Comparative Analysis of Videoconferencing Systems (revised version)

Experts of the EU Project *Pravo-Justice*:

Ivan Sherstyuk

Nataliia Kovalko

May 2020

Content

Introduction to the revised version of the analysis

A previous version of the comparative analysis, published in early May 2020, sparked a lively discussion. Most often, attention was paid to the list of selected evaluation criteria and the list of analysed systems.

It should be noted that from the very beginning the comparative analysis was planned as a purely technical document, which was to reflect the disadvantages and advantages of certain videoconferencing systems. Taking into account the feedback and public interest, it was decided to refine this analysis.

In particular, in order to ensure a complete and objective study, two systems (Microsoft Teams and TrueConf) and a number of additional criteria were added to the subject of analysis.

Introduction

In connection with the spréad of coronavirus in Ukraine, the Verkhovna Rada of Ukraine introduced legislative amendments to prevent the closure of courts due to the spread of COVID-19. In particular, *on April 2, the Law of Ukraine "On Amendments to Certain Legislative Acts of Ukraine Aimed at Providing Additional Social and Economic Guarantees in Connection with the Spread of Coronavirus Disease (COVID-19)" of March 30, 2020 № 540-IX, entered into force.* It amended the procedural codes regarding the possibility to participate, during the quarantine, in court hearings by way of videoconference while staying outside the court premises and using one's own technical means. The amendments also stipulate that identity of a party to the case shall be confirmed by applying an electronic signature; if a person does not have such a signature, it should be done in the manner envisaged in the Law of Ukraine "On the Unified State Demographic Register and Documents Proving Ukrainian Citizenship, Identity, or Special Status", or y the State Judicial Administration of Ukraine (hereinafter – SJA).

At the same time, in practice, these innovations have raised many questions, including relating to a software that can be used for court hearings by videoconference.

On April 8, 2020, the SJA Order No. 169 *"On Approval of the Procedure of Use of Video Conferencing Means at Court Sessions in Administrative, Civil, and Commercial Proceedings with Parties Staying Outside the Court"* has stipulated that courts shall use EasyCon system for videoconferencing during court hearings. The SJA did not advise to the courts using any other programmes. In The SJA's decision raised doubts relating in particular to the possible monopolisation by the EasyCon system. That was due to the fact that there were a number of other similar systems that could be used by courts to conduct court hearings by videoconference, such as Zoom, Skype, Webex Meetings etc.

On April 23, 2020, the SJA amended the above procedure by issuing another order which removed the word *EasyCon* from the order and provided for the possibility to use other systems for conducting court hearings by videoconference.

The lack of clear approach to resolving this issue has brought about confusion among the courts. Some courts have started holding court hearings by way of getting the participants connected via Skype and Zoom, while others believe the use of these systems be unacceptable.

A comparative analysis of the following videoconferencing systems has been carried out at the request of the Chairman of the Working Group of the Verkhovna Rada of Ukraine on Digitalisation of Justice and Related Legal Institutions in Ukraine.

Evaluated systems:

1. **EasyCon** – a system promoted by the State Enterprise "Judicial Services Centre" (hereinafter - SE "JSC") and SJA;
2. **Zoom** – a widely used videoconferencing system, both for personal and business use;
3. **Skype** – a well-known program for communication and calls;
4. **Webex Meetings** – system for videoconferencing in the corporate sector;
5. **Microsoft Teams** – system for group work from Microsoft as a part of Office 365;
6. **TrueConf** – videoconferencing system used in the courts of Ukraine in criminal proceedings.

The analysis was carried out in terms of ease of use and moderation, as well as a number of technical criteria.

Testing process

In order to obtain objective results, each system was tested in conditions which were as close as possible to real life:

- April 22, 2020 – EasyCon system tested on the basis of the Administrative Cassation Court under the Supreme Court;
- April 24, 2020 – Zoom system tested on the basis of the Dnipropetrovsk District Administrative Court;
- April 27, 2020 – Skype tested on the basis of the Economic Court of the city of Kyiv;
- April 27, 2020 – EasyCon system tested on the basis of SJA;
- April 30, 2020 – Webex Meetings tested on the basis of the EU Project Pravo-Justice.
- May 21, 2020 – Microsoft Teams and TrueConf tested on the basis of the EU Project Pravo-Justice;
- May 22, 2020 – EasyCon system tested on the basis of the Administrative Cassation Court under the Supreme Court.

We would like to express our gratitude to the judges, employees of these courts and the company "Special recording systems" for assistance in organising testing and analysis preparation.

Methodology and evaluation criteria

A free version of Little Snitch for Mac was used to evaluate the load of communication channels.

The average value of the channel load means the default value, which remained unchanged most of the time*.*

The peak value of the channel load means the maximum value obtained, which was repeated at least several times during the videoconference.

A 2 GHz Dual-Core Intel Core i7, 8GB RAM computer was used to estimate the load on the client equipment.

The service www.speedtest.net was used to estimate the bandwidth of the channel.

The testing took place with the participation of 5-10 people who used both computers and mobile devices with a connection to WIFI and 4G network.

Geography of participants - Ukraine and Estonia.

To obtain quantitative characteristics of the assessment, the following score scale was used:
   0 – no functionality or does not comply with the law;
   1 – functionality at the initial level or partially comply with the law;
   2 – functionality works or complies with the law, but there is room for improvement;
   3 – everything works properly and complies with the law.

The evaluation results are shown in the table below.

Comparative table

Criteria	EasyCon	Zoom	Skype	Webex Meetings	Microsoft Teams	TrueConf
Procedural items						
Initiation of videoconference	1	3	1	3	2	2
Connection of participant	1	3	2	3	3	2
Identification of participant	3	2	2	2	2	2
Moderation of videoconference	2	3	1	3	2	3
Open streaming of hearing	0	2	0	3	1	3
Handing of documents	3	3	3	3	3	3
Ukrainian language interface	3	2	3	2	3	3
Chat	0	3	3	3	3	3
Screen sharing	0	3	3	3	3	3
Simultaneous interpretation	1	2	1	1	1	1
Technical items						
Requirements to communication channels	1	3	3	2	3	2
Requirements to equipment	1	3	3	2	1	3
Quality of audio and video	2	3	2	2	2	3
Usability of interface	1	3	2	3	3	2
Security	1	1	1	3	1	1
Compliance with GDPR	1	3	3	3	3	2
Positive expert opinion of the SSSCIP[1]	0	0	0	0	3	0
Assignment of usage rights	3	1	1	1	1	1
Technical support	3	1	0	3	3	3
Total:	**27**	**44**	**34**	**45**	**43**	**42**

---

[1] State Service of Special Communication and Information Protection of Ukraine

Estimated cost of implementation

It is currently impossible to make a correct calculation of the cost of implementation of each of the systems. First of all, this is due to the fact that to build a system "Enterprise" level, which is definitely a system of videoconferencing in the courts of Ukraine, each supplier has individual approaches to building a solution and calculating the cost of its implementation and maintenance. There is also no information on technical aspects – how exactly the SJA plans to build the architecture of the videoconferencing system throughout Ukraine.

Therefore, for Zoom, Webex Meetings and Microsoft Teams, the cost is estimated on the basis of monthly tariff plans. TrueConf has perpetual licenses, with no time limit, and in the case of EasyCon, where the ownership of the product already belongs to the SE "JSC", the cost was estimated on the basis of salaries of employees who will further develop and maintain the system.

Initial data:
- Number of courtrooms equipped with a fixation system: 2199
- Number of judges in the staff: 6749
- How many years the system will work: 10
- Number of employees required to develop and maintain the system: 15
- The average salary of an employee: 2000 USD / month
- Simultaneous use of videoconferencing in courtrooms: 50%
- Cross-rate: 1 USD = 27 UAH, 1 EUR = 30 UAH.

Comparative table (in UAH million):

EasyCon	*Zoom*	*Skype*	*Webex Meetings*	*Microsoft Teams*	*TrueConf*
97.2	53.4	0	50.9	42.7	21.3

Argument:

1. **EasyCon** – 10 years * 12 months * 15 employees * 2000USD * UAH 27 = UAH 97.2 million.
2. **Zoom** – 10 years * 12 months * 2199 courtrooms * 14.99 USD * 27 UAH * 0.5 simultaneous use = UAH 53.4 million.
3. **Skype** – free software, cost = 0.
4. **Webex Meetings** – 10 years * 12 months * 2199 courtrooms * 12.85 EUR * 30 UAH * 0.5 simultaneous use = UAH 50.9 million.
5. **Microsoft Teams** – included in the Microsoft Business 365 package, the version of Microsoft 365 Apps for enterprise is selected for calculation, for which a positive expert opinion of the SSSCIP was received, the cost is: 10 years * 12 months * 2199 courtrooms * 12.00 USD * 27 UAH * 0.5 simultaneous use = UAH 42.7 million.

6. **TrueConf** – SE "ICS" has already purchased 530 perpetual local licenses, it makes sense to calculate the estimated cost for such a configuration. Cost: (6749 judges + 2199 court secretaries) * 0.5 simultaneous use - 530 previously purchased licenses) * (UAH 4,500 cost of one license + 20% support cost) = UAH 21.3 million

The results of the analysis

EasyCon – 27 scores

- **Flaws:** the required functionality is either completely missing or at a very initial stage, the biggest problems are relating to the technical aspect of EasyCon, which is very demanding on communication channels and equipment. The highest estimated cost of development and support.
- **Pros:** property rights belong to SE "JSC"
- **Summary:** EasyCon contains risks of unsuccessful implementation within the UJITS.

Zoom – 44 scores

- **Flaws:** lack of local support and almost zero probability that Zoom will submit documents for examination to the SSSCIP.
- **Pros:** all components of video conferencing work well, with minimal traffic and hardware requirements.
- **Summary:** the best tool for videoconferencing, subject to adaptation to information systems security legislation

Skype – 34 scores

- **Flaws:** initial videoconferencing moderation functionality and no functionality for streaming of the meeting.
- **Pros:** has decent functionality for videoconferencing, high performance from the technical standpoint.
- **Summary:** suitable only as a short-term solution for a decentralized organization of remote justice.

Webex Meetings – 45 scores

- **Flaws:** increased load on communication channels and client equipment.
- **Pros:** all components of videoconferencing work well.
- **Summary:** suitable for industrial implementation within the UJITS.

Microsoft Teams – 43 scores

- **Flaws:** lack of ability to easily organise a streaming of the court hearing, quite demanding on client equipment.
- **Pros:** the functionality of videoconferencing is convenient and clear.

- **Summary:** Microsoft Teams is a full-fledged teamwork tool in which videoconferencing is just one of a large set of interconnected features. It does not seem possible to technically integrate Microsoft Teams into UJITS. It would be faster to build an UJITS e-cabinet based on Microsoft Teams and related Microsoft products.

TrueConf – 42 scores

- **Flaws:** non-optimal load on communication channels.
- **Pros:** a quality videoconferencing system, available experience of implementation in other large projects (only in Ukraine - courts, Ministry of Internal Affairs, Ministry of Health) and the lowest estimated cost of implementation.
- **Summary:** suitable for industrial implementation within the UJITS subject to controlled operation in the local network.

Detailed review

Initiation of videoconference

All systems cope with this task, Skype and EasyCon have the lowest score, because they do not allow you to schedule a videoconference, just immediate scheduling.

Zoom and Webex Meetings also have the function of setting a password for access to a videoconference and allow administering participants during the connection.

In Microsoft Teams each participant must be invited personally, in TrueConf there is no possibility to set a password for guest access.

Connection of participant

EasyCon is the most inconvenient in these terms. The participant must log in to the system, open certain page of the website and wait until invited to participate. The videoconference does not have either notification or ID.

Only EasyCon does not have mobile applications and works only through a browser. An error occurs in the mobile phone when trying to configure the equipment.

Microsoft Teams, Zoom, Webex Meetings and TrueConf do not require mandatory registration. The invitation link to participate is sent to the mail and it can be added to the calendar.

In Skype, when you follow the videoconference link, the chat is automatically downloaded. To use the video you need to manually press the "Call" button, which is not very convenient.

During the EasyCon and TrueConf tests, there were technical problems with the hardware setup, the microphone and / or camera did not work.

Identification of participants

Only EasyCon allows identification of participants through QES; the rest of the systems only by direct link to the videoconference. It is deemed as an advantage of EasyCon, but at the same time:

1. The videoconferencing system is an integral part of UJITS and a component of the Unified Contact Centre of the Judiciary of Ukraine. User authorisation is available in the UJITS e-cabinet which requires mandatory application of QES. Therefore, in the framework of UJITS, QES-based authorisation in the videoconferencing system is redundant.

THIS PROJECT IS FUNDED BY
THE EUROPEAN UNION

Justice
Coopération
Internationale

EXPERTISE
FRANCE

CPVA · CENTRAL PROJECT
MANAGEMENT
AGENCY

PRAVO-JUSTICE

2. QES may be used to sign documents submitted to the court during the court hearing. The only existing multipurpose and free-of-charge way of signing and verifying a document with QES is to do so through the Central Certification Authority of the Ministry of Digital Transformation of Ukraine. It is possible to integrate this functionality with other systems, which would require additional funding to refine the EasyCon system.

Moderation of videoconference

EasyCon facilitates the moderator to invite a participant to speak or stop his/her speech. In such case, the participant will continue participating in the videoconference with no possibility to switch on his audio or video.

Zoom, Webex Meetings and TrueConf provide a full-scale moderation functionality, including remote command of participants' audio and video.

Since the end of May 2020, Skype has introduced the possibility of videoconferencing moderation at the initial level.

In Microsoft Teams, during a videoconference, the moderator can only mute the sound, but the participant can turn it back on.

Open streaming of hearing

Zoom, Webex Meetings and TrueConf allow streaming meetings in real time on Youtube.

Speaking of the inconveniences: each time Zoom generates a new link to Youtube stream, and does not allow copying it to the clipboard.

EasyCon and Skype do not have built-in functionality to stream on Youtube.

Microsoft Teams has its own module for organising online streaming, but it is not suitable for online streaminf of court hearings. Microsoft Teams does not have a simple feature for streaming a videoconference on Youtube.

Handing of documents

All systems have a functionality to exchange documents during videoconferencing. In EasyCon, this feature appeared in May 2020.

Ukrainian language interface

TrueConf, Microsoft Teams, Skype and EasyCon have a full Ukrainian-language interface.

Zoom and Webex Meetings are in Russian.

Chat

All systems, except EasyCon, provide the possibility of text communication during the videoconference.

Screen sharing

All systems except EasyCon provide screen sharing.

Interpretation

Simultaneous interpretation is implemented only in Zoom, as a separate audio stream.

Other systems allow organising consecutive interpretation, involving an interpreter as another participant in the videoconference.

Requirements to communication channels

In order to measure of the communication channel load, a special programme-traffic analyser was used; it showed the following average values:

System	Speed, Mbit / s
Zoom	1.2
Skype	1.2
Microsoft Teams	2
Webex Meetings	2.8
TrueConf	3.6
EasyCon	6.4

For comparison:

- the bandwidth of the communication channel of a typical court is 100-300 Mbit / s
- 4G network in Kyiv indoors shows the result from 2 to 12 Mbit / s

EasyCon turned out to be the most "demanding" towards communication channels with requiring 6.4 Mbit / s for a videoconference with 5 participants, and the peak value for videoconferencing with 6 participants was 16 Mbit / s.

Other systems for videoconferencing with 8-10 participants used 2-4 times less bandwidth, without significant peak deviations.

This is due to the following technical points:

This can be explained with the following technical aspects:

1. EasyCon is the only programme on the list that does not use server-side stream optimisation, all encoding/decoding processes take place solely on the client side using common WebRTC technology. While the EasyCon server serves only as a router.

   In practice, this means that more people participate in a videoconference, greater bandwidth of each participant should be. In fact, each participant will receive *n-1* separate stream, where *n* is the number of participants to the videoconference, and then decodes them locally putting load on his/her own computer.

2. EasyCon is the only programme on the list which, as we observed, does not use Scalable Video Coding (SVC) technology, which constantly analyses the bandwidth of each participant's channel and the load on the local hardware during a real-time videoconference. The quality of the video stream is individually adjusted for each participant.

Among other systems, Zoom proved to be the most reliable and user-friendly. For undetected reasons, Webex Meetings constantly adjusted the video stream, which damaged the video quality for some participants while the sound always remained good. TrueConf and Microsoft Teams worked without delays.

Requirements to equipment

As already mentioned above EasyCon is the only system putting the maximum load on the client equipment. While tested, that was reflected in the following quantitative indicators:

System	Load (max 200% CPU)
TrueConf	40
Zoom	50
Skype	60
Webex Meetings	80
Microsoft Teams	130
EasyCon	180

EasyCon has almost completely loaded both available processors; the computer became hot and started buzzing. The other systems gave 2-3 times less load for the reasons clarified and described above in the section "Requirements to communication channels".

Microsoft Teams also significantly loaded the computer, the rest of the systems worked without any significant load.

It is worth noting that EasyCon was tested on twice fewer participants than other systems. Thus, the number of participants is critical for EasyCon due to the peculiarities of architecture and communication channel bandwidth use.

Quality of audio and video

All systems coped with the task, except for EasyCon when tested with 10 participants. Zoom and TrueConf turned out to be the best and smoothest.

Usability of interface

The most user-friendly interface is offered by Zoom, the visual elements are placed in intuitive places.

Skype has a standard interface that all users are used to.

Webex Meetings and Microsoft Teams are similar to Zoom.

TrueConf looks complicated at first glance and needs to get used to. Mobile applications use an atypical set of icons.

EasyCon seems to be the least comfortable. In full screen mode, EasyCon allows displaying only the first 4 participants.

Security

All systems work through https using standard TLS encryption.

Only Webex Meetings has the option of end-to-end encryption of video conferencing.

However, there are some sensitive security issues with Zoom. There is quite a lot of information available on the Internet about the vulnerability of the Zoom system. In particular, perpetrators would steal users' personal data, which are then leaked into public access. Personal information includes users' email addresses, passwords, personal chat URLs, and a six-digit administrator PIN that allows one to manage a video conferencing in Zoom.

Compliance with GDPR

Regulation (EU) 2016/679 of the European Parliament and of the Council on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (hereinafter GDPR) was approved on 27 April 2016 and entered into force on 25 May 2018. GDPR aims to strengthen the rights of data subjects in the digital environment in order to increase the level of control of individuals over their personal data.

GDPR sets out general principles to be followed in any context of the processing of personal data and contains provisions on the types of safeguards to be implemented to

ensure an adequate level of security in the transfer and processing of personal data, including:
- pseudonymization and encryption of personal data;
- the ability to continuously ensure the confidentiality, integrity, availability and stability of processing systems and services;
- the ability to timely restore access to personal data in case of a technical malfunction of the equipment;
- the procedure for regular testing, evaluation and analysis of the effectiveness of technical and organisational measures to ensure data protection during processing.

During the research on the compliance of videoconferencing systems with the requirements for personal data protection established in accordance with the GDPR, the following should be noted::
- Webex Meetings, Microsoft Teams, Zoom and Skype videoconferencing systems have implemented appropriate technical and organisational measures and the data of videoconferencing systems comply with the rules and requirements of the GDPR.
- information on the compliance of the TrueConf videoconferencing system with the GDPR is not available in official sources. However, it should be noted that on the official TrueConf website you can find the privacy policy, which provides the user with information about the types of personal data collected, purposes of using such personal data, security measures to protect personal data, conditions of access to personal data.
- information on the compliance of the EasyCon videoconferencing system with the GDPR is not available in official sources. Also, there is no information on the privacy policy of this system. Although, it should be noted that when registering in the system there is a request for consent to personal data processing.

Positive expert opinion of the SSSCIP[2]

According to the list of means of technical protection of the information allowed for maintenance of technical protection of the state information resources and the information concerning which protection is established by the law, and information posted on the website of SSSCIP, the following software packages which allow deploying a full-fledged web conferencing system have the positive expert opinion of the SSSCIP in the field of technical or cryptographic protection of information:

– Cisco Unified Communications Manager 12x, manufactured by Cisco Systems Inc. (USA) - opinion №921, valid until December 28, 2021;
– Microsoft Office 365 Professional Plus software product manufactured by Microsoft Corporation (USA), opinion №1024, valid until February 19, 2022, which includes Microsoft Teams.

---

[2] State Service of Special Communication and Information Protection of Ukraine

The rest of the systems, according to the available information, did not apply to the SSSCIP for certification.

Assignment of usage rights

In April 2020, SE "ICS" transferred the EasyCon system from its balance sheet to SE "JSC". For other videoconferencing systems, only the assignment of the sublicense right to use the copyright and related rights is possible.

Technical support

EasyCon is supported by SE "JSC" employees. Webex Meetings, Microsoft Teams and TrueConf have offices in Ukraine with the ability to provide appropriate technical support.

Zoom provides only remote support, Skype does not have customer support.

Conclusions

1. In the short term, in order to promptly give remote access to justice, it is advisable to use the available free solutions: Zoom, Skype, Microsoft Teams or Webex Meetings, with the reservations expressed by the experts in the above analysis.

2. EasyCon is currently a non-competitive and non-commercial product. Finalising EasyCon will take some time and money.

3. Given the current situation and time needed to develop a product which would be ready-for commercial implementation, it should be expected that the solutions suggested in paragraph 1 may be applied for up to 1 year.

Annex

Background information
about the videoconferencing systems analysed

EasyCon

It is difficult to find information on the name of the organisation that has developed and maintains this software product on the system`s website. The contact page, at the time of preparation of this analysis, contains only references to physical address, e-mail and telephone number. Information on the website owners is not publicly available.

At the address indicated on the website of the video conferencing, EasyCon Group LLC is registered, which according to the state registers was established on March 13, 2020, i.e. the day after the introduction of quarantine (under the resolution of the Cabinet of Ministers No. 211 "On Prevention of Propagation of Respiratory Disease COVID-19 Caused by Coronavirus SARS-CoV-2").

According to the State Register of Certificates of Ukraine on Signs for Goods and Services, the rights to the EasyCon name and logo belong to Ivolga-2 LLC, which previously set up the computer programme EASYCON-VP (a web-based video conferencing service for inmates) to be used by the SE "Information Court Systems". Ivolga-2 LLC is currently owned by Catepoint Production Ltd. (Virgin Islands).

The license on the EasyCon program in 2016 was obtained by the SE "Information Court Systems" from Quanta Leasing Company LLC as debt repayment and penalties for late execution of the agreement on termination of the financial leasing agreement dated December 24, 2013. The license for the rights and obligations was issued by the mentioned Ivolga-2 LLC as the owner of the intellectual property rights to the state enterprise. The license price was UAH 1.93 million. The license does not provide the right to make any changes to the programme files. That is, the author, developer of this product, may limit the list of persons who will have the right to improve it.

In April 2020, the State Enterprise "Information Court Systems" transferred the EasyCon system from its balance sheet to the State Enterprise "Judicial Services Centre".

Zoom

Zoom was founded in 2011 by an engineer of Cisco Systems, a division of WebEx, formerly vice president for collaboration software development at Cisco. The company is headquartered in San Jose, California.

Anyone who has an account can organise a meeting. A free account allows for 40 minutes of videoconferencing, but for the period of the coronavirus pandemic, the service has removed

this restriction. You can use your current Facebook account to log in to Zoom. You can also link your Google Account to the Zoom platform.

Anyone with a link or videoconferencing ID can join the videoconference. One can plan an event in advance, as well as generate a recurring link.

The platform is available for Windows, MacOS, Android, and iOS; it has a plugin that allows using Zoom in Google Chrome and Mozilla Firefox.

Following the theft of Zoom user data, the UK intelligence services advised the Government and Parliament not to use the Zoom videoconferencing service for confidential conversations due to fears that it might be vulnerable to surveillance. The British National Cyber Security Centre (NCSC) has warned Parliament that Zoom can only be used for public activities.

SpaceX, NASA, and Google have banned their employees from using the programme for videoconferencing. Other large companies, including Daimler, Ericsson, NXP Semiconductors, and Bank of America, have also banned their employees from using Zoom.

Skype

Skype is a proprietary software for VoIP Internet telephony created by two entrepreneurs Niklas Zennström and Janus Friis, in collaboration with Estonians who developed a backend that was also used in the Kazaa file-sharing application. Since 2011, Skype has been owned by Microsoft. The headquarters is located in the United States, Redmond, Washington.

Skype users make phone and video calls through their computers using Skype software and the Internet. The system is based on free-of-charge communication among Skype software users. The product also allows Skype users to connect with regular landline or mobile phone subscribers. This software is now available for free and can be downloaded from the company's website.

Skype raises a lot of security-relating issues. In particular, there is information on the Internet that Microsoft contractors can wiretap Skype conversations of users which get translated through the built-in interpreter. Also, Skype users have repeatedly complained about failures in the application operation, namely failure to log in, failure to receive messages and voice calls.

Webex Meetings

Webex was founded in 1995 by Subrah Iyar and Min Zhu. In 2007, Webex was acquired by Cisco Systems. Today, the headquarters is located in Milpitas, California.

With Webex Meetings, one can conduct interactive and large-scale online conferences: from meetings and presentations up to trainings.

Video conferences can be recorded and subsequently saved on one's own servers.

To use Webex Meetings, one should simply connect to the system from a PC, tablet, or smartphone. It supports audio conferencing via both VoIP and regular phone. It is integrated with MS Office and some messengers.

The program has functions for noise reduction and automatic focusing of camera on the speaker. Participants who do not have Webex Meetings installed can still join the conversation. To do this, one just needs to share a link to one's personal online chat room on the Webex site with such a person. The person will just need to enter the password specified in the mail.

The platform easily integrates with mail, Google Calendar, Skype, Slack, and other applications.

The use of the Webex Meeting videoconferencing platform has recently quadrupled in Europe and increased by 3.5 times in the Asia-Pacific region. Over the past two weeks, the platform has been hosting more than 22 million video conferences a week.

Microsoft Teams

Microsoft Teams is a team center for Microsoft Office 365 that integrates the users, content, and tools the team needs to work more efficiently. Microsoft Teams was introduced to the market in early 2017.

The application combines everything in a common desktop environment, which includes chat for meetings, file sharing and corporate applications. Designed for smartphones running Android, iOS, Windows Phone and computers running Windows 10 S, Windows 7+ or Mac OS X 10.10+.

Key features in Microsoft Teams:
- collaborative work with files and online discussions, support for remote access to shared documents within the channel;
- individual and collective chats with the mode of text formatting: putting a sign "Importance", highlighting and other options;
- transition between workspaces;
- connection of reports from Power BI;
- organisation of web conferences with the possibility of screen sharing;
- viewing the history of communication;
- quick search in personal and group chats, search by name or e-mail address;
- archiving conversations;
- notification of receiving a message or a mention in the chat;
- connection of additional functions and services;
- record webcasts.

In 2020, Microsoft CEO Satya Nadella presented the corporation's quarterly report, which states that in April, more than 200 million people participated in online meetings in Microsoft Teams every day. They spent more than 4.1 billion minutes in negotiations. Microsoft Teams

has more than 75 million active users each day, and two-thirds of them share files or collaborate on them in Microsoft Teams. More than 183,000 educational institutions around the world use Microsoft Teams.

In business, 20 organizations with more than 100,000 employees use Microsoft Teams, including Continental, Ernst & Young, Pfizer and SAP.

In May 2020, Abnormal Security reported that between 15,000 and 50,000 users received emails as part of a phishing attack. The company stressed that because Microsoft Teams is directly linked to Office 365, the successful theft of data to log in to the Microsoft Teams account allows full access to Office 365. Microsoft reports that the vulnerability identified by experts has already been fixed.

TrueConf

TrueConf is a Russian company that produces software for videoconferencing and collaboration, as well as solutions for integrating video communication into telemedicine systems, video kiosks, ATMs and third-party programs. The company is headquartered in Moscow, has an official representative office in Ukraine.

Even before the introduction of the quarantine regime in Ukraine, TrueConf was used in the Ministry of Internal Affairs, the Ministry of Health and in the courts of Ukraine in criminal proceedings.