SIMULATION OF BOSNIA AND HERZEGOVINA AIRSPACE
SECTORIZATION AND ITS INFLUENCE ON FAB CE

Valentina Barta, student
Department of Aeronautics, Faculty of Transport and Traffic Sciences, University of Zagreb, Croatia
barta.valentina@gmail.com

Biljana Jurčić, PhD
Department of Aeronautics, Faculty of Transport and Traffic Sciences, University of Zagreb, Croatia
biljana.juricic@fpz.hr

Antonin Kazda, PhD
Air Transport Department, University of Žilina, Slovakia
kazda@fpdas.uniza.sk

Abstract The process of establishing new air navigation service provider (ANSP) and air traffic management system is a complex procedure that implies preliminary analysis and simulation of service provision within airspace concerned and its influence on air traffic flows within neighbouring airspaces. In such new conditions airspace structure and sector capacities should be analysed in terms of current and future air traffic demand as well as generated delay. This paper deals with the implementation of the new airspace structure and air traffic management (ATM) system within Bosnia and Herzegovina (BH) airspace as a part of Functional Airspace Block Central Europe (FAB CE). The transition from the current air traffic services provision to a service provided by a newly established ANSP will be simulated. Four different sectorization scenarios of BH airspace will be developed and their influence on the neighbouring airspace or a wider region such as functional airspace block.

In Bosnia and Herzegovina (BH) airspace the new ATM system and new national ANSP would take over the provision of air navigation services in years to come so it is necessary to make preliminary research and analysis how it would influence the neighbouring countries, i.e. Croatia, Serbia and Montenegro but also Functional Airspace Block Central Europe (FAB CE). There isn’t any previous research made on this actual situation.

The purpose of this research is to present preliminary results in the terms of traffic load and capacity of BH airspace sectorization as a part of wider ATM system implementation.

II. AIR TRAFFIC SERVICES WITHIN BOSNIA AND HERZEGOVINA AIRSPACE

Air traffic service provision in Bosnia and Herzegovina, is still being delegated to Croatia Control ltd. (CCL - Croatian ANSP) and Serbia and Montenegro Air Traffic Services llc (SMATSA - Serbia and Montenegro ANSP), as shown in the Figure 1. [6]

Key words – airspace structure, sectorization, simulation, air traffic management system, Bosnia and Herzegovina airspace, FAB CE.

I. INTRODUCTION

The process of establishing a new air navigation service provider (ANSP) and air traffic management system implies creation of regulations and airspace organization structure (sectorization) with clear division of responsibility that would balance traffic demand and airspace capacity. Airspace sectorization is based on predetermined parameters such as air traffic flows, traffic demand, air traffic management (ATM) system capacity and sector capacity. Traffic congestion, airspace overload and possible delay as a result of the new airspace structure influence the neighbouring airspace or a wider region such as functional airspace block.

In Bosnia and Herzegovina (BH) airspace the new ATM system and new national ANSP would take over the provision of air navigation services in years to come so it is necessary to make preliminary research and analysis how it would influence the neighbouring countries, i.e. Croatia, Serbia and Montenegro but also Functional Airspace Block Central Europe (FAB CE). There isn’t any previous research made on this actual situation.

The purpose of this research is to present preliminary results in the terms of traffic load and capacity of BH airspace sectorization as a part of wider ATM system implementation.

II. AIR TRAFFIC SERVICES WITHIN BOSNIA AND HERZEGOVINA AIRSPACE

Air traffic service provision in Bosnia and Herzegovina, is still being delegated to Croatia Control ltd. (CCL - Croatian ANSP) and Serbia and Montenegro Air Traffic Services llc (SMATSA - Serbia and Montenegro ANSP), as shown in the Figure 1. [6]

I. INTRODUCTION

The process of establishing a new air navigation service provider (ANSP) and air traffic management system implies creation of regulations and airspace organization structure (sectorization) with clear division of responsibility that would balance traffic demand and airspace capacity. Airspace sectorization is based on predetermined parameters such as air traffic flows, traffic demand, air traffic management (ATM) system capacity and sector capacity. Traffic congestion, airspace overload and possible delay as a result of the new airspace structure influence the neighbouring airspace or a wider region such as functional airspace block.

In Bosnia and Herzegovina (BH) airspace the new ATM system and new national ANSP would take over the provision of air navigation services in years to come so it is necessary to make preliminary research and analysis how it would influence the neighbouring countries, i.e. Croatia, Serbia and Montenegro but also Functional Airspace Block Central Europe (FAB CE). There isn’t any previous research made on this actual situation.

The purpose of this research is to present preliminary results in the terms of traffic load and capacity of BH airspace sectorization as a part of wider ATM system implementation.

II. AIR TRAFFIC SERVICES WITHIN BOSNIA AND HERZEGOVINA AIRSPACE

Air traffic service provision in Bosnia and Herzegovina, is still being delegated to Croatia Control ltd. (CCL - Croatian ANSP) and Serbia and Montenegro Air Traffic Services llc (SMATSA - Serbia and Montenegro ANSP), as shown in the Figure 1. [6]

I. INTRODUCTION

The process of establishing a new air navigation service provider (ANSP) and air traffic management system implies creation of regulations and airspace organization structure (sectorization) with clear division of responsibility that would balance traffic demand and airspace capacity. Airspace sectorization is based on predetermined parameters such as air traffic flows, traffic demand, air traffic management (ATM) system capacity and sector capacity. Traffic congestion, airspace overload and possible delay as a result of the new airspace structure influence the neighbouring airspace or a wider region such as functional airspace block.

In Bosnia and Herzegovina (BH) airspace the new ATM system and new national ANSP would take over the provision of air navigation services in years to come so it is necessary to make preliminary research and analysis how it would influence the neighbouring countries, i.e. Croatia, Serbia and Montenegro but also Functional Airspace Block Central Europe (FAB CE). There isn’t any previous research made on this actual situation.

The purpose of this research is to present preliminary results in the terms of traffic load and capacity of BH airspace sectorization as a part of wider ATM system implementation.

II. AIR TRAFFIC SERVICES WITHIN BOSNIA AND HERZEGOVINA AIRSPACE

Air traffic service provision in Bosnia and Herzegovina, is still being delegated to Croatia Control ltd. (CCL - Croatian ANSP) and Serbia and Montenegro Air Traffic Services llc (SMATSA - Serbia and Montenegro ANSP), as shown in the Figure 1. [6]

I. INTRODUCTION

The process of establishing a new air navigation service provider (ANSP) and air traffic management system implies creation of regulations and airspace organization structure (sectorization) with clear division of responsibility that would balance traffic demand and airspace capacity. Airspace sectorization is based on predetermined parameters such as air traffic flows, traffic demand, air traffic management (ATM) system capacity and sector capacity. Traffic congestion, airspace overload and possible delay as a result of the new airspace structure influence the neighbouring airspace or a wider region such as functional airspace block.

In Bosnia and Herzegovina (BH) airspace the new ATM system and new national ANSP would take over the provision of air navigation services in years to come so it is necessary to make preliminary research and analysis how it would influence the neighbouring countries, i.e. Croatia, Serbia and Montenegro but also Functional Airspace Block Central Europe (FAB CE). There isn’t any previous research made on this actual situation.

The purpose of this research is to present preliminary results in the terms of traffic load and capacity of BH airspace sectorization as a part of wider ATM system implementation.

II. AIR TRAFFIC SERVICES WITHIN BOSNIA AND HERZEGOVINA AIRSPACE

Air traffic service provision in Bosnia and Herzegovina, is still being delegated to Croatia Control ltd. (CCL - Croatian ANSP) and Serbia and Montenegro Air Traffic Services llc (SMATSA - Serbia and Montenegro ANSP), as shown in the Figure 1. [6]
• GUBOK
• DER - VOR Derventa
• BOSNA
• SOLGU
• VRANA
• Coordinate point 43.2900N - 017.1100E

In 2005 the Council of Ministers of Bosnia and Herzegovina adopted the Bosnia and Herzegovina ATM Strategy plan to create a national air navigation service provider and develop and implement the new BH ATM System. In the process of switching air traffic service provision from the CCL and SMATSA to the new national provider, Bosnia and Herzegovina Directorate of Civil Aviation (BHDCA) was established as a national supervisory authority, and Bosnia and Herzegovina Agency for Air Navigation Services (BHANSA) was established as a new national ANSP.[7]

The BH ATM system development comprised four major segments: the establishment of the ATM system, Institutional Transformation, Development of Human Resources and Civil Works.[8]

Establishment of BHANSA has to ensure safe, regular and efficient transition of the air traffic service provision (and wider air navigation services) by meeting all technical and operational conditions in every phase of transition.

Implementation of the new BH ATM System and establishment of BHANSA, are divided in the two phases of air traffic service provision:[9]
1. Phase I - expected to become operational by the end of 2014;
2. Phase II - it should be completed by the end of 2015.

**Phase I**

In this phase, BH ATM System implementation considers following BH airspace sectorization within control area (CTA): two sectors Lower sector up to FL285 and Upper sector from FL 285 to FL325, while above FL325 the service provision remains delegated to CCL and SMATSA.

All technical preconditions are expected to be completed by the end of 2014, when the first phase of BH ATM system implementation should become operative.

**Phase II**

In this phase, BH ATM system implementation should become operable by the end of 2015. The second phase includes taking the control over complete upper part BH airspace above FL325.

Since the technical preconditions should be fulfilled in the Phase I, the main task of the second phase of BH ATM system implementation would be the adaption of the existing system and insuring the sufficient number of air traffic controllers (ATCOs) and supporting personnel. The number of ATCOs needed is a direct function of the expected traffic load and the number of activated sectors. Expected air traffic flows which vary during time, airspace and route structure are also major parameters that influence type of airspace sectorization.

Therefore, the simulation of the Phase II of BH airspace sectorization will be analysed further in the text to observe its possible influence of the neighbouring countries and functional airspace block.

**III. METHODOLOGY OF CAPACITY DETERMINATION AND TRAFFIC FORECAST SIMULATION**

Analysis and simulation of the BH Implementation Phase II are made by using EUROCONTROL NEST software (Network Strategic Tool) where various scenarios are developed with different airspace sectors and traffic loads. Prior to the analysis it is necessary to prepare the input data and set the initial prerequisites. Then the reference capacity values are calculated and maximum sector capacity is determined as the parameter of future ATCO workload. One of the prerequisites is the fact that Bosnia and Herzegovina is a member state of FAB CE, and therefore the preliminary sector capacity was determined as an average value of sector capacities taking into consideration all sectors of FAB CE member states. The calculation is based on NEST sector capacity data declared in AIRAC 1405 dataset. Calculated value of average sector capacity was 38 operations per hour.[10]

For preliminary analysis, a safety buffer (rate reduction) must be taken into consideration when determining sector capacity. In this analysis the reduction rate of 25% was taken for BH sector capacity reduction (it is a mid-value of rate reduction in sector capacity between 15% and 35%, scaling down which were caused by major airspace or ATM system change projects in winter 2013/2014).[11] Therefore, the determined BH sector capacity is:

\[ \text{Capacity}_{BH} = 38 - 25\% \text{ operations/h} \]

\[ \text{Capacity}_{BH} \approx 28 \text{ operations/h} \]

This value of 28 operations per hour is assumed to be preliminary BH sector capacity, and will be used for further simulations. Real sector capacity calculations are far more complex and include various factors and detailed analyses which can be provided only within national ANSP taking into consideration ATCO workload and air traffic complexity assessments.

Since Phase II is scheduled for the end of 2015, for more accurate results it is necessary to simulate the traffic forecasted for 2016. STATFOR traffic forecasts provided by EUROCONTROL are available as a part of each AIRAC dataset at the end of each AIRAC cycle. Forecasts of traffic growth provided by STATFOR are used to generate future traffic samples. For simulation of air traffic inside BH airspace, AIRAC 1407 dataset is used and traffic growth is simulated according to STATFOR forecast rates for all the traffic which affects ECAC member states. Traffic forecast simulation applies STATFOR forecast rates to the AIRAC dataset used for the simulation, without adapting the calendar. Therefore AIRAC 1407 dataset used before the simulation will be referred to as Original data, while the dataset used after the simulation of 2016 traffic will be referred to as Adapted data.

The busiest day of AIRAC 1407 dataset in Europe is June 27th, counting 34537 operations in Original data, and 36521 operations in the Adapted data. Growth rate for 2016
simulation is rather constant, with the minimum value of 5.57% on July 3rd and the maximum value of 6.33% on June 28th.

On the other hand, the busiest day in BH airspace occurs on July 5th counting 1200 operations in Original 2014 data and 1274 operations in Adapted data. The growth rate tends to be constant; however it varies more than the total growth rate for entire Europe, extending from 4.43% which occurs on July 9 up to 7.21% on July 11th.

To present the impact of the simulation on traffic, July 11th is chosen as an example day. This day is the busiest day of July for total ECAC traffic from AIRAC 1407 dataset (July 1st – July 23rd) both in the Original data and in the Adapted data after the simulation of STATFOR traffic growth rate for 2016. The results of simulation for July 11th 2016 are presented in the Table 1, showing the comparison of Original data and Adapted data of total ECAC air traffic for the busiest day in July. In the table airspaces are presented by Area Control Centres (ACC). BH ACC is ACC Sarajevo-Banja Luka.

### Table 1 - Results of Traffic Forecast Simulation

<table>
<thead>
<tr>
<th>Air traffic 2014 [operations]</th>
<th>Air traffic 2016 [operations]</th>
<th>Difference [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECAC</td>
<td>33546</td>
<td>35480</td>
</tr>
<tr>
<td>FAB CE</td>
<td>7205</td>
<td>7632</td>
</tr>
<tr>
<td>ACC Bratislava</td>
<td>1710</td>
<td>1848</td>
</tr>
<tr>
<td>ACC Budapest</td>
<td>2561</td>
<td>2761</td>
</tr>
<tr>
<td>ACC Ljubljana</td>
<td>1388</td>
<td>1426</td>
</tr>
<tr>
<td>ACC Prague</td>
<td>2564</td>
<td>2743</td>
</tr>
<tr>
<td>ACC Sarajevo-Banja Luka</td>
<td>1101</td>
<td>1178</td>
</tr>
<tr>
<td>ACC Vienna</td>
<td>4193</td>
<td>4395</td>
</tr>
<tr>
<td>ACC Zagreb</td>
<td>2061</td>
<td>2288</td>
</tr>
</tbody>
</table>

The data show that the air traffic growth rate for each ACC is not directly related to total ECAC growth rate, but rather varies, while values of the growth rate for wider areas such as FAB CE are closer in number to the total ECAC growth rate value. Since the total ECAC traffic growth is comprised of numerous local changes in growth rate, it is directly dependent of any change in each local air traffic growth rate. The relation and the dependence of local traffic between ACCs, showing the impact of BH airspace on neighbouring countries and FAB CE will be presented in further analysis.

### IV. Simulation of Airspace Sectorization

To make different BH airspace organization (sectorization) analysis, it is needed to make a Preliminary scenario that would show traffic load within BH airspace, as single sector, taking into consideration traffic for a peak day from Original AIRAC1407 dataset as shown in the Figure 2.

![Figure 2 – Daily Entry Count for Preliminary Scenario](image)

Figure shows the number of aircraft entering the observed airspace in one day, where the x-axis indicates the time; the y-axis indicates the number of aircraft while the green line represents set sector capacity (28 operations/h).

It is visible in the top right corner of the Graph that the daily traffic crossing the BH airspace on the observed day is 919 aircraft. The highest number of aircraft entering the area in one hour is 67 aircraft.

Taking into account that the calculated maximum sector capacity is 28 operations/h, it is concluded that one sector cannot handle analysed historical traffic volume. So, it is necessary to make further sectorization of BH airspace.

Four scenarios are created with following airspace sectorizations:

- **Scenario 1** – BH airspace (CTA) is divided into two sectors vertically separated at FL 365;
- **Scenario 2** - BH airspace (CTA) is divided to Lower sector (FL 100 or above terminal areas to FL 355), High sector (FL 355 to FL 375) and Top sector (above FL 375);
- **Scenario 3** - BH airspace (CTA) is divided vertically into Lower sector from above the uncontrolled zone and TMA areas to FL 345, Upper sector from FL 345 to FL 365, High sector from FL 365 to FL 375 and Top sector from FL 375 upwards; and
- **Scenario 4** - BH airspace (CTA) is divided geographically into North and South sector, both of which were further divided vertically at FL 365 resulting with four sectors: High North, High South, Low North and Low South.

Scenario 1 and Scenario 3 were, after preliminary analysis, considered inadequate due to high traffic overloads and inadequate technical solution, leaving only two possible sectorization scenarios to be considered: Scenario 2 and Scenario 4.

### V. Result Analysis

**Scenario 2**

Distribution of traffic on July 11th simulation tends to be even for each sector, counting 426 aircraft operating through Low sector, 516 aircraft in High sector and 457 aircraft in Top sector (Figure 3).
Analysing Top sector (Figure 4) it can be noticed that the traffic peaks between 10:00 and 11:00, counting 40 aircraft in the sector, that consequently cause 12 overload flights in that hour.

Airspace overload occurs in three hours in the given day, causing 17 aircraft to be regulated or delayed. In other words, considering the traffic demand of 424 aircraft 4.01% of total traffic is causing sector overload.

High sector (Figure 5) is counting 482 operations in examined day, in spite of being the smallest of three sectors (FL 355- FL 375) and containing only two flight levels. The peak traffic occurs between 13:00 and 14:00, counting 37 entries in an hour and causing 9 overload flights.

The total overload is 27 aircraft distributed through six hours of a day, causing the sector to be overloaded 25% of the time. The amount of overload flights in total traffic demand is 5.6%.

On the observed day Lower sector (Figure 6) counts 410 operations with peak hour from 08:00-09:00, when 36 flights enter the sector and cause an overload of 8 aircraft in that hour.

Sector has the sum of 10 overload flights, which is 2.44% of total traffic demand and occurs in 3 hours of the day. Such traffic allows the sector to operate without causing delays and regulations in 87.5% of the day.

Comparing traffic distribution in Top, Lower and Upper sector, it can be seen that each sector has peak hours at different time of a day, leaving the opportunity to solve overload flights by changing their flight level and passing them to other sectors.

Analysis of the traffic distribution in the configuration for simulation of 2016 on July 11th, show that from 1041 flights operating through the BH airspace, 336 will fly within Lower North sector, 358 High North, 356 Lower South and 415 High South (Figure 7).

The peak hour of High North sector appears from 10:00 to 11:00 and counts 41 operations, causing an overload of 13 flights, as presented in Figure 8.

Sector overload appears in seven hours of a day, causing total of 36 flights to be regulated or delayed. The share of 7.48% of total 481 flight operating through High North sector is in overload and it causes the sector to be overloaded in 29% of its working time.

Lower North sector (Figure 9) has slightly less dense traffic with 397 flights. The peak hour appears between 08:00 and 09:00 when 34 aircraft are entering the sector, causing 6 overload operations.
Being the only overloaded hour, the 6-operation overload in the peak hour take part of 1.5% of the overall traffic.

**Figure 9 - Daily Entry Count and Traffic Volume Overload for Scenario 4 – Lower North Sector**

High South sector (Figure 10) counts 453 aircraft in the observed day and had two afternoon peak hours of 34 aircraft entering the sector from 14:00 to 15:00 and from 20:00 to 21:00. Sector overload caused by the peak hours is 6 aircraft in each hour.

**Figure 10 - Daily Entry Count and Traffic Volume Overload for Scenario 4 – High South Sector**

Being the sector with the least traffic, Lower South sector counts 382 aircraft entering the airspace in the observed day. Entries are distributed in a day as shown in Figure 11.

**Figure 11 - Daily Entry Count and Traffic Volume Overload for Scenario 4 – Lower South Sector**

It can be seen that two peak hours stand out, from 08:00 to 09:00 and from 12:00 to 13:00, both counting 28 entries, which is the same as calculated sector limitation per hour, owing to which there are no overloads in that sector.

As in the Scenario 2, peak hours in each sector of Scenario 4 appear at a different hour in a day.

VI. IMPACT OF BOSNIA AND HERZEGOVINA AIRSPACE SECTORIZATION ON FAB CE

FAB is a block of airspace established regardless of State boundaries and it includes several ANSPs in order to achieve better performance and cooperation in provision of air navigation services. Europe is divided to nine FABs, one of which is Functional Airspace Block Central Europe (FAB CE). Member states of FAB CE are: Austria, Bosnia and Herzegovina, Croatia, Czech Republic, Hungary, Slovakia and Slovenia.[1]

The aim of FAB CE incentive mechanism is to improve cooperation between states in order to improve Capacity performance, while keeping high quality services. The main Key Performance Indicator (KPI) for Capacity performance is en route air traffic flow management (ATFM) delay per flight. The pan-European performance target for the delay is defined with 0.5 minutes for 2014, while FAB CE wide target delay is planned to be maximally 0.15 minutes per flight, with capacity performance targets set individually for each State.

For the FAB CE Performance Plan for the second Reference Period (2015 - 2019) shown in the Table 2 Bosnia and Herzegovina is the only state not being a member of EU and therefore has no national capacity target published.[4]

**Table 2 - Targets for ATFM delay on National and FAB CE Level**

<table>
<thead>
<tr>
<th></th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAB reference values</td>
<td>0.32</td>
<td>0.31</td>
<td>0.31</td>
<td>0.30</td>
<td>0.29</td>
</tr>
<tr>
<td>National targets:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Austria</td>
<td>0.23</td>
<td>0.23</td>
<td>0.23</td>
<td>0.22</td>
<td>0.21</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>0.14</td>
<td>0.13</td>
<td>0.12</td>
<td>0.11</td>
<td>0.11</td>
</tr>
<tr>
<td>Slovak Republic</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.11</td>
<td>0.10</td>
</tr>
<tr>
<td>Hungary</td>
<td>0.0649</td>
<td>0.0549</td>
<td>0.0549</td>
<td>0.0449</td>
<td>0.0549</td>
</tr>
<tr>
<td>Slovenia</td>
<td>0.21</td>
<td>0.21</td>
<td>0.22</td>
<td>0.23</td>
<td>0.22</td>
</tr>
<tr>
<td>Croatia</td>
<td>0.23</td>
<td>0.22</td>
<td>0.21</td>
<td>0.21</td>
<td>0.19</td>
</tr>
</tbody>
</table>

Each FAB CE State should provide its performance plan, except for states not being member of EU at the time when the regulation is applicable.

Due to NEST system limitations, in the field of delay calculation and its inability to simulate rerouted flights, ATFM delay results for the performed simulation are considered unwarrantable, and they are not presented in this paper. Therefore, the number of shared flights remains the only valid indicator of impact of BH sectorization on FAB CE member states.

**Table 3 - Shared number of flights of BH traffic and each FAB CE member state**

<table>
<thead>
<tr>
<th>Bosnia and Herzegovina [flights]</th>
<th>Percentage of BH TV [%]</th>
<th>Percentage of FAB CE member state TV [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>850</td>
<td>66.7</td>
</tr>
<tr>
<td>Croatia</td>
<td>1256</td>
<td>98.6</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>15</td>
<td>1.2</td>
</tr>
<tr>
<td>Hungary</td>
<td>15</td>
<td>1.2</td>
</tr>
<tr>
<td>Slovak Republic</td>
<td>17</td>
<td>1.3</td>
</tr>
<tr>
<td>Slovenia</td>
<td>652</td>
<td>51.2</td>
</tr>
</tbody>
</table>

Since Croatia and Slovenia share high percentage of traffic with Bosnia and Herzegovina (>45%), it is expected for them to be significantly influenced by possible BH ATFM
delay. Austria, with 25.5% of traffic shared with BH could expect lower impact resulted by BH ATFM delay, while the impact on Czech Republic, Hungary and Slovak Republic with less than 1.5% of traffic shared with BH should be negligible.

VII. CONCLUSION

Sectorization of the newly established control areas is a complex process which depends of numerous factors, most of which dynamically change in time, therefore it is usually performed by an ANSP responsible for provision of air traffic services in the observed area. The purpose of this research was to present preliminary results of BH airspace sectorization within BH ATM implementation Phase II.

Sectorization scenarios were created based on the traffic demand simulated according to STATFOR forecast for 2016 and BH sector capacity calculated as an average value of FAB CE member states sector capacity. After analyses of several sectorization scenarios for Phase II implementation, the results have shown that Bosnia and Herzegovina has a heavy traffic load in the summer season. In order to accommodate future traffic demand, it is important for BHANSA to ensure accurate sector capacity calculations and adapt the sectorization analysis for the possible scenarios accordingly.

This research has showed that the majority of flights within Bosnia and Herzegovina airspace operate between FL 345 and FL375, which is limiting factor for vertical division of airspace. Therefore it is recommended to consider two scenarios with the proposed airspace sectorizations: Scenario 2 with three vertically separated sectors and Scenario 4 with four sectors vertically and geographically separated. Both scenarios ensure similar capacity with the approximately same values of sector overloads. The further analysis should include flight rerouting and accurate calculations of ATFM delay generated due to sector overloads but also Costs Benefit Analysis of both Scenarios.

As a FAB CE member state, Bosnia and Herzegovina should ensure a standard level of ATS quality in order to meet the requirements and a target set for FAB CE level, even though it is not an EU member and is not obliged to present a Performance Plan.

The main indicator for airspace capacity is ATFM en-route delay per flight. Although the delay simulation couldn’t be done in this research because of the NEST system limitation, it can be assumed that the most of FAB member states wouldn’t be significantly affected by the situation in BH airspace. This is assumed according to the simple analysis of number of the shared flights between Bosnia and Herzegovina and other FAB CE member states. Croatia and Slovenia are the only two FAB CE members with almost 50% of their traffic shared with BH, hence they are influenced by BH air traffic services.

Regardless of the low impact of BH on other FAB CE members individually, any delay caused by BH directly influences the overall FAB CE ATFM delay. For that reason, it is advisable for BH to develop national Performance Plan during the implementation of Phase I, in order to positively contribute to FAB CE targets and objectives in the future.

VIII. REFERENCES