool for large operators. This tool should be able to transfer large amounts of data to the platform. Entrepreneurs have to prepare data files (e.g., CSV or XML) on their own, based on their inventory systems. The tool would assist in checking the correctness and structure of the data.

Quality checks in broadband mapping

Data obtained from public and private sources are at the core of high-quality broadband mapping systems. Therefore, it is imperative to check all data used in the process. Thus, it is not a question of whether or not to check data in the broadband mapping process, but rather, which quality check process or which combination of processes to install. The three basic quality checks methodologies applied to broadband mapping are:

1. plausibility checks;
2. manual checks;
3. additional user feedback Plausibility checks.

Plausibility check

Plausibility check is a method of data quality verification, where a value is checked to determine, whether it is plausible or not, that is if it is acceptable for the type of information being collected. It is not always possible to check the correctness of every data in such a way, but this type of check will allow detecting any obvious inaccuracy. Data collection tools used for broadband mapping ought to be designed to automatically check a range of plausibility rules. The validity of particular data can be either rejected by the software or flagged as being unlikely to be valid. In the broadband mapping process, it is the second approach that is more applicable, as flagged data may be additionally verified both by the supplier at the point of entry, and then by the data collecting body, when verifying full data sets obtained through the process. Plausibility checks may be done manually, but most

commonly are automated and are incorporated into the software of the collection tool used in the process.

Manual checks

Manual checks are not compulsory to be used within the broadband mapping process, but under certain circumstances, it may be useful to improve data quality for the process. They may be carried out using different approaches and intensities. A relatively simple approach is to cross-check data with data otherwise published by the same operator or infrastructure owner or check the same set of data provided by two different sources. When it comes to services provided, operators frequently publish the availability of their services on their own websites.

Additional user feedback

User feedback offers another additional route to check and potentially improve data quality. There is a number of routes that the user feedback may be obtained from, such as:

- functionality of the broadband mapping visualisation tool – the interested public may provide feedback directly through the map functionality, if they deem that information is not accurately presented for their situation;
- communication channels directly to the data collecting body – via collecting body's website;
- contact point or any other route offered;
- e-government contact routes for public – general routes of contacting governmental units provided by e-government tools.

This type of checks requires long term maintenance efforts on the collecting body's side.

Access to data

Publication of broadband data is an important tool by which end-users can obtain information about the availability and selection of services and the location of the telecommunications infrastructure. At the same time, in accordance with national laws on commercial confidentiality and personal data protection, some information collected as part of the broadband mapping may be considered confidential and should be protected by the national regulatory/national competition authorities.

The choice any mapping initiative has to make with regard to data publication is about who should have access to the data. There are three options for data access:

- internal use - data is collected only for analysis purposes;
- limited access to data - data made available in justified cases, upon request;
- public access - all data collected within broadband mapping is publicly available.

The goals of the broadband mapping initiative, as well as the level of detail that is theoretically available from the data collected, usually determine the choice of these options. If the goal is to inform

the public or even generate interactions with the public, e.g., through a feedback function, then detailed data access that does not reveal any company secrets seems to be the most obvious choice.

A good incentive from the regulatory authorities would be to publish reference infrastructure sharing offers thus providing an incentive for public sector institutions (e.g. local governments) and other public or private institutions to publish the data. This would provide an incentive for traditional telecom operators to come forward finding that benefits outweigh the costs of sharing information about one's own network.

In addition to the issue of commercial confidentiality and protection of personal data, the particularity of critical infrastructure should also be taken into account in data publication.
A minor problem is found with the publication of data on mapping services and demand. The information can, in principle, be available to everyone, including users who are not logged in.

When considering publishing data on telecommunications infrastructure in the context of critical infrastructure, three options can be mentioned:

1. Define in the act what the critical infrastructure is and:
    - collect information about it and do not publish it,
    - do not collect this information.

2. Collect information about critical infrastructure with the attribute, whether the infrastructure is critical (yes/no) and provide such information only in justified cases.

3. Do not collect information about critical infrastructure and decide what critical infrastructure is left to network operators.

It is recommended to consider a scenario which mixes these three possible options of the confidentiality, i.e., defining the critical infrastructure in the legal act, introducing an attribute (yes/no) where the operator can indicate on the basis of the elements of the critical infrastructure described in the act and determining which collected information on the critical infrastructure cannot be publicly available.

Publication format

The choice of the form of data publication depends mainly on the preferences of potential users. One way to facilitate access to data may be to present the data in various publication formats. For some stakeholders, it may be important to visualize the data on a map and download it in vector form, for another group of entities, a report presenting a subset of results and analyses may be more useful. It is also worth verifying which group of potential recipients depends on the already processed and which on the raw data. Raw data can be provided in the form of tables, geographic files or web services. Web services have the advantage of being always up-to-date as the data is stored on the initiative's web server and is made available on request over the network for display in the user's GIS. Therefore, if errors in the dataset are corrected, it is guaranteed that external users will also receive updated information. The website allows the use of many different forms of visualization, from text,

tables and picture map to dynamic maps, e.g. with the zoom function, to fully interactive maps that also allow us to access additional data or perform data analyses. *BEREC Guidelines on Geographical surveys of network deployments* suggests several options for publishing GIS data:

- Interactive maps published in a dynamic web application;
- Interactive address search published in a dynamic web application;
- Application Programming Interfaces ("APIs") for accessing data;
- Datasets in open and generalized formats such as CSV;
- Statistical reports, including tables and analyses.

Update frequency of data supply

The frequency of reporting data by entrepreneurs and public entities should correspond to the needs of the government administration. Data reporting should be done at least once a year. It is viable to set up a large reporting window, i.e., a quarter, however with presumed reporting the status of data as of a set date. This enables smooth monitoring of the telecommunications market, as well as meeting most reporting needs.

Depending on the collecting body's needs, semi-annual or quarterly reporting might be considered. However, it should be noted that more reporting obligations mean greater workload and costs for reporting entities. The possibility of reporting and updating data should be continuous, and the reported data should be up to date for the time reported. The choice of the form of data publication depends mainly on the preferences of potential users. One way to facilitate access to data may be to present the data in various publication formats. For some stakeholders, it may be important to visualize the data on a map and download it in vector form, for another group of entities, a report presenting a subset of results and analyses may be more useful. It is also worth verifying which group of potential recipients depends on the already processed and which on the raw data. Raw data can be provided in the form of tables, geographic files or web services. Web services have the advantage of being always up-to-date as the data is stored on the initiative's web server and is made available on request over the network for display in the user's GIS. Therefore, if errors in the dataset are corrected, it is guaranteed that external users will also receive updated information. The website allows the use of many different forms of visualization, from text, tables and picture map to dynamic maps, e.g. with the zoom function, to fully interactive maps that also allow us to access additional data or perform data analyses.

BEREC Guidelines on Geographical surveys of network deployments suggests several options for publishing GIS data:

- Interactive maps published in a dynamic web application;
- Interactive address search published in a dynamic web application;
- Application Programming Interfaces ("APIs") for accessing data;
- Datasets in open and generalized formats such as CSV;
- Statistical reports, including tables and analyses.

Project design

When initiating a broadband mapping system project, in addition to defining the reasons for undertaking a project, one should start with the stakeholder analysis. It is an important stage because it is worth starting with a consultation with interested parties, especially when there are no regulations regarding the implementation of such a system in a given country. Stakeholders are parties who will be affected by the project at any point during its life cycle, and their input can directly impact the outcome. It is essential to practice good stakeholder management and continuously communicate to collaborate on the project.

Listening to stakeholder concerns and feedback is a valuable source of information that can be used to improve projects and outcomes and help to identify and control external risks. For stakeholders, the consultation process creates an opportunity to be informed, as well as to inform the company about local contexts that may not be obvious, to raise issues and concerns, and to help shape the objectives and outcomes of the project.

The more a stakeholder group will be materially affected by the proposed project, the more important it is for them to be identified, properly informed, and encouraged to participate in the consultation process. It is therefore critical to determine who the various stakeholders are, as well as their level of interest in the project, the potential impact it will have on them, and the power they have to shape the process and outcome. In the case of broadband mapping system projects, identifying the stakeholders is not difficult, as it can be based on the experiences of other countries. The main stakeholders in Bosnia and Herzegovina were already identified in the first phase of this ITU project. As already mentioned, it is particularly important to involve stakeholders at various stages of the project. Below the following phases that are recommended:

Informing phase: Providing stakeholders with balanced and objective information to help them understand the project, the problem, and the solution alternatives.

Consulting phase: Gathering feedback on the information provided. Contribution levels can range from minimal interaction (online surveys etc) to extensive. It is also possible to consult the scope of collected information or data formats.

Involving phase: Working with stakeholders during the process of defining system requirements to ensure that their ideas and concerns are fully understood and taken into account.

Collaboration phase: While stakeholders will not be useful when developing the system, they can be very useful at the stage of system testing. It is therefore worth involving them in this phase. One of the most important decisions to be made in the project is the choice of the system implementation formula. This decision must depend on the internal factors of various countries and their institutions, the strategic and regulatory objectives that the country seeks to achieve, and the financial means and available human resources. In fact, before setting up a project, broad objectives should be defined.

ITU Recommended technical requirements for the public tender and proposed contractual obligations

This chapter covers a series of suggestions and recommendations designed specifically for the development of a broadband mapping system owned and operated by CRA focusing on infrastructure mapping. These recommendations also include a series of recommended technical and human capacity requirements for potential applicants and detailed technical specifications. It also emphasized what kind contractual obligation should be put in place.

Proposed requirement for technical and human capacity

Required experience in the last (3) three years	Supporting document
Knowledge and experience in the field of planning and implementation of spatial systems of economic public infrastructure in the field of telecommunications	At least three references certificates signed by the contracting entity, which show: - project title; - project value; - duration of the project (exact start and end date of the project); - contact person of the project Contractor and his e-mail address or telephone number. The bidder may also provide several references. (In case of doubt, the Contracting authority may verify compliance with the condition).
Knowledge and experience in the field of planning, establishing and maintaining information support in the creation of spatial databases	At least five reference certificates signed by the contracting entity, which show: - project title; - project value; - duration of the project (exact start and end date of the project); - contact person of the project Contractor and his e-mail address or telephone number. The bidder may also provide several references. (In case of doubt, the Contracting authority may verify compliance with the condition).
Knowledge and experience in the field of collection and analysis of spatial data in the field of public utility infrastructure	At least two reference certificates signed by the contracting entity, which show: - project title; - project value; - duration of the project (exact start and end date of the project); - contact person of the project Contractor and his e-mail address or telephone number. The bidder may also provide several references. (In case of doubt, the Contracting authority may verify compliance with the condition).
Knowledge and experience with the entry of network connection points in the collective cadastre of public infrastructure	At least three reference certificates signed by the contracting entity, which show: - project title; - project value;

	- duration of the project (exact start and end date of the project); - contact person of the project Contractor and his e-mail address or telephone number. The bidder may also provide several references. (In case of doubt, the Contracting authority may verify compliance with the condition).
Knowledge and experience with management, maintenance with PostgreSQL database management systems and with PostGIS extension and GeoServer server	At least one reference certificate signed by the contracting entity, which show: - project title; - project value; - duration of the project (exact start and end date of the project); - contact person of the project Contractor and his e-mail address or telephone number. The bidder may also provide several references. (In case of doubt, the Contracting authority may verify compliance with the condition).
Knowledge and experience in managing and using GIS software QGIS	At least one reference certificate signed by the contracting entity, which show: - project title; - project value; - duration of the project (exact start and end date of the project); - contact person of the project Contractor and his e-mail address or telephone number. The bidder may also provide several references. (In case of doubt, the Contracting authority may verify compliance with the condition).
Knowledge and experience in performing mass network analyses.	At least three references certificates signed by the contracting entity, which show: - project title; - project value; - duration of the project (exact start and end date of the project); - contact person of the project Contractor and his e-mail address or telephone number. The bidder may also provide several references. (In case of doubt, the Contracting authority may verify compliance with the condition).
Expert knowledge	Certificates of appropriate education of employees collected by the provider: - at least a university degree in geodesy (at least two employees); - at least a university degree in informatics (at least one employee) (In case of doubt, the Contracting authority may verify compliance with the condition).
Experiences	Curriculum vitae collected by the provider

	- key personnel who will participate in the project - at least two other employees who can provide support during the project
Quality of execution and data security	A description by the provider of the details of the measures to ensure the quality and security of the data - ISO9001 certificate or equivalent proof - other relevant certificates

Recommended general technical specifications

The general technical specifications are covered below and in the next subchapter more detailed ones are presented, where CRA may choose which ones will come in handy when designing a public tender.

- Capture of spatial data from various databases of public economic infrastructure
- Establishment of a local database that connects existing spatial databases and establishment of a system for capturing and integrating new data into the existing system
- Identification of geographical areas according to the number of households / population density
- Identification of rural and urban areas
- Determination of endpoints and in the intermediate space: inspection of the existing network (objects, availability …), if not, sewerage construction: route, distances, roads, etc.
- Collection of data on the availability of capacities of electronic communications operators
- Collection of data on the availability of capacities of other public infrastructure suitable for the sharing of electronic communications
- Geographical segmentation: overview of the territory of BIH and determination of the number of available access networks according to geographical units.

It is therefore necessary to establish connections between the existing spatial databases and to establish a geo-data system taking into account the existing hardware, software and communication equipment in the CRA.

Considering that CRA aims to perform various tasks with these analyses, it appears at the moment of writing that CRA is still defining the exact objective of these tasks, therefore GIS experts appear to be necessary in such a way that their services could be used by the agency on a daily basis and not on a completed task. In this way, the tasks of the persons concerned could be changed on an ongoing basis, and further needs could be identified on the basis of the current results. It is essential that the CRA may be able to determine on an ongoing basis what data and what analyses it expects. At the same time, the Contractor may, to some extent, provide additional training for the CRA's employees who will be intensively involved in this in the future, for the basic operations of retrieving data, basic reports and analyses from the aforementioned databases.

Recommended detailed technical specifications

Working with databases (collection, processing, retrieval and validation of data)
The Contractor must merge and combine publicly accessible databases. In particular, the databases to which it has access as a user with the highest priority, the databases it has acquired from other public

authorities, the databases it has collected or acquired from operators, and the databases it has acquired through data collection by means of field measurements.

Tasks in this area include:

- Consulting in the management of databases in the geo-information system, (eg: records of network connection points, cadaster of public infrastructure, register of spatial units, business register, cadaster of buildings, land cadaster, central population register, data on the retail and wholesale products or broadband access services, data from an operator with significant market power, data on the coverage of mobile networks with a signal and data on high-quality products, etc.)
- Pairing and linking databases for further processing,
- Advising and carrying out logical checks to detect irregularities occurring both on the reporting side and on the import and vaporization side of this data,
- Periodic acquisition and import of data from the above records according to the instructions of the Contracting authority,
- Advice on the usability of data from various databases, options and on the procedures for ordering data for use and the implementation of the import of additional databases in accordance with the needs of the Contracting authority,
- Advising, importing and processing data on locations of expressed market interest

Database and server management and configurations

The Contractor's tasks in this area should include checking the status of servers, reviewing and installing operating system updates where available, resolving potential performance issues, updating software, monitoring the area, and advising in the event of updates, add-ons, or software updates and also the equipment that would bring improvements to GIS system. Tasks in this area additionally include care for the proper functioning of all connected systems, care for archiving and proper implementation. The Contractor will also be required to respond quickly and rectify in the event of a failure and malfunction of the connected systems.

Establishment, maintenance, upgrade and graphic design of an internal web GIS viewer and consulting in connection with a web GIS viewer

The Contractor should establish an internal online geographic information system that obtains data from databases on the Contracting authority's server and displays them graphically. The architecture of a web GIS browser must consist of a web page that combines graphical and attribute data into views, and of databases from which the web page draws this data, and a geographic server GeoServer. The databases on the Contracting authority's server from which the web GIS browser draws data are, for example: records of network connection points, cadastre of public infrastructure, register of spatial units, business register, cadastre of buildings, land cadastre, central population register, etc. GeoServer is a geographic server that makes images from geometric and geographic data. Functionally, the viewer must allow the user several types of access to the data itself and the ability to export tables. The website itself can be developed in the Microsoft Visual Studio 2015 environment. It is a web project with the ASP.NET MVC architecture using the Microsoft.NET Framework. Additional booklets are from the NuGet repository, which are updated automatically. Tables and database insights are prepared with SQL script.

Tasks in this area include:

- Establishment and maintenance of an internal web GIS viewer of network connection points from the register of infrastructure networks and facilities and electronic communications from the cadastre of public utility infrastructure,
- Advising the Contracting authority on potential possibilities for improvements to the web GIS viewer,
- Consulting and implementation of solutions to improve the functionality of the web GIS viewer,
- Identification and troubleshooting of the web GIS browser,
- Care and tasks for the smooth operation of the web GIS viewer and its updates,
- Care for the correct operation and correct presentation of results,
- Elimination of web GIS browser errors according to the Contracting authority's instructions,
- Care, advice and execution of tasks for optimal operation of the web GIS viewer,
- Ensuring the information security of data accessed via an online GIS browser,
- Careful handling of data and notification of the identification of possible safety deficiencies,
- Implementation of measures to eliminate security deficiencies,
- Managing and arranging various level of access to the web GIS viewer according to the instructions of the Contracting authority and its IT department,
- Import and preparation of new data layers as required and according to the Contracting authority's instructions,
- Preparation of tools in the web GIS viewer that will enable individual analyses and processing of this data and export of results in the form of tables and displays,
- Updating graphical filtering and preparing the possibility of exporting graphs and tables taking into account the filter criteria,
- Graphic design of a web GIS browser,
- Taking care of compatibility and implementation of solutions for correct display using different web browsers,
- Participation in the implementation of an in-depth study for the preparation of a public version of the web GIS viewer for publication on the Contracting authority's website,
- In agreement with the Contracting authority and on the basis of the findings of the in-depth study, if necessary, the preparation of a public version of the web GIS viewer for publication on the Contracting authority's website,
- - pairing and linking databases for the completeness of the display of results in a web GIS browser,
- Pairing and linking databases in the preparation of new data layers,
- Preparation and interpretation of instructions regarding changes and application of improvements in the web GIS viewer,
- If necessary and according to the Contracting authority's instructions, preparation of a script with an open source web GIS browser, supplemented with an explanation (in accordance with the implemented updates),
- Execution of project tasks in connection with the web GIS viewer according to the current instructions of the Contracting authority,
- Related tasks related to the web GIS viewer according to the Contracting authority's instructions.

Geo-data system maintenance

Tasks in this area include:

- Care and tasks for the smooth operation of the system,
- Updates,
- Security updates,
- Ensuring proper operation,
- Editing database archiving,
- Debugging.

Geo-data system optimization

In the geo-data system, the Contractor should combine large databases with large amounts of data, and certain operations are complex, so it will continue with certain optimizations.

Tasks in this area include:

- Care, consulting and implementation of process optimization as needed by the Contracting authority,
- Consulting, implementation, application development, in case of need and possibility for automation of certain related procedures,
- Archiving and clear marking and classification of performed analyses, tables and displays for reusability.

Concern for information security of the geo-data system and consulting

The Contractor would combine many databases in a geo-information system as some of which contain sensitive data. A high degree of caution is required for some databases that are part of a geo-information system.

Tasks in this area include:

- Advising and implementing measures to maintain a high level of protection of the databases that make up the Contracting authority's geo-information system,
- Careful handling of data,
- Notification of the identification of possible safety deficiencies.

Production of displays, tables, reports and basic instructions

Tasks in this area include:

- Production of all types of cartographic displays, tables, projects in the GIS tool, reports, short instructions,
- Interpretation of results and preparation of methodological explanations,
- Meaningful naming and classification of results for later use.

Geographical analysis and consulting

The Contracting authority aims to perform a number of analyses based on geo-located data. It carries them out on a regular basis as well as part-time, as needed. In addition to performing regular and "ad hoc" analyses according to the Contracting authority's instructions, the Contractor's task will also be

to advise on methodologies, appropriate approaches and potential improvements. Analyses will be performed as needed, which will be agreed upon by the Contracting authority with the selected Contractor. It is also important for the Contracting authority to determine the geographic market in accordance with legal provisions.

Tasks in this area include advising and performing geographical analyses in the analysis and use of data in connection with:

- The relevant markets defined in the European regulatory framework,
- Universal service,
- Coverage and availability of mobile and fixed broadband networks,
- The entire telecommunications infrastructure,
- Measures to reduce the cost of setting up high-speed electronic communications networks,
- Various "ad hoc" geographical analyses required by the Contracting authority in the process of regulating and supervising the electronic communications market in Bosnia and Herzegovina,
- Services and prices of the retail and wholesale electronic communications market,
- The required periodic reporting to the European institutions and the replies to the ad hoc questionnaires,
- Support for other regulatory decisions,
- Related areas.

Acquisition of input data with data from mobile infrastructure networks at the level of Bosnia and Herzegovina

The Contracting authority has at his disposal existing data on mobile networks (locations of base stations, network capacities). The Contractor will advise on obtaining this data and entering it into the existing geo-data system. Based on this data, the Contractor will be able to conduct a study of the capacity of mobile networks in the field of data transmission by individual geographical areas.

Consulting and implementation of the determination of the appropriate methodology for the implementation of the geographical segmentation of the relevant markets for access to the broadband network

European Commission Recommendation of 11 September 2013 on consistent non-discrimination obligations and methodologies for calculating costs to promote competition and improve the environment for broadband investment (2013/466 / EU) as a basis for assessing market power in each country or for segmenting regulatory measures indicates geographical segmentation. Geographic segmentation can take place in a variety of ways. According to the legal provisions, the definition of a geographic market is one of the two main components of the definition of the relevant market suitable for prior market regulation (product market definition and geographic market definition). After defining the relevant product or service market, it is necessary to define the geographical scope of the market, which enables the assessment of the conditions of effective competition in it. According to established practice, the relevant geographic market comprises an area in which the undertakings concerned are involved in the supply and demand of the products and services concerned, in which the conditions of competition are uniform, and which can be distinguished from neighbouring areas. In the field of electronic communications, the geographic scope of the relevant market is determined

in accordance with established practice on the basis of two main criteria: the area covered by the network and the existence of legal and other normative instruments. Using the method of geographical segmentation, the Contractor will check whether the competitive conditions for entering the market are the same in all areas of the Republic of Bosnia and Herzegovina. In particular, it will be necessary to check whether the competitive conditions differ throughout those parts of the national territory where there is more infrastructure (urban centres) than those where only one infrastructure is present and there is only one operator with significant market power.

Tasks in this area include:

- Advising and carrying out the determination of the appropriate methodology for carrying out geographical segmentation in future analyses of the relevant markets defined in the European regulatory framework.

Consulting and implementation of geographical analyses in the analysis of retail prices in the telecommunications market in Bosnia and Herzegovina

For the purposes of the new regulation of the relevant markets 3a and 3b, the Contracting authority will identify flagship products based on the revised Recommendation on relevant markets and the recommendation on consistent non-discrimination obligations and methodologies for calculating costs to promote competition and improve the broadband investment environment. To this end, operators can expect to be provided with a questionnaire on the leading packages they offer to end users. To this end, for the purposes of reporting on the leading packages provided by operators to end users, the Contractor should prepare the optimal format for the preparation of input data and subsequent input into the geo-data system. Leading products will be a constant in further regulation, so analyses at the geographical level will also be permanent, which should be performed by the Contractor in agreement with the Contracting authority.

Consulting and implementation of various "ad hoc" geographical analyses that the Contracting authority needs in the process of regulating and monitoring the electronic communications market in Bosnia and Herzegovina

The Contracting Authority often encounters the need to perform geographical analyses, which it needs in various processes of regulation and supervision of the electronic communications market and management and control of the radio frequency spectrum in Bosnia and Herzegovina and performing tasks in the field of radio and television activities. The Contractor will advise and perform various ad hoc geographical analyses, especially in the field of electronic communications market infrastructure, and, if necessary, cooperate in conducting analyses with other sectors in the Agency.

Expansion in connection with additional collection of network layout forecasts and inquiry into market interest for the construction of high-performance networks and demonstration of new spatial layers due to legal changes

The Contracting authority is likely to take over the competence to investigate market interests for the construction of high-performance electronic communications networks. The Body of European Regulators for Electronic Communications (BEREC) has issued Guidelines to support national regulators and other public institutions in consistent implementation of the provision of Article 22 of the EECC, which he supplemented with guidelines on verification and procedures for this purpose. The Contractor should expand to enable easy generation of data on inhabited residential and inhabited

addresses from the CRA's database and to prepare public calls or publications. The GIS needs to be expanded in such a way that it is easy to collect, verify and enter stakeholder data on construction interests (including any additional parameters deriving from the guidelines). It is necessary to customize the scripts and enable navigational association with this table. Coordination with staffing agencies and geoportal operators will also be required to show the spatial layer. The Contractor should cooperate with the technical and operational implementation of updates and provide all necessary technical support to the employees of the agencies.

Development of spatial applications and production of dedicated tools for spatial data processing tailored to the Contracting authority

The GIS will be used by the CRA in practically all areas of its operation, as a support in the implementation of tasks and decision-making. Individual tasks that are repeated and performed by users with different levels of information and GIS knowledge, such as: inputs, validations, geocoding, generalization of statistical data, cross-sections, complex calculations with data from several tables, etc. The task of the Contractor will be with the development agency scripts and applications (Java, Pytho, etc.) that will help to optimally perform the regular work tasks of the CRA, with special emphasis on simplicity and durability. This additionally includes automatically scheduled tasks (updates, startups, operation of WFS and WMS services, etc.).

Advice and support in performing advanced spatial analyses

If necessary and by agreement, the Contractors task should be to advise the CRA on the most complex spatial analyses (network analyses, geo-routing, etc.). In addition, tasks in this area may include cooperation in the context of updating and supplementing the geoportal, specifically regarding the operation of the Geoserver and the display of data layers.

Providing all necessary information to the employees of the agency for the smooth use of tools

The task of the Contractor should be to provide the CRA's employees with full access to the prepared tools, applications and scripts and to provide all the necessary substantive explanations. The task of the Contractor will also be to instruct the employees of the agency for the smooth management of tools and on the possibilities of their updates and additions. The Contractor will have to design and present all the tools in such a way that the CRA's employees will be able to use them independently. If necessary and upon request, the Contractor should prepare additional written instructions for the products.

In addition to the permanently available geoportal, GIS employees use it daily for many tasks, so the Contractor is expected to provide all the necessary support in case of errors and all of the above to avoid disruptions at all.

Technical support in the operation of the Geoportal and development of an application for the use of the browser on portable devices

The Contractor should advise the CRA on updates and, in agreement with the CRA's employees, will ensure the smooth implementation of Geoportal upgrades (in the .NET environment). It will follow the relevant area and propose appropriate solutions for the smooth and safe operation of the system and for optimizing performance. For the CRA, it should implement the possibility of reporting errors in the displayed TK data on Geoportal directly by users, and participate in other similar upgrades that

will relate to the new data layers and their display. In the event that the Contracting authority's side needs additional functionality, the Contractor will implement it in the user interface after examining the options and in agreement with the Contracting authority.

In agreement with CRA employees, the Contractor will develop an application for portable devices (smartphones, tablets and similar devices), which will offer a comparable user experience as a desktop version and take care of publishing security and functional upgrades. The app will need to be available in the Google Play and AppStore libraries and therefore run on the two largest platforms, Android and iOS.

Proposed contractual obligations

Consultants' hours for the provision of services under this contract should be carried out successively in accordance with the needs of the Contracting authority. The Contractor should start performing the service on the basis of an oral or written request from the Contracting authority. Under this contract, the Contractor should perform work at the Contracting authority's registered office, except in exceptional cases, unless otherwise agreed with the Contracting authority.

An important addition to the contract should be signing a non-disclosure agreement that should be concluded with the Contractor before the start of the provision of services.

The Contractor's response time to the Contracting authority's request should be as short as possible and/or not longer than 24 hours in the case of an intervention request or 3 days in the case of a normal request. The intervention of the task is defined by the Contracting authority.

Under the contract, the Contractor should undertake to:

1. Perform the services with the care of a good expert, flawlessly and with quality, taking into account regulations and standards in this field and to cooperate with Contracting authority's and take into account their requirements, insofar as they are in accordance with the subject and scope of this contract,
2. provide the Contracting authority with all necessary explanations and, if necessary, to resolve problems that may arise in the performance of services,
3. Provide services economically and for the benefit of the Contracting authority and to ensure the highest quality of services,
4. Fulfil its obligations within the time limit and in the prescribed manner.

The Contractor should also, separately by days and members of the project team who will perform activities in the previous week, report in writing on a weekly basis (e.g. every Tuesday) on the activities performed for the previous week and on the hours spent for these activities. This report must also show the number of hours spent for each activity or member of the project team. Several activities performed by person in one day and a description of the performed activity or performed activities.

The Contractor should undertake to report in writing to the Contracting authority, in the same way as on a weekly basis, by the 5th day of the month at the latest, on the activities performed and the hours

spent for the previous month. The mentioned reports (weekly and monthly) must be submitted by the Contractor in writing (electronically) within the mentioned deadlines to the Contracting authority, who reviews them and within 5 days of their receipt answers whether he agrees with them or not. If the Contracting authority does not respond to the report within 5 working days of receiving of the monthly report, the report is considered confirmed. The individually approved monthly report should be the base for issuing an invoice for the consulting hours in the previous month.

After completing all activities defined by the contract, the Contractor must write a final report containing all possible technical details and instructions that the Contracting authority will need for further independent work.

Conclusions

This paper is the second report of a series of technical reports produced by ITU to deliver technical assistance to CRA of Bosnia and Herzegovina in its path to develop and establish a broadband mapping system at the country level, which is an essential tool to help government authorities to advance their digital agenda.

This technical assistance, designed in three phases, has delivered in 2021 the policy paper "Enabling environment for broadband mapping in Bosnia and Herzegovina". Building from this body of knowledge, this report under form of technical specifications conclude the second phase of this technical assistance by delivering on the technical specifcations that would help CRA to design a bidding request to establish, own and operate a broadband mapping system. In addition to

Chapter one and chapter two of this report introduces the subject at hand and presented the body of knowledge from which the technical specifications are based, I.e the European experience produced via a series of European documentations as well as the ITU Guidelines on establishing or strengthening national broadband mapping systems. Both pillars have helped to narrow down the scope of the legal and technical specifications, therefore allowing CRA for an efficient examination of what is really required when establishing a broadband mapping system.

Chapter three encompasses a series of technical specifications that may be utilised by CRA and integrated in a tendering procedure for contracting the development of a broadband map. In the first part of the chapter, a series of elements were covered. Those requirements and suggestions related to project framework and objectives (i); data sources (ii); information to be collected (iii); data formats (iii); data supply process (iv); data conversion (vii); quality checks in broadband mapping (viii); Access to data (ix); publication format (x); update frequency of data supply (xi); project design (xii). In the second part of the chapter, a series of recommendations on the technical requirements for the public tender and proposed contractual obligations were also addressed. In order: recommendations for technical and human capacity (i); recommendations on general technical specifications (ii); recommendations on detailed specifications (iii) and recommendations on proposed contractual obligations (iii).

Annex to the ITU's technical specifications for the implementation of a broadband mapping system in Bosnia and Herzegovina, ITU under specific request of CRA has also provided a concise informative and non-binding informal opinion on the parallel ongoing project: Information System for electronic

monitoring of network resources and licenses in telecommunications in the competent institutions through the Geographic Information System (GIS). This concise informative and non-binding informal opinion is framed as a stand-alone brief document that tries to analyse at a high level the current legal contract that CRA has established with potential contractor as part of the parallel large-scale public procurement happening at the moment at the country level.

In conclusion, ITU's technical specifications aim at supporting CRA's path in establishing, owning and operating a broadband mapping system at the national level, allowing Bosnia and Herzegovina to equip itself with the right instrument to leverage the power of ICT and telecom for the benefit of its citizens.