



Универзитет „Св. Кирил и Методиј“ во Скопје  
ФАКУЛТЕТ ЗА ИНФОРМАТИЧКИ НАУКИ  
И КОМПЈУТЕРСКО ИНЖЕНЕРСТВО

# How we changed to Online at FCSE/UKIM to support our students because of Covid19

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IXP.mk



# Problem description

- The Faculty of Computer Science and Engineering (FCSE) in Skopje, North Macedonia has 4000 active students.
- Due to the COVID-19 pandemic the schools, high-schools and the universities were ordered to close from the 11<sup>th</sup> of March 2020.
- Challenge: Organize classes for 4000 students and have up to 10 parallel sessions on the Faculty servers.
- Opportunity: Existing faculty infrastructure and network availability.
- FCSE accepted the challenge of continuing the lectures online.



# Implementation challenges

- Provide needed infrastructure: CPU, RAM, Storage
- Have good Internet capacity
- Provide excellent end user experience both for students and professors.
- Do everything in very short period of time

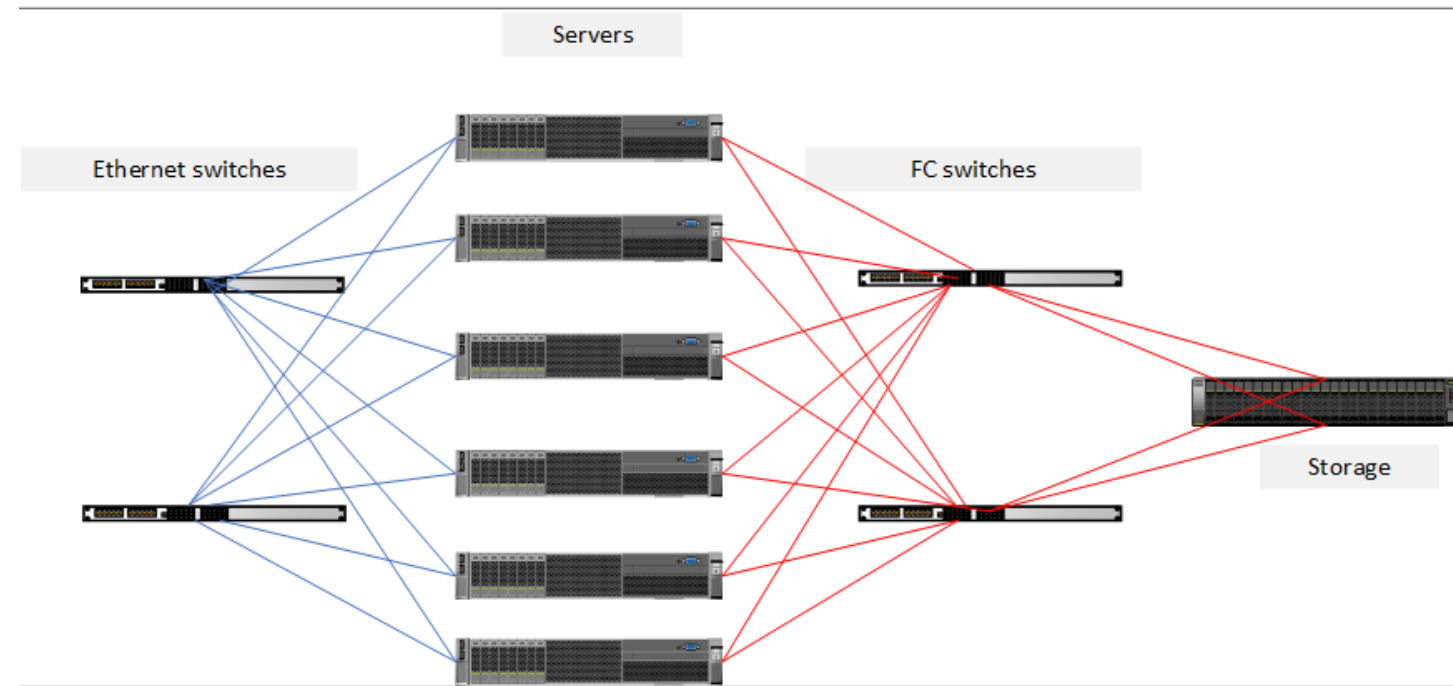


# Implementation details

- Hardware implementation – based on existing resources of FCSE

Following hardware resources were (either partially or fully) used in this effort:

- six Huawei RH5885H V3 servers
- one Huawei OceanStore 5500 V3 FC storage system with redundant controllers
- two SNS2248 Fiber Channel switches
- two Huawei Cloud Engine 6851 10 Gbit Ethernet switches in stacked configuration





# Implementation details (2)

- Connectivity implementation

In order to provide better end user experience for the users additional work was done on the topic of network connectivity. FCSE is already well connected to the general internet based on 2 full Internet up-links as following:

- 1 Gbit upstream via GEANT project provided via the University network
- 500 Mbit upstream via a commercial ISP provided in cooperation with the Ministry of Education

Additionally 10G connection to the University/Faculty project for IXP (Internet exchange point) – IXP.mk was used

Peer name	Homepage	AS	Status	Connected to	Capacity
BIDI IN V.I.B - Content services		AS203274	Connected	• FCSE	• 10 Gbit
FCSE	<a href="http://finki.ukim.mk">finki.ukim.mk</a>	AS52188	Connected	• FCSE	• 10 Gbit
INTERSPACE	<a href="https://interspace.com/">https://interspace.com/</a>	AS200899	Connected	• FCSE	• 10 Gbit
Makedonski Telekom	<a href="http://telekom.mk">http://telekom.mk</a>	AS6821	Connected	• Rectorate	• 10 Gbit
Telekabel	<a href="http://www.telekabel.com.mk">www.telekabel.com.mk</a>	AS41557	Testing	• FCSE	• 1 Gbit
Telesmart	<a href="http://www.telesmart.mk">www.telesmart.mk</a>	AS34547	Connected	• FCSE	• 1 Gbit
UKIM	<a href="http://www.ukim.edu.mk">www.ukim.edu.mk</a>	AS5379	Connected	• Rectorate	• 10 Gbit



# Implementation details (3)

- Software implementation – based on existing Moodle based LMS

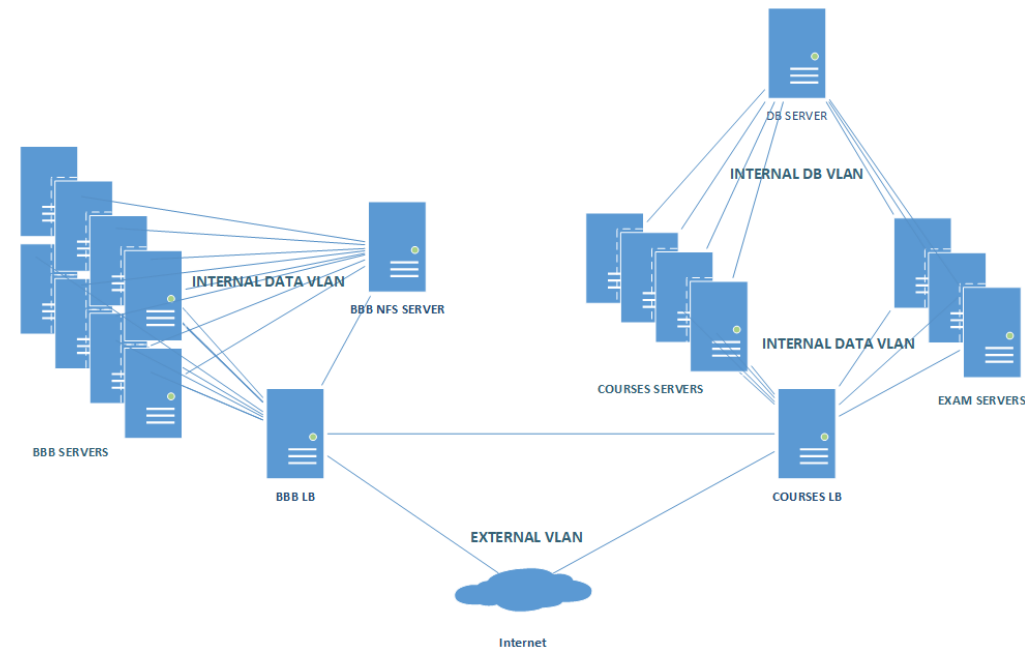
How to scale the system in order to be able to perform the task at hand?

After some testing this is the final platform setup which we use now:

- Course learning platform using 3 front end nodes
- Course exam platform using 4 front end nodes
- Database server for course learning and course exam platforms
- Load balancer virtual machine serving both course learning and exam clusters to end users
- Big Blue Button web conference platform composed of 8 web conference front end nodes, one NFS storage and special BBB load balancing machine.

Network separation was done in the platform:

- External VLAN for load balancers serving content from course and web conference platforms to all users
- Internal VLAN for exchanging data between load balancers and application servers
- Another internal VLAN for database access between database server and application servers

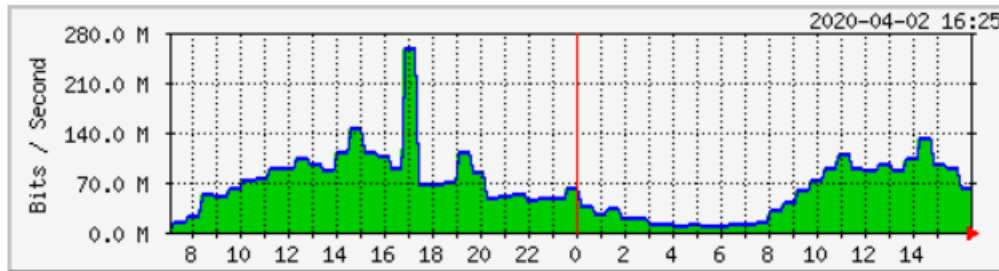




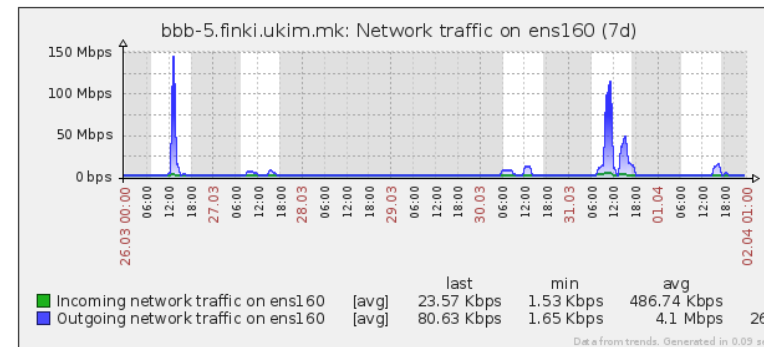
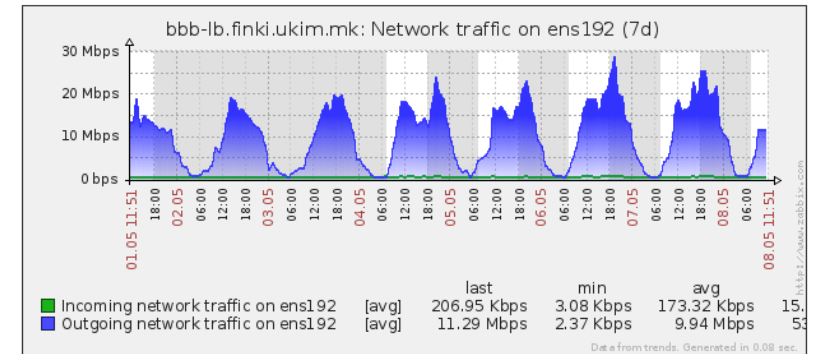
# Infrastructure stats

- Traffic depends on the classes and number of students in the classes
- The system was working as expected with most of the reported problems on the end user side

## IXP.mk Aggregate Traffic



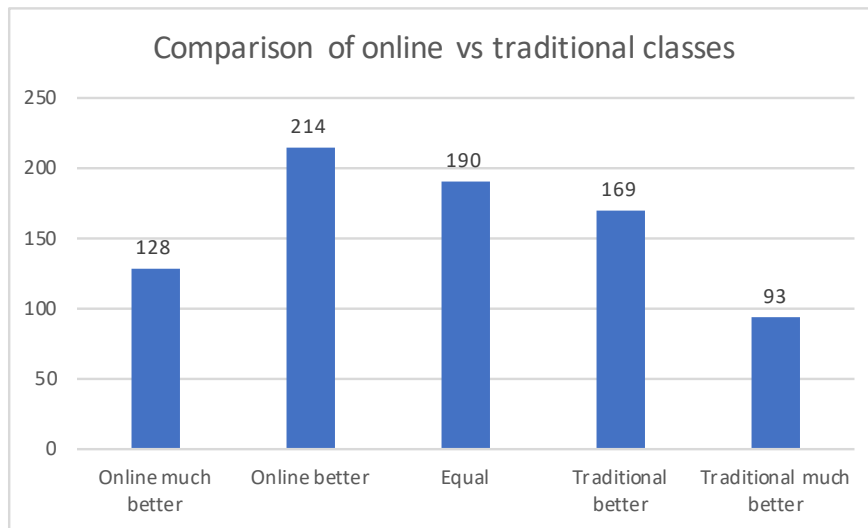
	Max	Average	Current
In	254.821 Mbits	64.264 Mbits	58.818 Mbits
Out	254.809 Mbits	64.268 Mbits	58.835 Mbits



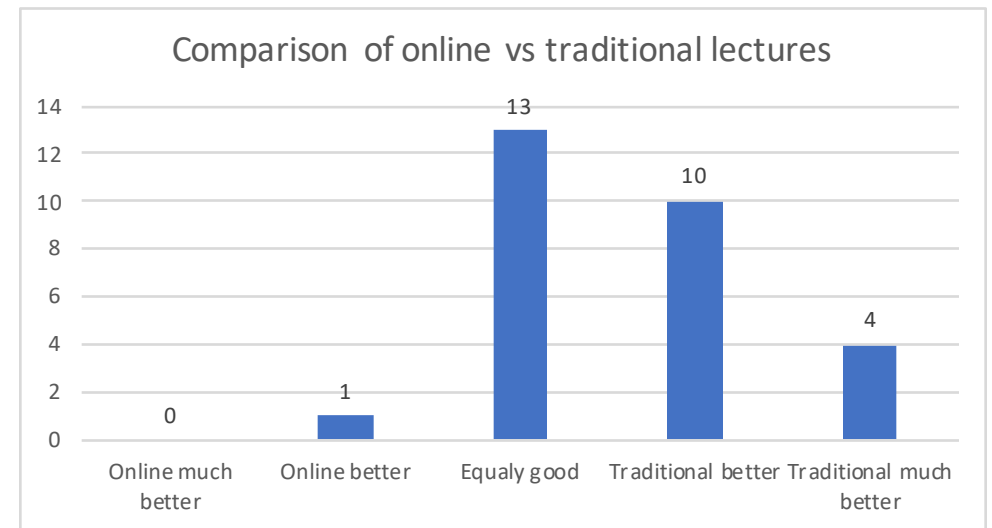


# Student VS Teachers comparison of online and traditional classes

- Students



- Teachers







# Conclusion

- FCSE fully restarted the classes on 17.03.2020 with several classes being experimentally held in the previous period.
- Both students and teachers are generally satisfied with the online classes.
- Older students prefer online lectures rather than traditional ones while teachers mainly prefer traditional lectures based on the initial surveys.
- Additional surveys are planned after the end of the semester and additional research is planned after the results from the exams to further evaluate online education and compare it with the traditional one.