Y. MYKHAYLICHENKO, O. DERKACH, I. VOLOVYK
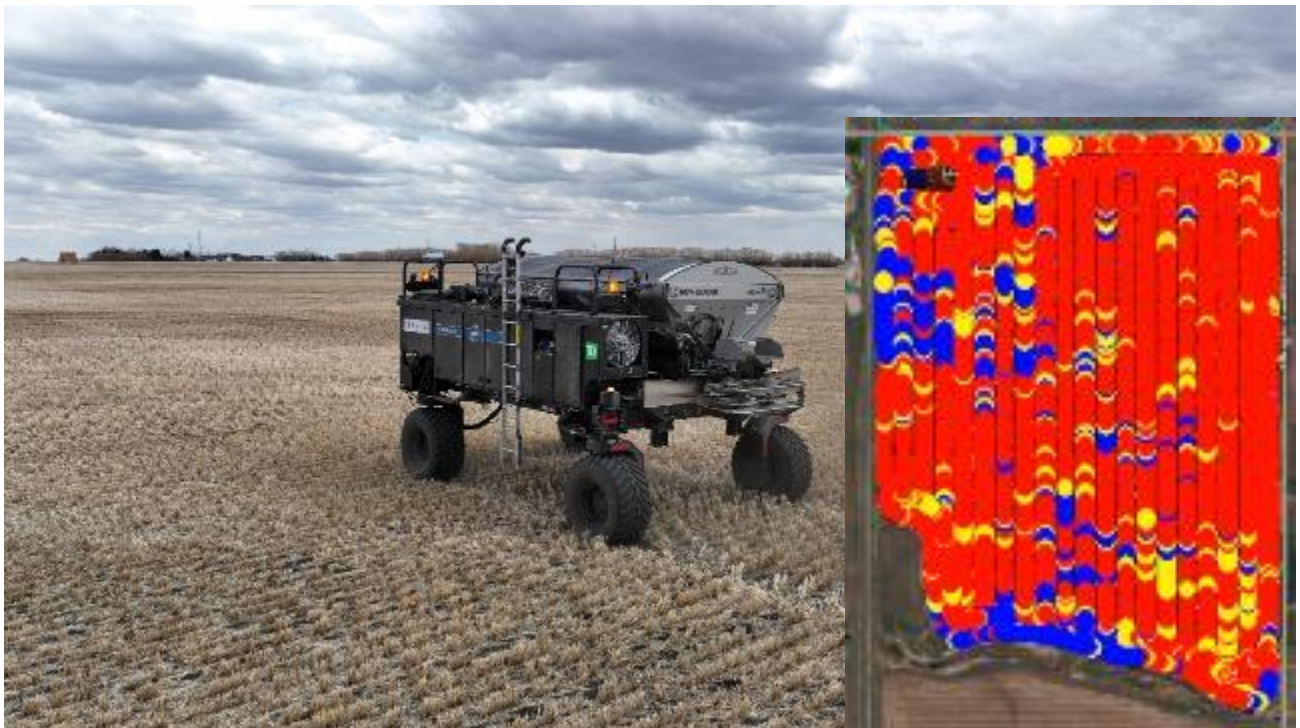
DIGITAL FARMING

TUTORIAL

УДК 631:2:5.004:9.65

Рекомендовано до друку вченою радою Дніпровського державного аграрно-економічного університету

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MYKHAYLICHENKO Y., DERKACH O., VOLOVYK I.

Digital Farming: tutorial. Дніпро: Журфонд, 2023. 103 р.

Навчальний посібник «Digital Farming» з вибіркової навчальної дисципліни «Технології цифрового землеробства» для здобувачів другого (магістерського), рівня вищої освіти спеціальності 208 АгроінженеріяОПП «Агроінженерія».

Розглянуто на засіданні кафедри експлуатації машинно-тракторного парку

Протокол №º 04 від 27 листопада_ 2023 року

Схвалено науково-методичною радою інженерно-технологічного університету

Протокол №º 3 від 27 листопада 2023 року

CONTENT

ВСТУП

Навчальний посібник «Digital Farming» написаний англійською мовою і призначений для здобувачів вищої освіти другого (магістерського) рівня за спеціальністю 208 Агроінженерія, освітньо-професійної програми «Агроінженерія». Матеріал посібника розкриває принципи роботи, методи використання і основні рішення, що стосуються машин і обладнання в технологіях цифрового землеробства. Наведено економічні аспекти при застосуванні розглянутих техніко-технологічних рішень.

Посібник включає 8 тем, має інтерактивні посилання на візуалізацію навчального матеріалу у вигляді QR-кодів та гіперпосилань. В кінці кожної теми розміщені тести для самоперевірки, контрольні питання та корисні посилання.

Зміст посібника безумовно актуальний тому, що підвищення ефективності використання машин у рослинництві сьогодні є можливим тільки у разі застосування сучасних навігаційних систем, софтів для точного та цифрового землеробства у вигляді веб-версій і мобільних застосунків. Також залучається додаткове обладнання, як от монітори для паралельного водіння, GPS-, GMS- та GNSS-антени та супутнє устаткування.

Сьогодні аграрії України застосовують разом із традиційними технологіями землеробства і такі як Mini-Till, No-Till, Drill-Till, Strip-Till, Controll-Traffic та нові інші технології. Також має місце і поєднання декількох технологій в межах одного агропідприємства. Як правило, технології ефективно адаптуються до умов землеробства в Україні і навіть до умов конкретного підприємства.

Щоб отримати високі врожаї при помірних витратах коштів та інших ресурсів (людських, матеріально-технічних) необхідно проводити технологічні операції в максимально стислий (короткий) період. Для дотримання агротехнічних термінів у середніх (100…1000 га) та великих (1000…20000+ га) агропідприємствах використовується потужна і високопродуктивна техніка: трактори John Deere 8335R, John Deere 8345RT, Case IH STX 535/600 Quadtrack та інші; комбайни Case IH 9240, Lexion 770, John Deere 670i; сільськогосподарські машини Horsch Maestro SW 36.50, Turbosem II 19-60, Ecolo-Tiger-730 та багато іншої різноманітної техніки. Щоб ефективно управляти такою продуктивною і складною технікою, оперативно і раціонально керувати виробничими процесами, сьогодні доцільно використовувати різні інтерактивні програми для цифрового землеробства: Cropwise, AFS Connect, PLM Software, JD Operations та інші.

Майбутні фахівці за спеціальністю 208 «Агроінженерія» мають володіти методами підвищення ефективності використання техніки шляхом впровадження елементів цифрового землеробства, дистанційного управління, контролю та моніторингу за роботою техніки, вміти оцінювати виробничі ситуації. Оволодіти цими якостями дозволяє матеріал, представлений в даному курсі лекцій.

Навчальний посібник «Digital Farming» є невід'ємною складовою до навчально-методичного комплексу з вибіркової навчальної дисципліни «Технології

цифрового землеробства» для здобувачів другого (магістерського), рівня вищої освіти спеціальності 208 Агроінженерія.

Викладений матеріал викладений англійською мовою, адаптований для вивчення в умовах дистанційного навчання, з використанням відкритих джерел, так і з використанням виробничого обладнання на філіях кафедри експлуатації машинно-тракторного парку.

TOPIC 1

TELEMETRY (TELEMATICS) INTEGRATION

Agenda

1.1.   Telematics and telemetry
1.2.   How telematics works
1.3.   Telematics: past, present and future

First, students will learn the basic operating principles, installation, and troubleshooting of Telematics (Telemetry). Students will understand the importance of utilizing Telematics in data sharing among farm managers, operators and the farm office. Second, students will learn the economic benefits of utilizing Telematics and communicate to customers. Third, our graduated specialists will easily identify single and multibrand fleets and know how to work with different Telematics producers in the current market and support customers with specific inquiries.

1.1.   Telematics and telemetry

Just like all terms having a Greek root "tele", these both directions imply the remote operations with some object. The difference is that the definition of "Telemetry", being less fuzzy, became a part of everyday life and found its place in our language much earlier, along with the launch of the first ballistic missiles.

Telematics is a science while **telemetry** is the practice
What is Telematics? Video

You Tube link: https://www.youtube.com/watch?v=XYlFdl47Fb4

Telemetry in its restricted sense means a remote acquisition of information about an object, and to its wide extent – control over an object by means of data reception & analysis and transmission of the control commands back to an object.

The term of "Telematics" is rather applicable to the science, particularly to its direction that researches the processes of data interexchange by means of communications. Also relatively associative in the same range look the terms such as, for example, "mathematics" or "Kinematics". Nevertheless the word "telematics" is being more & more frequently used by the manufacturers of equipment that on consumer level uses the communication with distant objects, in cases when the functions composition doesn't allow to refer to the system as to a fully-fledged telemetric one, but it is necessary to apply some scientific tingle to the commodities for the sake of marketing purposes.

Which tasks telematics is able to solve?

Certainly, the knowledge domain related to telematics broadens constantly and the whole systems based on telematic data flows are being established, such as the systems of logistics optimization on the basis of GPS/GLONASS monitoring. But the implementation range and possibilities of such solutions is huge.

What telemetry is capable for?

A full-fledged telemetry system should correspond to at least two criteria: to be able to timely register the whole data flow which can be released by all sensors of the controlled device, and to possess a maximal command set which could be accepted and processed by all controlled elements of the system.

Precision Solutions & Telematics Video.

You Tube link: https://www.youtube.com/watch?v=oB3iKvmqUEw

Info source: Pandora DXL-5000L (5000S)

Explain the principles of operation for Telemetry (telematics).(1 hour)

1.2. How telematics works\

Fleet telematics gathers a range of data using Global Positioning System (GPS) technology, sensors and vehicle engine data to provide fleet operators with the information they need to manage their fleet.

-Global Positioning System (GPS) technology - powers live visibility into vehicle location, speed and movement within points of interest through geofencing.

-Sensors - enable the capture of data on driver activity, including aggressive acceleration, harsh braking and erratic cornering, but sensors can be used to monitor any in-vehicle activity.

-Engine diagnostics - these solutions pull data directly from the in-vehicle diagnostics system and are primarily used to gather real time data on fuel efficiency and vehicle odometer readings that help power digital fleet maintenance solutions.
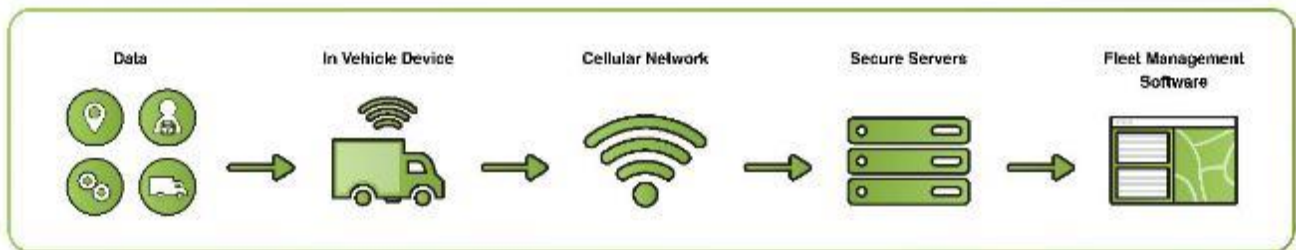

Fig. 1.1. The principle of operation of telematics

The data is temporarily stored in a telematics device that in installed in each vehicle, and is then transmitted over private cellular networks to secure servers. It is this central data hub that enables fleet management software to provide easy-to-understand visualisations that help fleet managers optimise their operation.

1.3. Telematics: past, present and future

Telematics technology developed out of the rapid expansion of the internet from the mid-1990s onwards. The greater availability and practicality of telecommunications technologies that arose in tandem with this expansion also produced new forms of remote communication. Over the years, these developed into what we know recognise as modern telematics systems, and these have been particularly widely adopted over the last decade.

Fleet management programs, such as AFS/PLM Connect, Farmobile, JDLink, now enable farms to manage fleets of all sizes – from a handful of vehicles to hundreds – and help deliver major improvements across the board. Telematics has now developed to the point where it goes well beyond mere dot-on-a-map tracking to incorporate vehicle and driver performance as well as maintenance management.

The growth of telematics technology continues apace. Although the adoption of telematics has already become standard across various industries, the technology itself continues to evolve, and to grow in power and capacities, all the time.

1.3.1. Telematics devices and software

Most commonly, telematics data is collected by a small device installed in the vehicle (or other asset) itself. This collects stores and transmits different types of information relating to the vehicle's performance, condition and usage. There are different types of telematics devices available that offer different functionality and benefits. The most accurate and secure telematics devices are hardwired, these devices offer tamper proof functionality and a wider range of connectivity to peripheral devices.

Telematics devices are often connected to other in-cab driver interfaces that enable drivers to receive jobs, capture proof of delivery and even get real-time feedback on their driving performance.
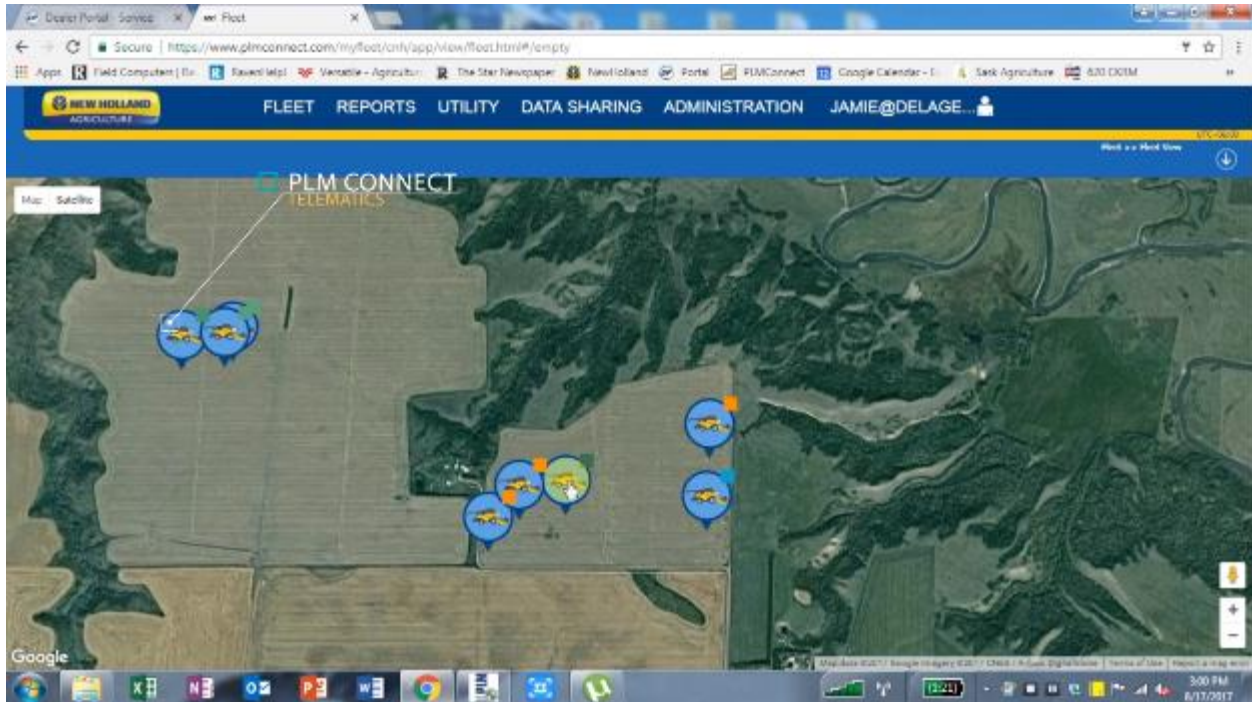

Fig. 1.2. An example of telematics system functioning.

We can see not only the exact location of the equipment, but also carry out diagnostics and monitor the technical condition of the equipment: fuel level, equipment temperature, etc.
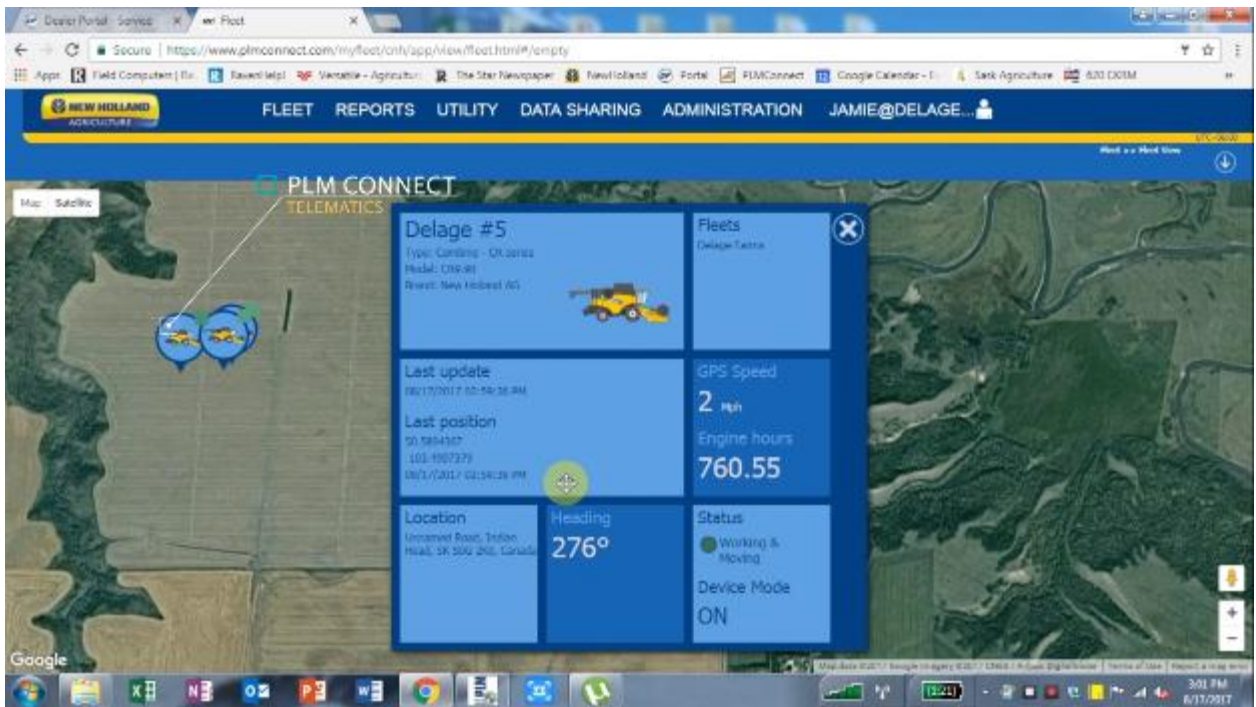
Fig. 1.3. Obtaining basic data on a specific combine in the PLM Connect system.
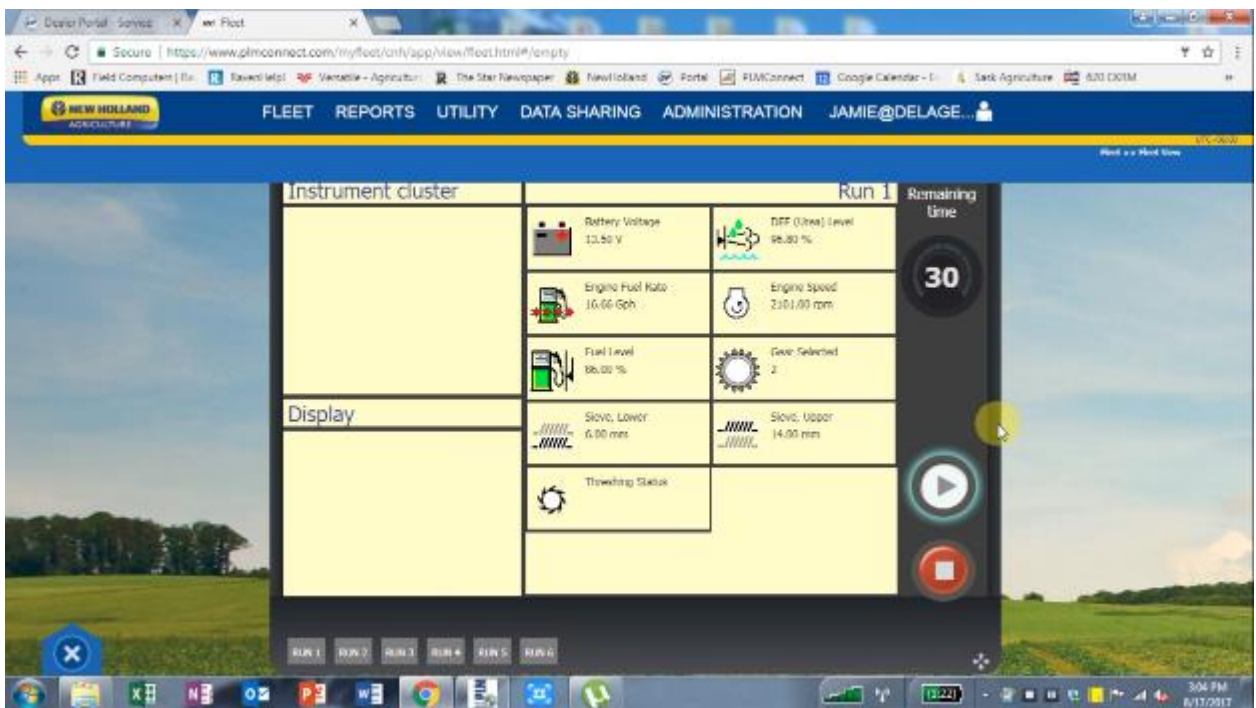

Fig. 1.4. Detailed data on the harvester in the PLM Connect system.

PLM Connect Telematics. Video

You Tube link: https://www.youtube.com/watch?v=vkaaYq14be0

Info source: https://www.teletracnavman.co.nz/resources/resource-library/faqs/what-is-telematics

i.Define GPS (global positioning system) and GNSS (Global Navigation Satellite System).

GNSS stands for **Global Navigation Satellite System**, and is the standard generic term for satellite navigation systems that provide autonomous geo-spatial positioning with global coverage. This term includes e.g. the GPS, GLONASS, Galileo, Beidou and other regional systems. GNSS is a term used worldwide The advantage to having access to multiple satellites is accuracy, redundancy and availability at all times. Though satellite systems don't often fail, if one fails GNSS receivers can pick up signals from other systems. Also if line of sight is obstructed, having access to multiple satellites is also a benefit. Common GNSS Systems are GPS, GLONASS, Galileo, Beidou, IRNSS and other regional systems.

1.   What is GNSS and how does it work? Video

You Tube link: https://www.youtube.com/watch?v=CCKisghkcA4

The **Global Positioning System (GPS)**, originally NAVSTAR GPS, is a satellite-based radio navigation system owned by the United States government and operated by the United States Air Force. GPS is a satellite navigation system used to determine the ground position of an object. GPS technology was first used by the United States military in the 1960s and expanded into civilian use over the next few decades. Today, GPS receivers are included in many commercial products, such as automobiles, smartphones, exercise watches, and GIS devices.

The GPS system includes 24 satellites deployed in space about 12,000 miles (19,300 kilometers) above the earth's surface. They orbit the Earth once every 12 hours at an extremely fast pace of roughly 7,000 miles per hour (11,200 kilometers per hour). The satellites are evenly spread out so that four satellites are accessible via direct line-of-sight from anywhere on the globe.

Each GPS satellite broadcasts a message that includes the satellite's current position, orbit, and exact time. A GPS receiver combines the broadcasts from multiple satellites to calculate its exact position using a process called triangulation. Three satellites are required in order to determine a receiver's location, though a connection to four satellites is ideal since it provides greater accuracy.

In order for a GPS device to work correctly, it must first establish a connection to the required number of satellites. This process can take anywhere from a few seconds to a few minutes, depending on the strength of the receiver. For example, a car's GPS unit will typically establish a GPS connection faster than the receiver in a watch or smartphone. Most GPS devices also use some type of location caching to speed up GPS detection. By memorizing its previous location, a GPS device can quickly determine what satellites will be available the next time it scans for a GPS signal.

NOTE: Since GPS receivers require a relatively unobstructed path to space, GPS technology is not ideal for indoor use. Therefore, smartphones, tablets, and other mobile devices often use other means to determine location, such as nearby cell towers and public Wi-Fi signals. This technology, sometimes referred to as the local positioning system (LPS), is often used to supplement GPS when a consistent satellite connection is unavailable.

2. How GPS works today? Video.

You Tube link: https://www.youtube.com/watch?v=wCcARVbL_Dk.

3. How does GPS work? Video.

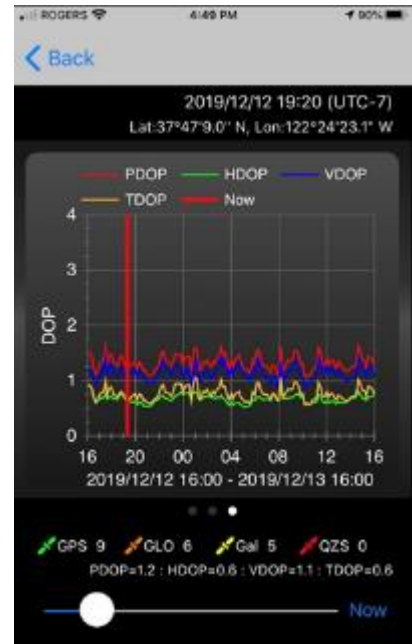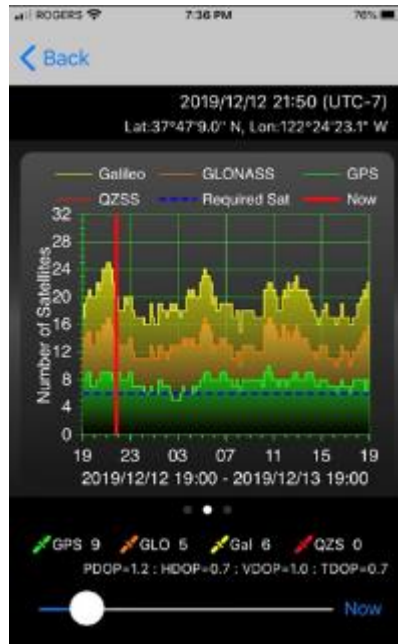You Tube link: https://www.youtube.com/watch?v=FU_pY2sTwTA

Please install the following applications for

IOS system:

- **Orbit-Satellite Tracking**
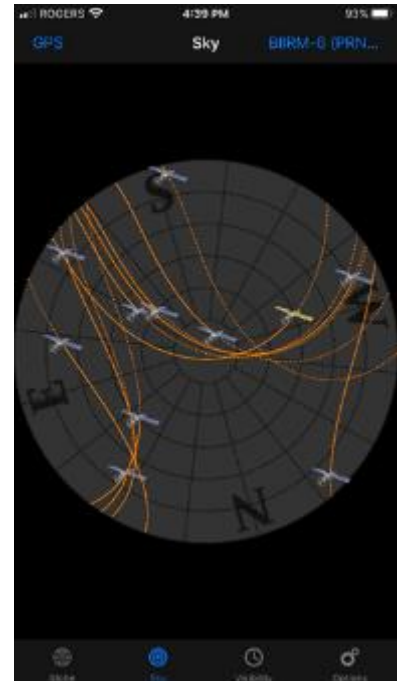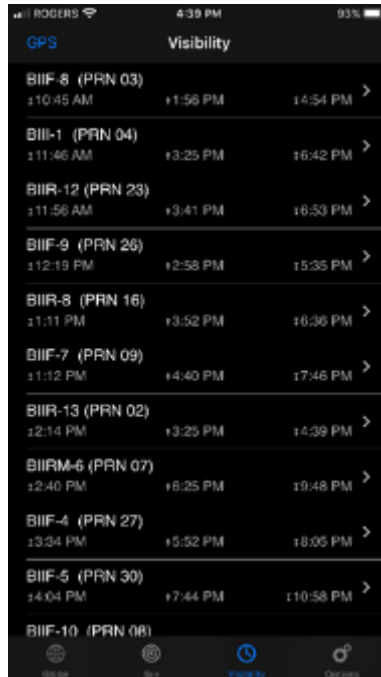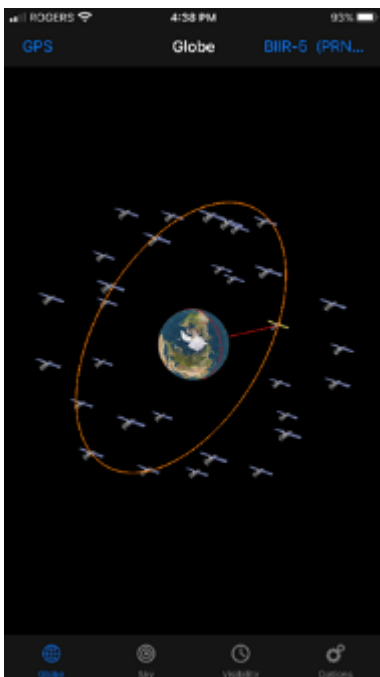
- **GPS Plan**

Android system:
- **GPS Satellites Viewer**

For Android, the program is installed from Play Market.

QUIZ:

1. How many satellites do you need for accurate positioning the combine on the field?
a. 12
b. 3
c. 16
d. 4 (r)

 2. How much time does a GPS satellite take to fly around the Earth?
a. 8 hours
b. 36 hours
c. 24 hours
d. 12 hours (r)

3. GPS is part of GNSS.
a. Yes (r)
b. No

4. What are worldwide systems? (more than one answer)
a. Beidou
b. IRNSS
c. GPS (r)
d. GLONASS (r)

CONTROL QUESTIONS

1. What are the main tasks solved by GNSS and GPS systems?
2. What are the functions of GPS satellites?
3. How was the term "Telematics" formed?
4. Name the numbers of the first and second cosmic velocities. What is their essence?

Info sources:
https://techterms.com/definition/gps
https://www.semiconductorstore.com/blog/2015/What-is-the-Difference-Between-GNSS-and-GPS/1550/

TOPIC 2

ADVANTAGES AND DISADVANTAGES OF CELLULAR AND WI-FI DATA TRANSMISSION

Agenda

1. **What is Wi-Fi and how does it work?**
2. **What is Cellular and how does it work?**
3. **Difference between Wi-Fi and Cellular.**

Introduction. For years, the term Wi-Fi has been used in conjunction with wireless internet whether it's your private home network or free Wi-Fi hotspots which you can get access to almost anywhere be it cafes, streets, colleges, and so on. Wi-Fi is a networking technology that allows computer, laptops, smartphones, and other mobile devices to connect to the internet or communicate with each other wirelessly within specified range. Integrated Wi-Fi and cellular is seen as having the best of two worlds, capitalizing on the strengths offered by each technology. Owing to the widespread adoption of the wireless LAN systems at homes, offices, and other commercial spaces, cellular operators are not seeing WLAN(wireless local area network)as their competing technology, but something that complements them to increase the cellular system capacity. Both the technologies can be used to access internet, but they are very different from each other.

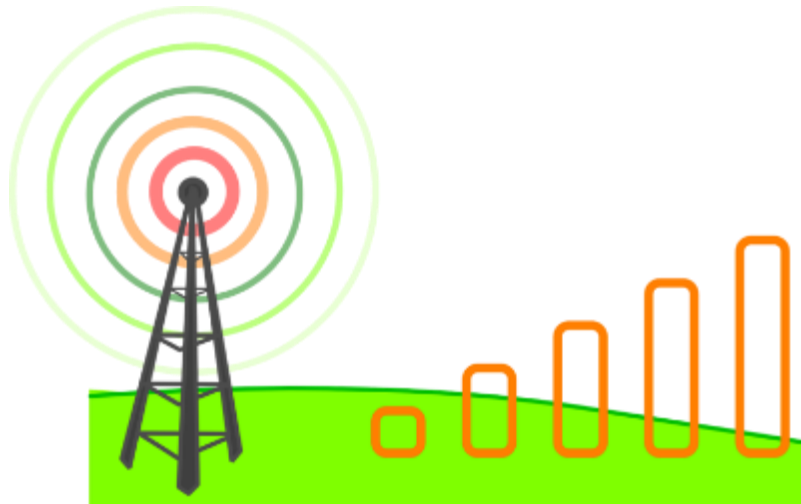### 2.1. What is Wi-Fi and how does it work?

Have you ever wanted to just sit and relax on a beach somewhere and surf the internet? Or connect to a wireless network in a café and check out your emails, or chat with your friend in a coffee shop? With Wi-Fi, you can do all these things and more. Put together some computers in your home and make them communicate with each other wirelessly – this can only be possible with a Wi-Fi. Wi-Fi is a technology that uses radio waves to provide internet access to mobile devices such as smartphones, laptops, tablets, etc and to facilitate intercommunication wirelessly.

How Wi-Fi Actually Works. Video.

You Tube link: https://www.youtube.com/watch?v=hePLDVbULZc

2.2. What is Cellular and how does it work?

Cellular (GSM) is a networking technology typically associated with a mobile telephone system that uses short-range radio stations to facilitate mobile device communication over areas comprised of cells and transceivers. The past few years have witnessed phenomenal growth in the wireless industry, both in terms of mobile technology and subscribers. Cellular network refers to a mobile network and the idea is to provide high-capacity coverage over a wide area. When you're not connected to a Wi-Fi network and still uses your phone to connect to internet, you're using cellular data associated with your cell phone plan.

The **Global System for Mobile Communications (GSM)** is a standard developed by the European Telecommunications Standards Institute (ETSI) to describe the protocols for second-generation (2G) digital cellular networks used by mobile devices such as mobile phones and tablets. It was first deployed in Finland in December 1991. By the mid-2010s, it became a global standard for mobile communications achieving over 90% market share, and operating in over 193 countries and territories.

How WiFi and Cell Phones Work | Wireless Communication Explained. Video

You Tube link: https://www.youtube.com/watch?v=kxLcwIMYmr0

2.3. Difference between Wi-Fi and Cellular

2.3.1. Meaning of Wi-Fi Vs. Cellular

Wi-Fi is primarily a local area networking technology that uses radio waves to provide high-speed internet access to mobile devices enabled with Wi-Fi. It not only allows mobile devices such as smartphones, laptops, and tablets to connect to the internet but also allows them to communicate with each other wirelessly. Cellular is a networking technology typically associated with a mobile telephone system that uses short-range radio stations to facilitate mobile device communication over areas comprised of cells and transceivers. Cellular means there is a cellular plan attached to the device which uses cellular signal to connect to the internet.

2.3.2. Technology involved in Wi-Fi and Cellular

Wi-Fi is a critical element and a crucial wireless networking technology based on the IEEE 802.11 standards. It is the Wi-Fi Alliance's name for a wireless standard, or protocol, used for wireless communication. The Wi-Fi Alliance is a not-for-profit organization that certifies the interoperability of wireless devices to promote wireless technologies. It means any Wi-Fi enabled device can seamless communicate with another Wi-Fi enabled device wirelessly. Cellular refers to a mobile network which is distributed over a wide area commonly referred to as cells which are linked to one base station which in turn facilitates wireless connection via a mobile phone.

2.3.3. Network

Wi-Fi enabled means if there is a wireless signal, the device can use the Wi-Fi standard to broadcast and receive information. It means anyone can work almost anywhere by using a mobile Wi-Fi device to connect to the internet without wires on-the-go. Wi-Fi is the name given to the wireless devices that are certified to use the 802.11 standard for communication. The main objective of a cellular communication network is to provide high-capacity coverage over a wide area and to provide a cost-effective

solution for the networks in terms of coverage, capacity and quality. Mobile technology is the technology used for cellular communication.

2.3.4. Data Limit on Wi-Fi and Cellular

A Wi-Fi device relies solely on Wi-Fi to connect to the internet and is generally much faster than a cellular network. Wi-Fi is perfect for data-intensive use such as online movies, YouTube, video conferencing, downloading music and videos, etc. Generally, Wi-Fi has no limit on how much data you can use in a day or a month. Cellular networks, on the other hand, use a proprietary frequency and a dedicated cellular operator and the services are chargeable based on weekly or monthly plans. Cellular data plans usually have daily or monthly cap on the data consumption limit.

The difference between Wi-Fi and Cellular is shown in the table. 2.1

Table 2.1 – Different between Wi-Fi and Cellular

Wi-Fi	Cellular
Wi-Fi is a networking technology that allows computer, laptops, smartphones, and other mobile devices to connect to the internet	Cellular is networking technology associated with a mobile telephone system that uses short-range radio stations to facilitate mobile device communication
Wi-Fi is the name given to the wireless devices that are certified to use the 802.11 standard for communication	The main objective of a cellular communication network is to provide high-capacity coverage over a wide area
Wi-Fi enables devices use Wi-Fi to send and receive wireless signal and cannot accept SIM	Cellular network is offered by mobile network operators or service providers
Wi-Fi spands a limited area within a specified range	Cellular network spans a wide area covering cities, towns, etc.
WI-Fi is typically much faster than a cellular network	Cellular network is relatively slower than Wi-Fi in terms of speed and reliability
Wi-Fi has no limit on amount of data and is typically based on the WI-FI network	Cellular data is based on monthly data plans that come with limited amount of data

In the training process, we will encounter two types of data transmission between tractors or combines and the office.

1.GSM (cellular)

Topcon AM53 modem is the on-board hardware device used for fleet management. Where are these modems are used today? They are used on brands such as Case

IH, New Holland, Challenger, Massey Fergusson, Fendt, Valtra. Since 2017, these modems, including the main wiring, are installed from the factory, so the dealer only needs to activate the subscription.

AM53 takes little space in the cabin (135 x 118.8 x 35.8 mm) and is lightweight and very easy to install. It offers complete localization features and data logger capabilities, automatically recording timestamp, GNSS position and relevant CAN data, and periodically transmitting data packages to the server through the GSM network.

2.Wi-Fi

Vehicle Sync, part of Trimble's Connected Farm™ solution, allows real-time wireless data exchange between multiple vehicles operating in the same field. Operators no longer need a USB drive to transfer data from one vehicle to another. Data such as guidance lines, instant yield and moisture, coverage maps, and other valuable data can be shared wirelessly with all operators, as well as their real-time locations. When used with Trimble's Field-IQ™ crop input control system, multiple operators can wirelessly communicate with one another to prevent over application of seed or other inputs. Improving communication between multiple vehicles not only reduces input costs but also improves operational efficiency and accuracy.

How SIM Cards Actually Work. Video

You tube link: https://www.youtube.com/watch?v=qqwAr-kwGxM

QUIZ:

1. At what frequency do the Wi-Fi router works? (more than one answer)
a. 1.2
b. 2.4 (r)
c. 4.0
d. 5.0 (r)

2. What standard for communication does Wi-Fi use?
a. 100.50
b. 801.11
c. 766.00
d. 802.11 (r)

3. Cellular network is relatively slower than Wi-Fi.
a. Yes (r)
b. No

4. Wi-Fi is a technology that uses…
a. radio waves (r)
b. transverse waves
c. microwaves
d. electromagnetic waves

Info sources:
http://www.differencebetween.net/technology/internet/difference-between-wi-fi-and-cellular/
https://en.wikipedia.org/wiki/GSM
https://www.topconpositioning.com/na/insights/topcon-introduces-am53-and-tierra-telematics-solutions-remote-ag-fleet-management

TOPIC 3

COMPARING MAIN INDUSTRY PRODUCERS AND TELEMATICS PLATFORMS IN THE CURRENT AND EMERGING MARKET

Agenda
3.1.   **Telematics from Deere&Company.**
3.2.   **Case International Harvester (CNH corporation).**
3.3.   **New Holland.**
3.4.   **AGCO. (Challenger, Fendt, Massey Ferguson).**

Today, we will talk about the main manufactures of agricultural equipment represented in Western Canada (and Ukraine) and their telematics division: John Deere, Case IH, New Holland and AGCO. In this part, we will consider manufactures, and not third-party companies.

The main advantages of the "original" telematics platforms over third-party companies are:

-ability to read data from the CAN (Controller Area Network);

-receive error codes (in short, have direct access to the engine module);

-transfer files with VRA maps.

3.1. Telematics from Deere&Company

JD Link is John Deere's telematics system that connects all make/model machines in the field with the office and mobile devices.
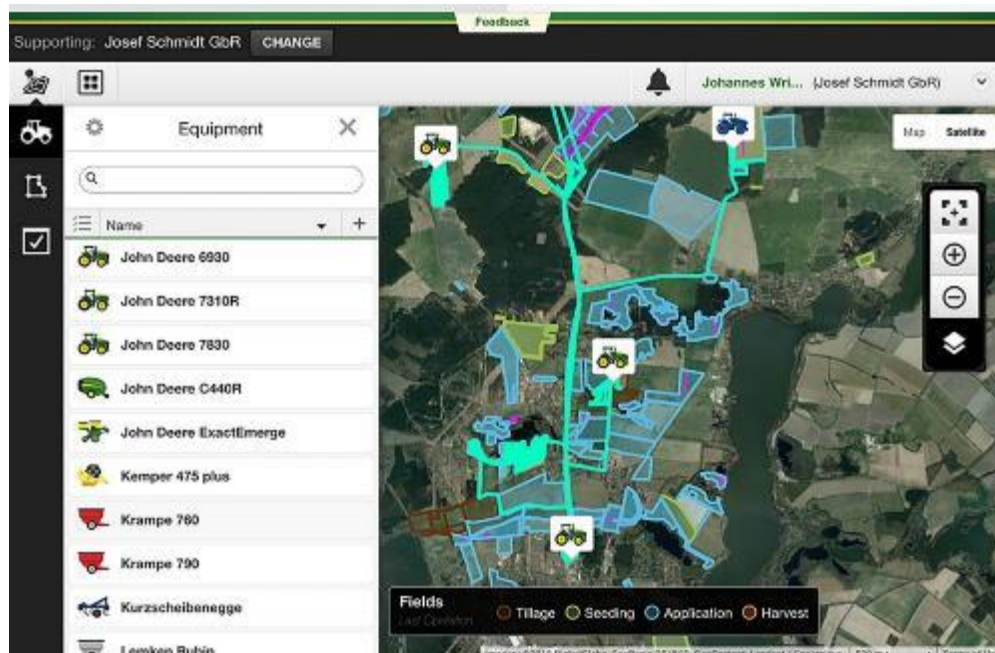
Fig. 3.1. JD Link program interface

JD Link delivers producers value:
- keep machines running with reduced diagnostic time
- support operators quicker than ever before with Remote Display Access (RDA)
- access machine and agronomic data from the machine, the office, and a mobile phone
- manage the fleet and operation in one view

JD Link technology enables producers to:
-Access machine data, track actual machine location and location history, set up and manage geofence and curfews, and manage maintenance plans and alerts
-Remotely view John Deere displays
-Diagnose a machine and send updates from the workshop with Service ADVISOR™ Remote
-Wirelessly send setup and documentation data between machine and the Operations Center
-Share coverage maps and AB lines between displays working together in the field
-Use Mobile RTK Signal

In order to use JDLink, the following is required:
-Modular Telematics Gateway (MTG)
-An active JDLink subscription: JDLink Connect or JDLink Access + RDA
-A MyJohnDeere™ portal account to access machine and agronomic data

JD Link Access + RDA subscription:
For all John Deere and non-John Deere machines, JD Link Access + RDA enables producers to:
-Monitor machine location and work progress via Location History
-View essential information (e.g., machine hours)
-Set up curfew and geofence alerts
-Track machine maintenance plans
-Use Mobile RTK Signal

On compatible John Deere machines, additional machine data and diagnostics are available, such as:
-Remote diagnostics and controller area network (CAN) data tracking capabilities as well as over-the-air software updates through Service ADVISOR Remote, allowing for preventative maintenance, quick problem resolution, and maximized machine uptime
-Factory maintenance plans with alerts for John Deere machines

-Remotely view and compare machine utilization, performance, and other important information, such as fuel consumption and machine idle time to improve overall performance and operational efficiency

JD Link Connect subscription:

In addition to the JD Link Access + RDA features mentioned above, JD Link Connect enables:

-Seamless remote exchange of important setup and field documentation data with John Deere Wireless Data Transfer (WDT), eliminating the inconvenience and time needed to manually transfer data between the office and the machine via USB

-Sharing coverage maps and guidance lines with up to six machines with In-Field Data Sharing

-Data streaming every 30 seconds between the Operations Center and machine with Data Sync

-Remote view and adjust of S700 Combine settings using the MyOperations™ app

Accessing JDLink Data:

Agronomic and basic machine data can be accessed through the Operations Center in the office or the MyOperations app on a mobile phone. The JDLink Dashboard is recommended for more detailed machine analysis and additional tools. The Operations Center and JDLink Dashboard are available through the MyJohnDeere.com login page.
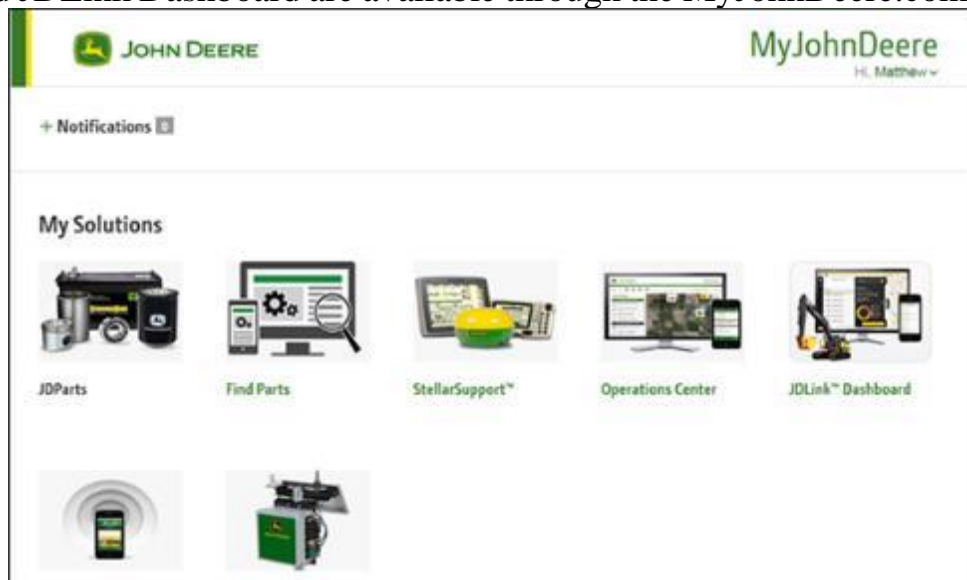
Fig. 3.2. My John Deere program interface

John Deere Operations Center - Connected Machines. Video.

You Tube link: https://www.youtube.com/watch?v=8XOVviBmdgU

3.2. Case International Harvester (CNH corporation)

AFS Connect™ - Advanced Farm Management system from Case IH gives you total control over your data. It provides you real-time dashboard access to your equipment on any device. So you have instant access to location, diagnostics, fuel and engine stats — just like you would see it in the field. Plus, the power to decide who can see or can't see your data.

AFS Connect
AFS Connect advanced farming management system gives you instant access to information for every machine in your fleet - including machine location, diagnostics and fuel and engine stats. Use it to manage operator and equipment performance and monitor real-time data to make informed decisions that impact your bottom line.

Real Time
It's a real-world scenario, but not a best-case one: The producer observes that often his machines spend time waiting in the field to unload or waiting for a fuel truck. It squanders valuable time from the limited windows that every producer experiences.

Real Data
It's bold. It's easy to read. The AFS Connect dashboard provides a clear display of machine health parameters such as engine speed, hydraulics, oil temperature, fuel level and more.

Fig. 3.3. The AFS Connect dashboard.

Features may include:

RTK + Cellular Guidance
Delivers guidance correction to a reliable sub-inch accuracy from year-to-year using AFS Connect hardware. Cellular RTK guidance correction signals alleviate problems associated with traditional radio delivered RTK such as line-of-sight issues, including hills, valleys, trees, buildings or other structures — extending your distance of travel from a cellular base while maintaining sub-inch accuracy. Seamless connectivity reduces application overlaps and skips, improves field efficiency and allows for more accurate placement of inputs, such as fertilizer and herbicides. This helps achieve repeatability — even in the most narrow rows — and keep tire tracks on the same path to reduce compaction.

Fleet Management
Pinpoints the exact location of each machine and through custom reports you can setup geofences, curfews and more.
Machine Dashboard Monitoring
Allows you to view real-time machine parameters from a remote location. Monitor engine speed, oil temperature, coolant temperature and level, hydraulic oil temperature and pressure, fuel and more.
Monitor Vehicle and Implement Data

Lets you view real-time equipment performance data, including; yield, moisture, singulation, target rates, rotor speed, engine speed and more.

2-Way File Transfer

Helps you remotely transport AFS data easily to your home office or trusted adviser and upload prescriptions directly to your machine.

View Graphs and Reports

Shows area worked, yield average, flow average, moisture average and more.

Fig. 3.4. View graphs and reports in the AFS program in the
Fleet Management section

Live Time Streaming

AFS Connect from Case IH provides you with up to 30 minutes of Live Time streaming access to your equipment. So you can see what's happening in your equipment as it happens.

Fast Data Refresh

AFS Connect also has a one-minute data refresh rate - the fastest in the industry. It continuously provides you with updates on equipment location and performance to any Web-enabled device.

Stay in Contact

Additionally, with AFS Connect, you can send messages through your Web portal to the system to stay in constant contact with the people operating your equipment.

Case IH AFS Connect - Dashboard Graphic Interface. Video

You Tube link: https://www.youtube.com/watch?v=U7smmaV88O0

3.3. New Holland

New Holland's **PLM Connect** advanced farm management system gives you instant access to information for every machine in your fleet – including machine location, diagnostics, and fuel and engine stats. Use it to manage operator and equipment performance, and monitor real-time data to make informed decisions that impact your bottom line.

Features
-**Graphic Reports** show area worked, yield average, flow average, moisture average and more
-**Custom Alerts** allow you to create alerts for maintenance, geofencing, curfew and more
-**Fleet Management** pinpoints the exact location of each machine
-**Machine Dashboard Monitoring** allows you to view real-time machine parameters from a remote location: monitor engine speed, oil temperature, coolant temperature and level, hydraulic oil temperature and pressure, fuel and more
-Vehicle and/or Implement Data Monitoring lets you view real-time equipment performance data including yield, moisture, singulation, target rates, rotor speed, engine speed and more
-**Data Sharing** seamlessly transfers PLM data wirelessly between your machines and home office or trusted adviser — upload prescriptions directly to your machine and drive daily management decisions based on your current agronomic data:
− My Farm Manager™ web platform from Decisive Farming
− AgWorks by AgRetail, for AgRetail
− Farmer Pro software from Trimble
-**Cellular RTK Guidance (NTRIP)** delivers guidance correction to a reliable sub-inch accuracy from year-to-year using PLM Connect hardware

Wireless Data Transfer

PLM Connect further enhances your connectivity with its wireless file-transfer feature that uses the cloud to easily and securely transfer data to and from your machines. This means easier access, or transfer, of data such as guidance lines, boundaries, variable-rate prescriptions, as-applied data, coverage maps, yield and moisture data, etc

Remotely Manage Machines From the Office

By using the PLM Connect virtual dashboard, you can monitor key operating parameters such as engine speed, hydraulic oil temperature, fuel level, and much more, to manage individual vehicle efficiency. You can also receive fault code alerts so that any service issues that arise can be quickly resolved.

Fig. 3.5. PLM Connect virtual dashboard

Fig. 3.6. Control of the engine speed parameter

Optimizing Fleet Management

Monitor up to 40 different vehicle parameters in real time. This allows you to proactively optimize each vehicle's settings using a simple messaging service, which is used to send the operator information on how they can implement the ideal machine settings to improve performance. This feature can also be used to remotely troubleshoot any service issues that might arise, minimizing any downtime and ensuring that your equipment is quickly back up and running.

PLM Connect Telematics. Video

You Tube link: https://www.youtube.com/watch?v=vkaaYq14be0

3.4. AGCO (Challenger, Fendt, Massey Ferguson)

Machine-focused telemetry software

Turn valuable ag and machine data into improved uptime and efficiency throughout the lifecycle of your machine. **AgCommand®** enables you — and your dealer — to coordinate, optimize and seamlessly connect your fleet, to better manage maintenance and remotely monitor equipment in the field.

Specifications

Choose to self-monitor, or take full advantage of your dealer's expertise. Data — like location, vehicle status, hours and performance information — is collected on the machine and wirelessly transferred to the secure AgCommand server. Transfers are done by a hardware module, utilizing an AgCommand subscription.
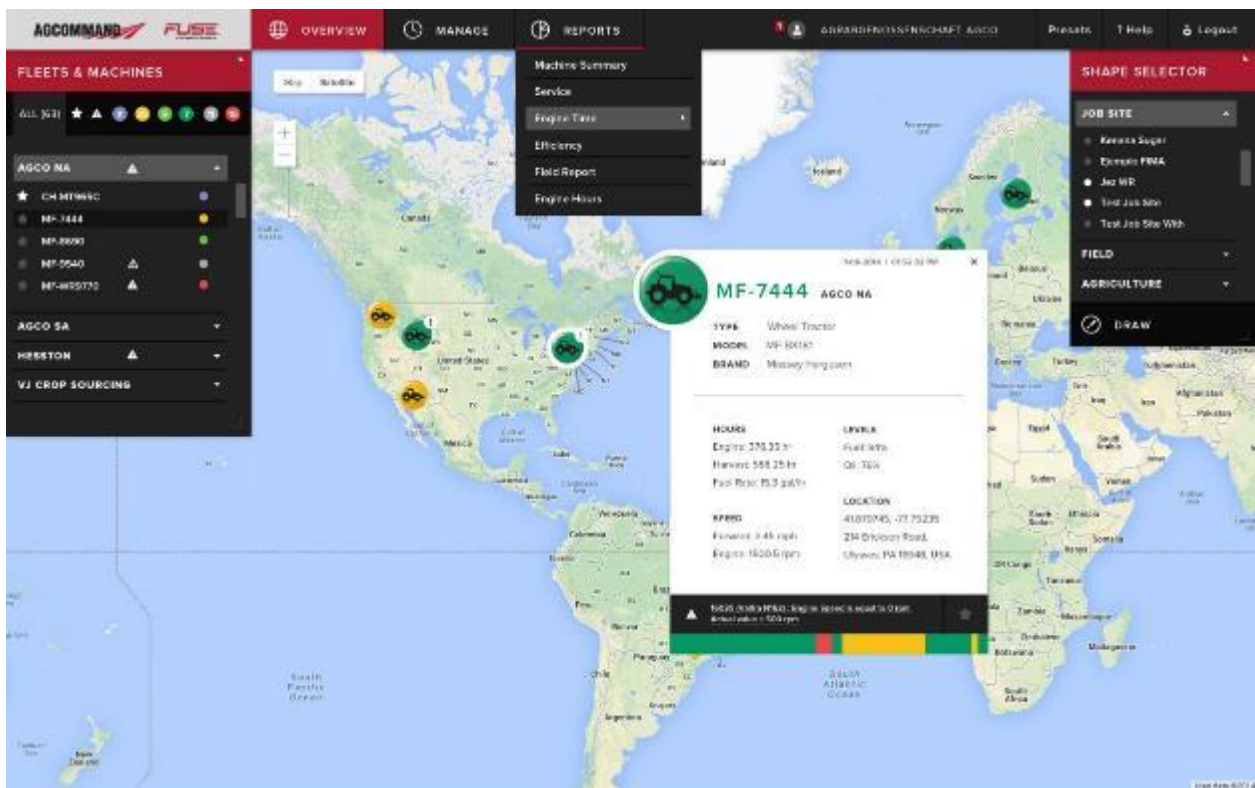
Fig. 3.7. AgCommand® programme interface

Features

-Customization. Customizable and pre-populated vehicle and engine views let you determine when machines are idle, stopped or in need of service.

-Automation. Automated, actionable, near real-time alerts let you identify problems, so you can react quickly.

-Geofencing. Machine geofencing enhances fleet security and reduces theft.

-Optimal Coverage. Data is transferred via GSM, 3G and CDMA networks. In areas with poor or non-existent cellular connection, data is transmitted over the Iridium® satellite network, ensuring seamless transfer.

Agro Link

Wireless agronomic data collection that's loyal to only one brand. Yours.

Having to navigate multiple data collection technology platforms, depending on your different machines, isn't fun. It isn't efficient, either. Different file types. Multiple data points. No way to aggregate them. It's like your agronomic data is controlling you, not the other way around.

Agro Link can free growers and agronomy service providers from the hassle of multiple data collection technologies.

How it works.

A centralized, universal data exchange platform facilitates wireless data movement between your cloud storage, equipment telematics systems and almost any farm management information system (FMIS).

Securely store and transfer data—in one unified file type—to your computer or mobile device or share information with trusted partners. Manage prescription formats and move data between cloud storage, equipment telematics and your FMIS. Easily convert an ISO XML file to a shapefile or vice versa.

AGCOMMAND Overview. Video.

You Tube link: https://www.youtube.com/watch?v=ToAiXNohd0I

AGCO Connect - Right There with You at Every Turn. Video.

You Tube link: https://www.youtube.com/watch?v=vNjYnhPiwZo

QUIZ:

1.What telematics platforms can send prescription files? (more than one answer)
a. JDLink(r)
b. AFS Connect (r)
c. PLM Connect (r)
d. AgCommand (r)

2. How long does it take to stream data between the Operations Center and machine with Data Sync in JDLink?
a. 10 min
b. 1 min
c. 0.5 min (r)
d. 4 min

3. Does AFS Connect have a feature like Geo-fence?
a. Yes (r)
b. No

4. Which telematics platform has the function Sharing coverage maps between displays?
a. JD Link (r)
b. AFS Connect
c. PLM Connect
d. AgCommand

CONTROL QUESTIONS

1. What main functions can the AFS Connect software perform?
2. Name the tasks that JD Link technology can solve.
3. What brands of equipment belong to the AGCO corporation?

Info sources:
https://www.deere.ca/en/technology-products/precision-ag-technology/data-management/jdlink/
https://www.caseih.com/northamerica/en-us/products/advanced-farming-systems/afs-connect-(old)#0
https://www.newhollandrochester.com/precision-farming/new-holland-plm-connect-software/
https://www.fusesmartfarming.com/products/connect/

TOPIC 4

COMPARING TELEMATICS AND GPS TRACKING

Agenda

4.1. The difference between GPS tracking and Telematics.
4.2. Setuping basic functions of Telematics using specified Telematics account (eg: AFS/PLM Connect)

4.1. The difference between GPS tracking and Telematics

GPS tracking is an essential and central component of a telematics system. As we've discussed, it allows fleet managers to keep track of their fleet assets at any given time, providing them with a comprehensive overview of what resources they have at their disposal. However, telematics cannot be reduced to a simple vehicle tracker – we have already highlighted that it has a vast array of capabilities other than this. It is because of this versatility that telematics has become so central to fleet management in recent years. Telematics devices capture data points including the following:

-Vehicle location, speed, status (customisable)

-Geographical point of interest (Geofencing)

-Vehicle diagnostics (e.g. EPM, MPG, odometer) and incidents (harsh braking, acceleration)

-Remote vehicle inspection reports

-Job dispatch and messaging

In addition, telematics systems integrate vehicle routing and maintenance scheduling with driver performance, providing a comprehensive and broad-based solution to the key challenges facing fleet management. Thus, they go well above and beyond vehicle GPS tracking alone.

-GPS tracking
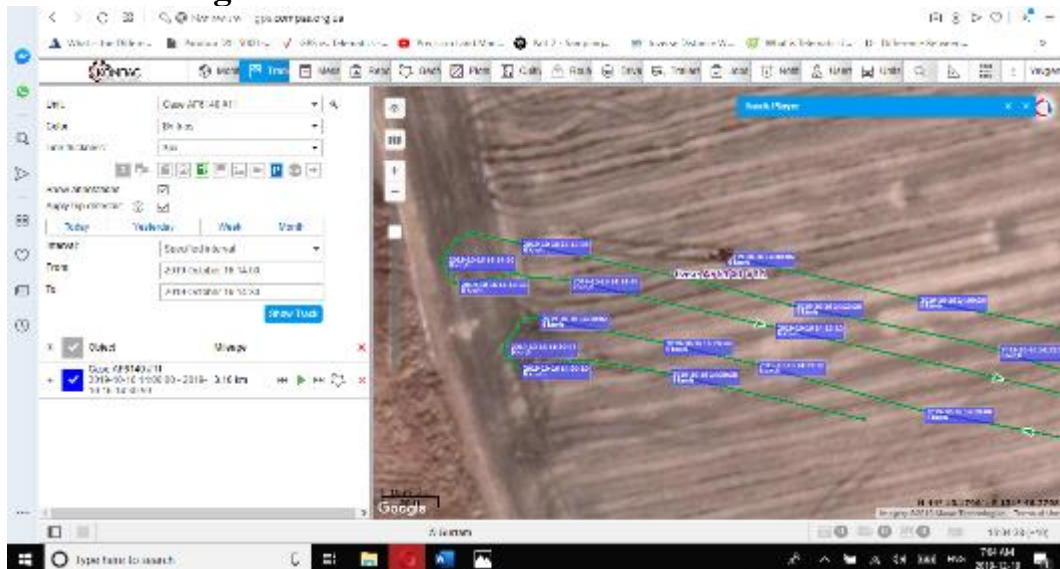
a)

-Telematics
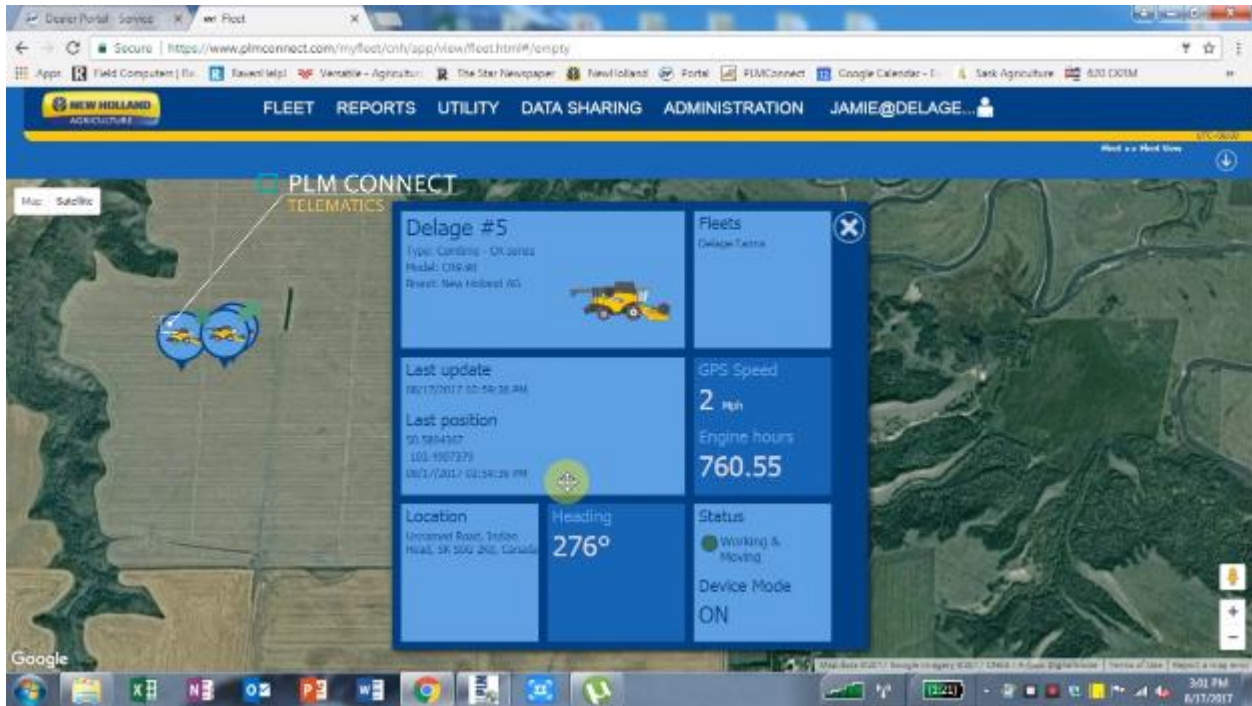
b)

Fig. 4.1. An example of an image of GPS tracking (a) and Telematics (b)

Info source: https://www.teletracnavman.com/resources/resource-library/faqs/what-is-telematics

QUIZ*:*

1.Can we track a tractor using telematics?
a. Yes (r)
b. No

2. What word is undue here?
a. Vehicle status
b. Geo-fence
c. Livestock counting (r)
d. Fleet management

4.2. Setuping basic functions of Telematics using specified Telematics account (eg: AFS/PLM Connect)

1. Perform Telematics installation and troubleshooting of basic components. Today, we will look at the basic components of the telematics kit, which is suitable for the following producers: New Holland, Case IH, Challenger, Massey Ferguson, Fendt, Valtra. Since 2017, these modems, including the main wiring, are installed from the factory, so the dealer only needs to activate the subscription.

Components:

1. AM-53 Topcon modem with data transfer function;
2. Telematics antenna;
3. File transfer cable;
4. CAN cable set;

For example, if you need to purchase the up-mentioned telematics kit for Case IH or New Holland equipment, then you go to your local dealer and provide the following part number: 47735700.

Each modem has its own serial number (S/N 1223-09XXXXXX), which you will add to the telematics portal and assign it to a specific combine or tractor.
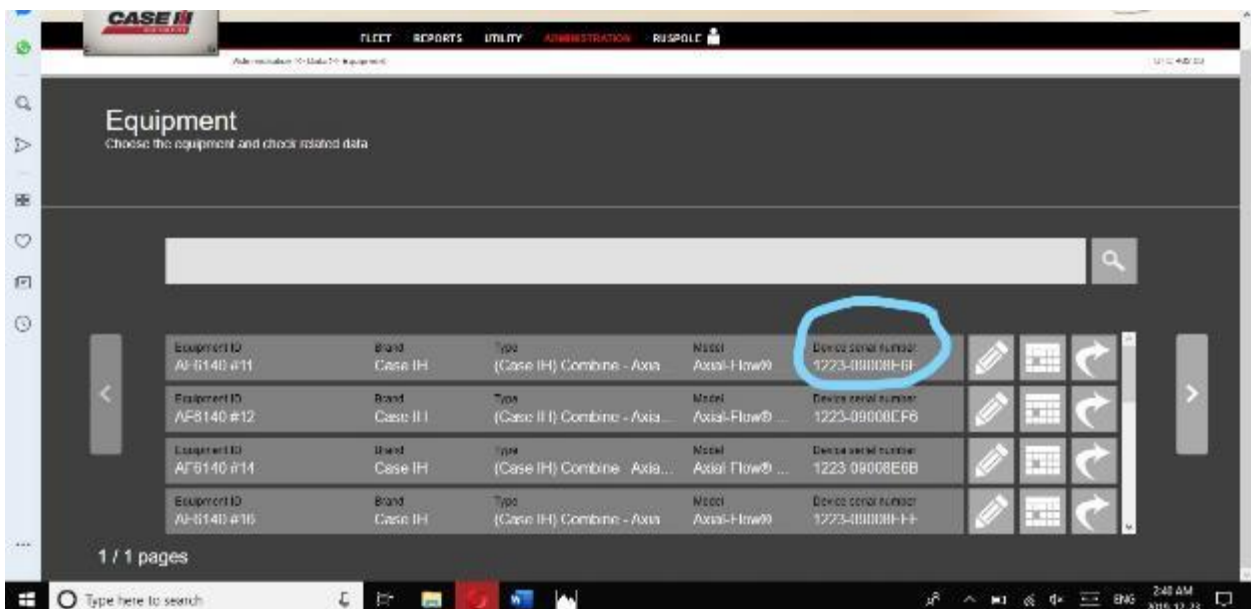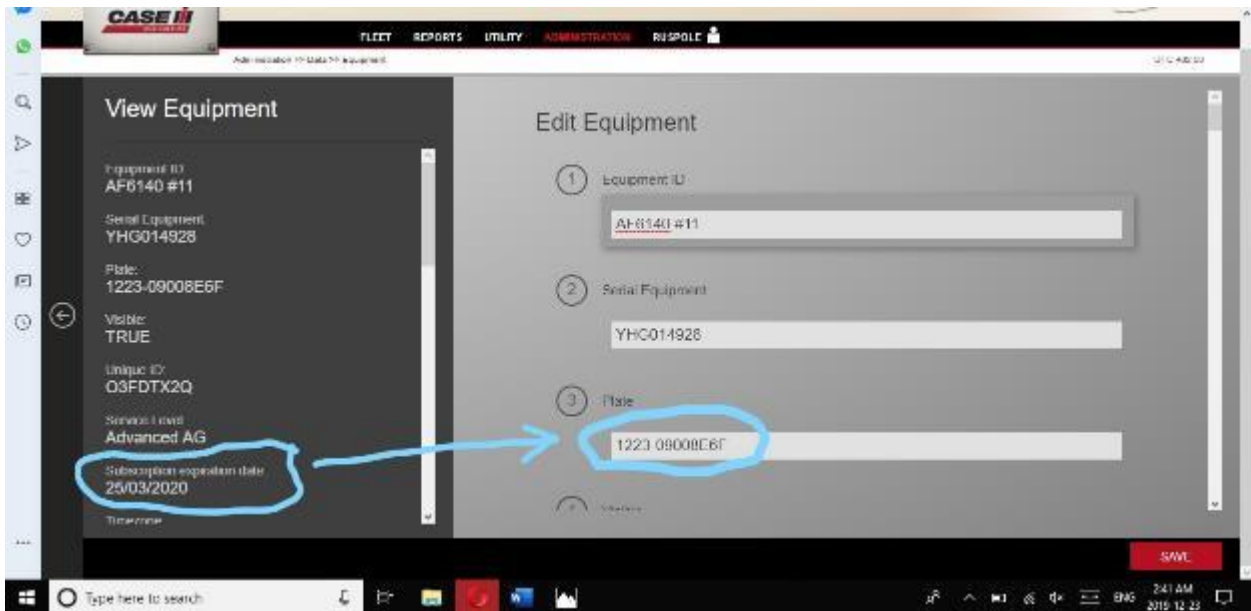
Fig. 4.2. Adding to the telematics portal and assign it to a specific combine or tractor.

Since the modem works through the GSM module, it is assigned a subscription for data transfer.

File transfer cable connects the display and the AM-53 modem. Its function is to transfer data from the display via iCloud to the telematics portal and back in real time.

What possible faults can be in the operation of Telematics?

Examples.

1. Fault: Grey telematics icon on tractor display.

Cause: Incorrect connection of the CAN1 and CAN2 connectors.

Solution: Swap them until the icon turns green.

2. Fault: The icons of GPS satellites, data transfer and cellular connection on the AM-53 do not blink.

Cause: No 12V voltage on the AM-53 modem.

Solution: Check the power supply with a multimeter on the AM-53 modem itself and also 12V cigarette light output in the cabin.

3. Fault: The grey telematics icon on tractor display and the grey status of the tractor icon in the telematics portal, although everything works properly: the data is transmitted online.

Cause: Outdated modem firmware.

Solution: Update firmware using RS-232 cable and EST (Electronic Service Tools).

Let's generate the next situation.

If you need to move the AM-53 modem to Case IH, which used to work on New Holland, you need to call PLM Connect (New Holland) support and ask them to transfer the corresponding modem serial number to iCloud of Case IH. As soon as you change producers, you are ready to use this modem on the Case IH telematics portal.

Telematics installation. AM-53 modem. PLM Connect. Video#1. New Holland CR 8.90. Video.

You Tube link: https://www.youtube.com/watch?v=Bmwl6pq8h3c

QUIZ:

1.When there is an open in the telematics modem circuit, what value will we check?

a. Resistance (r)
b. Current
c. Voltage

2. What word is undue here?

a. Telematics
b. AM-53
c. GPS tracker (r)
d. File transfer

3. What type of data transfer is on the AM-53 modem?

a. Cellular (r)
b. Wi-Fi

2. Set up the Curfew function.

Today, we will begin to consider the basic functions of telematics. As an example, we take New Holland telematics PLM (Precision Land Management) Connect.

To understand what the customer needs, you must personally install and configure all the functions with him and show from the practice. To do this, we will start to create our account and add all the features there.

Let's begin with **Curfew**.

Enhance your machine's security with curfew function. You can set curfews so that you are alerted if your machines are used outside of the predefined working hours.

Curfew function of telematics. PLM Connect. Video#3. Canada. Video

You Tube link:

https://www.youtube.com/watch?v=xRp06pIdgTw&list=PL2XV1AyLKkJHwBD3FK-gQieF2nVTX6G1j&index=3

QUIZ:

1.Will the Curfew function work, if we just turn on the ignition, but don't go anywhere on the combine?

a. Yes (r)
b. No

2. What word is undue here?

a. CAN data (r)
b. Notification group
c. Curfew
d. Time

TOPIC 5
SETUPING AND READ DATA FROM THE CAN VIEWER FUNCTION

Agenda
5.1. Terms.
5.2. Setuping equipment utilization function

5.1. Terms

PLM Connect enables you or your fleet manager to connect to your machines from the comfort of your office through the utilization of the mobile network. You can stay in touch with your machines at all times, and you can send and receive real-time CAN information that saves time and enhances productivity.

The display of receiving data on the CAN Viewer screens depends on the configuration of the combine or tractor, namely the presence of sensors from which the data will come.

PLM Connect Manager utilizes the industry standard ISO J1939 protocol.

What is CAN and J1939 protocol? Brief definition.

CAN. Controller Area Network.
-Is a serial networking technology for embedded solutions.
-Needs only two wires named CAN_H and CAN_L.
-Operates at data rates of up to 1 Megabit per second.
-Supports a maximum of 8 bytes per message frame.
-Does not support node IDs, only message IDs. One application can support multiple message IDs.
-Supports message priority, i.e. the lower the message ID the higher its priority.
-Supports two message ID lengths, 11-bit (standard) and 29-bit (extended).
-Does not experience message collisions (as they can occur under other serial technologies).
-Is not demanding in terms of cable requirements. Twisted-pair wiring is sufficient.

SAE J1939 protocol.

-Is a standard developed by the Society of Automotive Engineers (SAE)
-Defines communication for vehicle networks (trucks, buses, agricultural equipment, etc.)
-Is a Higher-Layer Protocol using CAN as the physical layer
-Uses shielded twisted pair wire
-Applies a maximum network length of 40 meters (~120 ft.)
-Applies a standard baud rate of 250 Kbit/sec

-Allows a maximum of 30 nodes (ECUs) in a network

-Allows a maximum of 253 controller applications (CA) where one ECU can manage several CAs

-Supports peer-to-peer and broadcast communication

-Supports message lengths up to 1785 bytes

-Defines a set of Parameter Group Numbers (PGNs, predefined vehicle parameters)

-Supports network management (includes node IDs and an address claiming procedure).

CAN Viewer function of telematics. PLM Connect. Video#7. Canada. Video.

You Tube link:
https://www.youtube.com/watch?v=CtX0DNYDhyA&list=PL2XV1AyLKkJHwBD3FK-gQieF2nVTX6G1j&index=7

Info sources:
https://copperhilltech.com/a-brief-introduction-to-the-sae-j1939-protocol/

QUIZ:

1. What two message ID lengths does CAN support? (more than one answer)
a. 11 bit (r)
b. 29 bit (r)
c. 32 bit
d. 48 bit

2.How many CAN parameters can be selected for reading data at the same time in PLM Connect?
a. 24
b. 40 (r)
c. 50
d. 72

3. How many CAN parameters can be displayed in one Run screen of CAN Viewer in PLM Connect?

a. 8
b. 12 (r)
c.24
d. 32

4. What a standard baud rate for J1939 protocol?
a. 25 Kbit/sec
b. 100 Kbit/sec
c. 200 Kbit/sec
d. 250 Kbit/sec (r)

5. Initially, what determines the display of data on CAN Viewer screens in PLM Connect?

a. type of cellular connection
b. type of subscription
c. configuration of the equipment (r)
d. AM-53 modem registration.

5.2. Set up equipment utilization function. (1 hour + 1 hour)

PLM Connect is your eyes and ears in the field. You can remotely monitor where your machines are and proactively plan where they are going to best optimize the utilization and productivity of your fleet.

Know when your equipment is actively being used versus sitting idle on a job site. Stop equipment hoarding and improve overall utilization. Instantly see the location and activity of all of your equipment across your job sites.

Equipment Utilization function of telematics. PLM Connect. Video#5. Canada. Video.

You Tube link:
https://www.youtube.com/watch?v=Nn6bKUKWOOw&list=PL2XV1AyLKkJHwBD3FK-gQieF2nVTX6G1j&index=5

a.   Read data using the History function. Data reading. (1 hour + 1 hour)

The History function in PLM Connect allows you to monitor the movement of all equipment on the farm, its status, speed and position. This function helps to identify excess limits by the up-mentioned parameters.

History function of telematics. PLM Connect. Video#4. Canada. Video.

You Tube link:
https://www.youtube.com/watch?v=scKmngETNlc&list=PL2XV1AyLKkJHwBD3F K-gQieF2nVTX6G1j&index=4

b.   Set up the Messaging function. (30 min + 1 hour)

PLM Connect messaging allows farm owners and managers, as well as New Holland dealer technicians, to send advice directly to the machine's display – so operators can improve their performance on the move.

Messaging function of telematics. PLM Connect. Video#6. Canada. Video.

You Tube link:
https://www.youtube.com/watch?v=qzp1tLVkmc8&list=PL2XV1AyLKkJHwBD3FK -gQieF2nVTX6G1j&index=6

c.   Set up the Geo-Fence function. Set up account. (1.5 hour + 2 hour)

Enhance your machine's security with geo-fences. With geo-fencing technology, you can predefine working areas for your machines and receive alerts if they leave this area.

As a dairy farmer whose farm is spread over quite a distance, the PLM Connect can help you manage your fleet during baling and wrapping to ensure every tractor is

in the right place at the right time. It can also give you peace of mind that when the tractors are parked somewhere overnight you will get an alert if they are moved.

Geo-Fence function of telematics. PLM Connect. Video#2. Canada. Video

QUIZ:

1.Will the Geo-Fence function work, when the combine is outside the geofence boundary and the From inside to outside option is selected?

a. Yes
b. No (r)

2. What option is undue here?

a. From inside to outside
b. Notification group
c. J1939 protocol (r)
d. Geo-Fence

d.   Read data from the Dashboard function. You can see real-time vehicle status through your PLM Connect virtual dashboard, which enables you to monitor key operating parameters to maximize efficient farming. By keeping an eye on the online vehicle dashboard, you can maximize uptime, improve productivity and efficiency and even optimize fuel consumption.

Dashboard function of telematics. PLM Connect. Video#8. Canada. Video

You Tube link:
https://www.youtube.com/watch?v=I1C7j_ryzOU&list=PL2XV1AyLKkJHwBD3FK-gQieF2nVTX6G1j&index=8

Info source: https://agriculture.newholland.com/nar/en-us/precision-land-management/products/receivers-modems-controllers/am53-modem/plm-vision

TOPIC 6
READING DATA USING THE REPORTS FUNCTION

Agenda
6.1. Fuel Efficiency
6.2. Equipment utilization

With 24/7 access to fleet information, it's easy to track both fixed and movable assets from anywhere. Reports and updates can be received and viewed through an online dashboard using a laptop, smartphone, or tablet, so your fleet data comes directly to you. Once the information is received, fleet managers can then easily generate comprehensive diagnostic reports.

Here is one of the areas which can greatly benefit from reporting.

6.1. Fuel Efficiency

Fuel is a large expenditure, especially when you have a fleet of vehicles to continuously fill up. By allowing managers to track fuel usage through detailed reports, fleet telematics reduces fuel costs and promotes better fuel efficiency. Reports provide an in-depth look at where and how fuel is being used, or in some cases, misused. Certain driving patterns, such as idling and speeding, lead to wasted fuel, which is bad for both your finances and for the environment. With alerts and reports that pinpoint unnecessary or unauthorized fuel use, managers are better able to address these concerns.
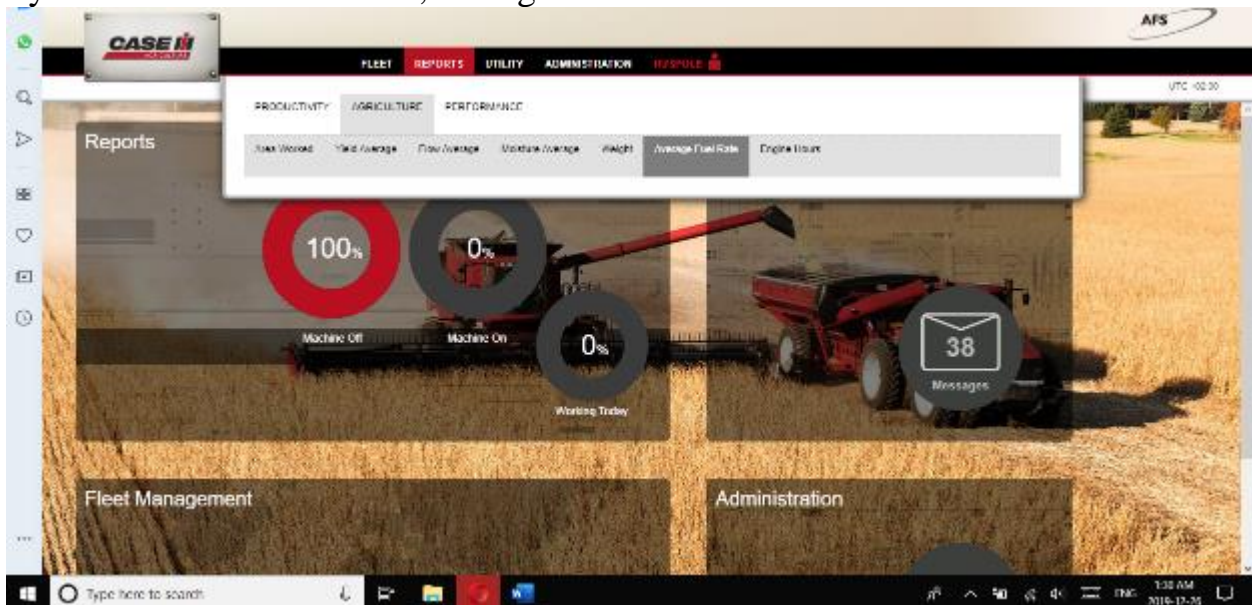
Fig. 6.1. Menu "Average Fuel Rate".

Here we can see that it is possible to obtain data on fuel consumption in different modes and for different periods of tractor or combine operation
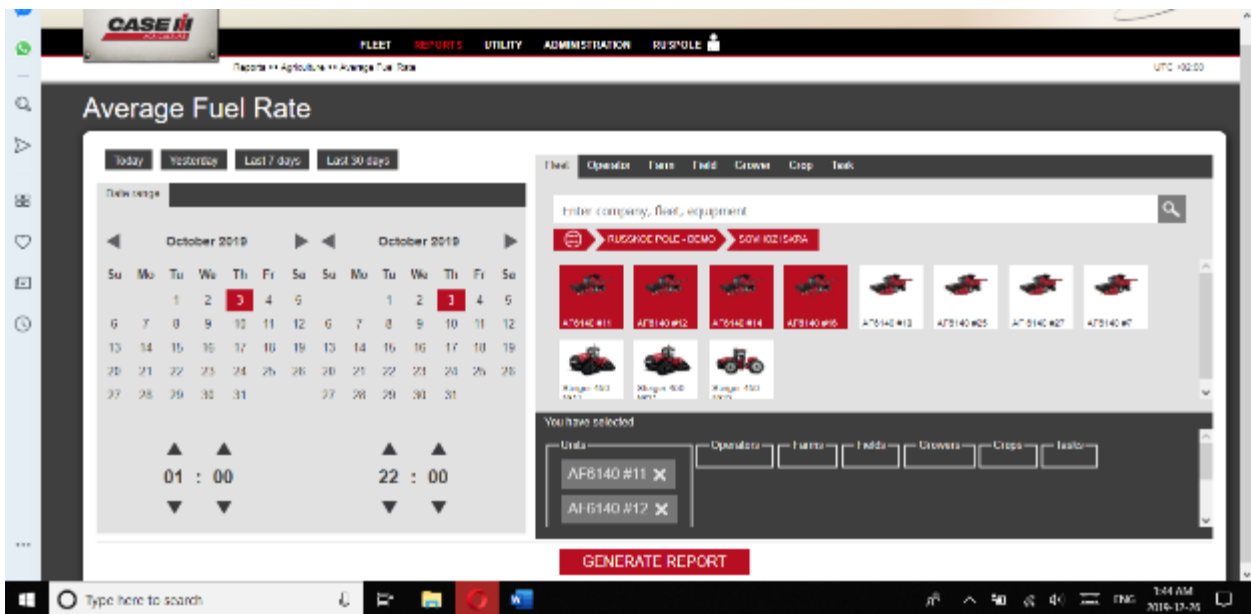
Fig. 6.2. Menu "Average Fuel Rate" for each tractor and combine separately.

In this figure, we can control the fuel consumption of any unit at any time.

Fig. 6.3. Menu "Average Fuel Rate" - report for a specific period of use of equipment.
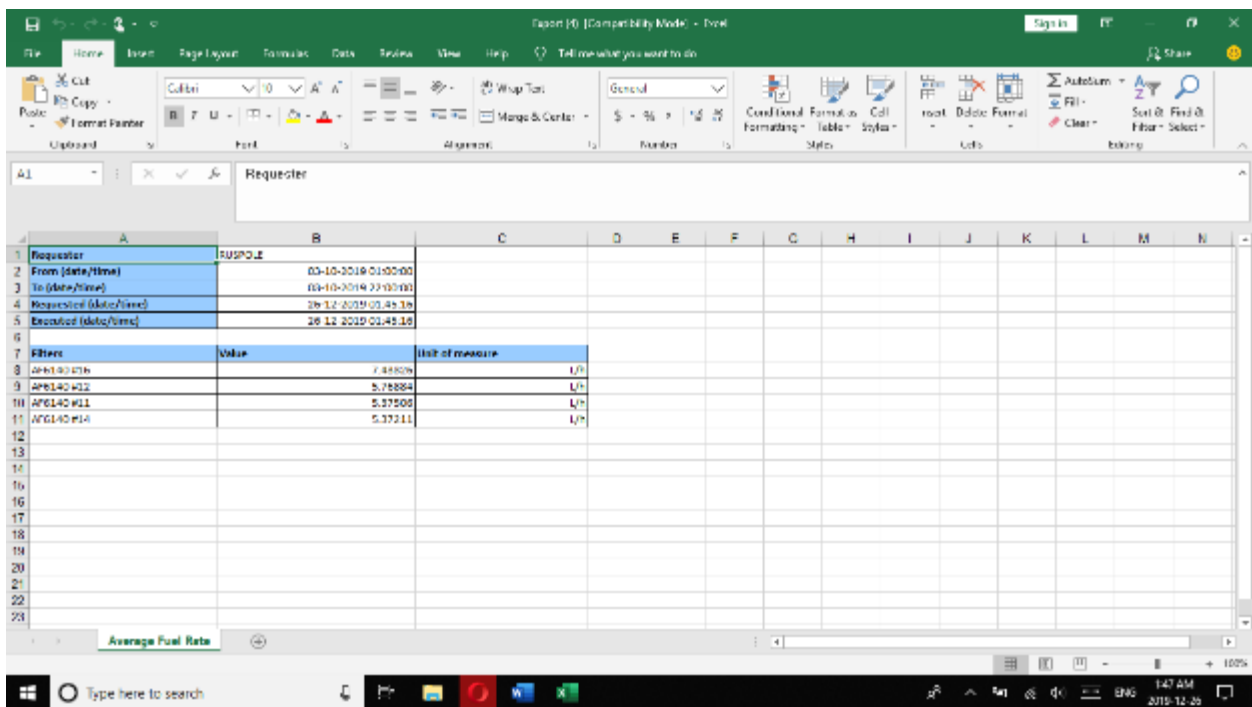
Fig. 6.4. Menu "Average Fuel Rate" - a report for a specific period of use of equipment in the format of Excel tables.

6.2.   Equipment utilization

The following figures show the main possibilities of using the equipment. Let's analyze what is shown here.
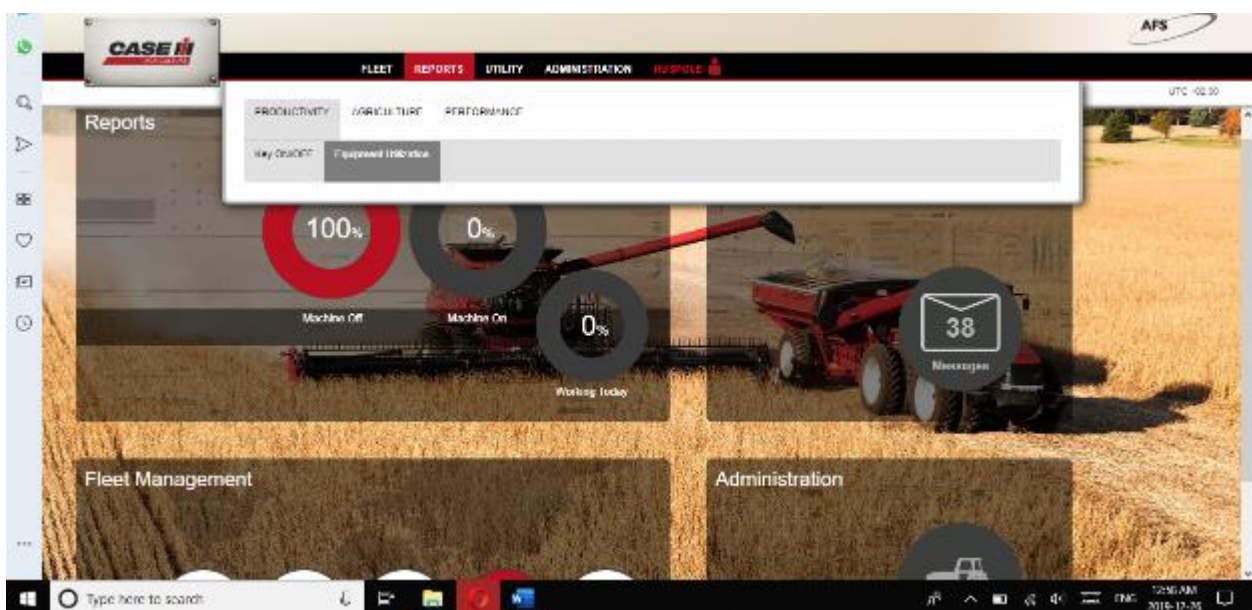
Fig 6.5. Menu "Equipment Utilization"
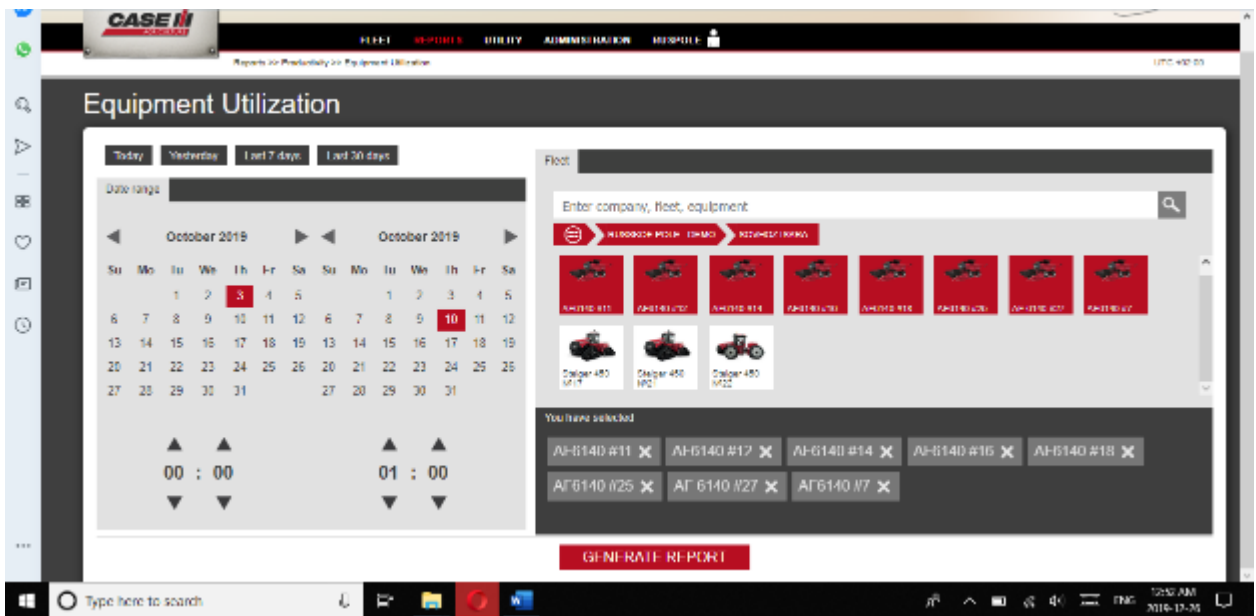
Fig 6.6. Menu "Equipment Utilization" - in detail for each individual unit of equipment
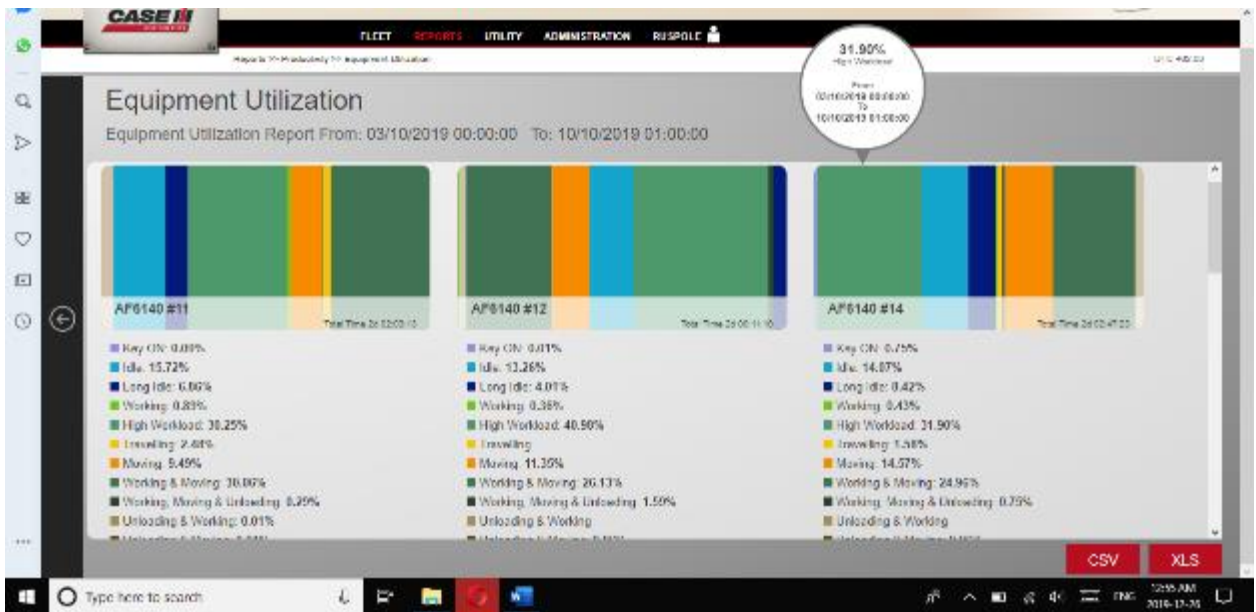
Fig 6.7. Menu "Equipment Utilization" - graphic representation of elements of the use of technology
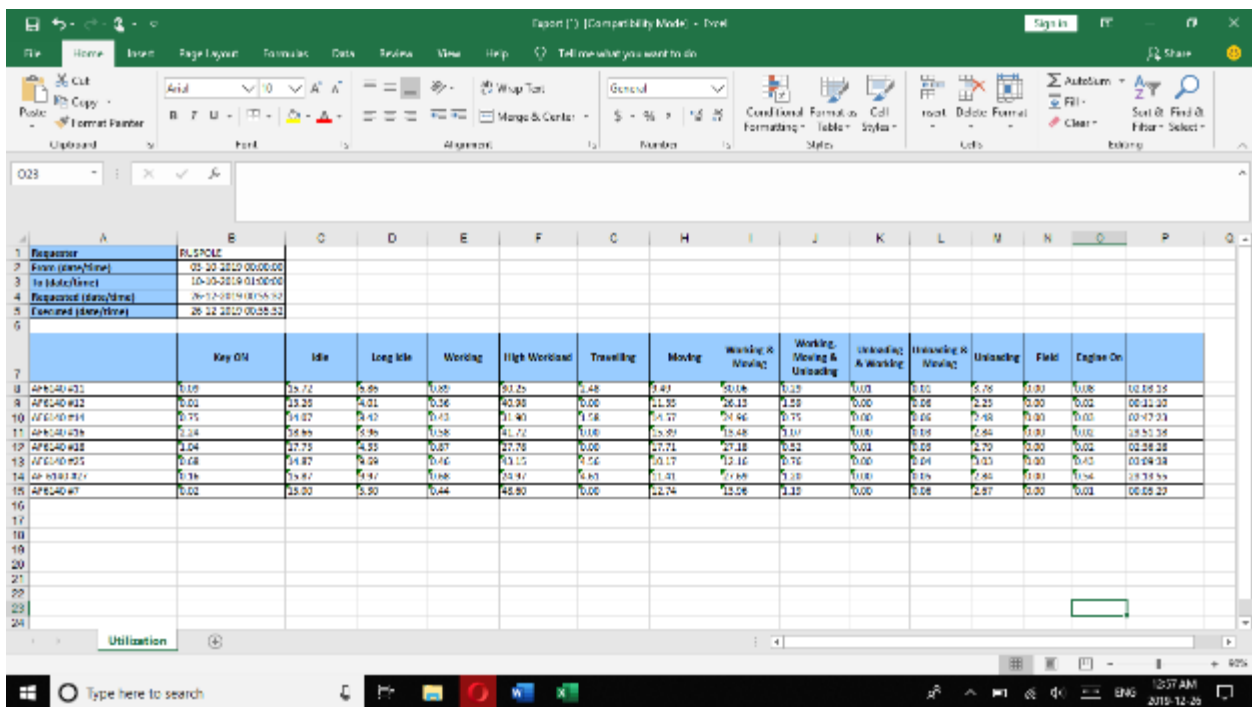
Fig 6.8. Menu "Equipment Utilization" - tabular representation of the elements of the use of technology in Excel format

1. Perform transfer, reading, synchronization and troubleshooting of data within/among the fleets/office.
2. Create and transfer a file with the basic information: farm, field, operator, supplies, guidance lines.

Today, we will look at how to create files with basic information and export them to the AFS Pro 700 display.

Note. Such desktop software as AFS, PLM, Farm Works and Trimble have one common platform, so there is no difference among them.

In the following videos, we will learn how to build a management tree and transfer basic data to different displays: AFS Pro 700 and Raven Viper Pro.

Management tree. AFS Software. Video#2. Australia. Video

You Tube link: https://www.youtube.com/watch?v=N2C5mdYvBJs

Nutrients Rx based on NDVI maps. PLM Software. Video#19. Canada. Video

You Tube link:
https://www.youtube.com/watch?v=o54BX4_TPrU&list=PL2XV1AyLKkJElDS6W
NqJcXdbL9IkHxNOv&index=18

CONTROL QUESTIONS

1. How to use the Average Fuel Rate function.
2. What control measures can ensure consumption control and fuel economy?
3. Write other resource saving measures in digital farming!

LECTURE 7
CREATE AND TRANSFER A VARIABLE RATE
APPLICATION (VRA) FILE

Agenda
1. Defining "as-applied maps" using various examples
2. Analyze data from downloaded "As applied maps"
3. Comparing existing and emerging systems for sharing and receiving data.

1. Defining "as-applied maps" using various examples

In Precision agriculture, Variable Rate Application **(VRA)** refers to the application of a material, such that the rate of application is based on the precise location, or qualities of the area that the material is being applied to. This is different from uniform application, and can be used to save money (using less product), and lessen the environmental impact.

Note. In the future, you will meet three different spellings of VRA, such as Prescription and Rx. Just you know that this is one and the same. Different producers of precision agriculture products write the same word in different ways. *VRA=Prescription=Rx*

Variable rate application can be either map based or sensor based.

-Map based VRA is pre-planned, and applications are based on VRA prescription maps that an Agronomist or Advisor prepares based on data sources. For example, prescription maps can be created using electromagnetic induction, which is considered to be cost-effective, and non-destructive.

-Sensor based VRA is calculated real-time, based on sensors that are local to the variable rate applicator.

In precision agriculture, VRA is known to be used in the following areas.

Variable Rate Seeding. Planters and drills can be made into VRA sensors, by attaching a motor or gear box. With this, you can vary the rate of the seeds. The seeding rates can also be connected to match the application of agrochemicals.

Variable Rate Weed Control. For variable rate weed control you need both a task computer and a system to physically change the flow rate of the agrochemicals.

Variable Rate Fertilizer. Crops do not always require a uniform application, as some areas will have different nutrient requirements due to their location (soil properties, sunlight). Variable rate fertilizer spreaders can be used to increase or decrease fertilizer application rate, using a global positioning system (GPS). They can also use "on-the-go" sensors, or a combination of the two.

In the next two videos, we will look at how to correctly build VRA maps based on NDVI images and send such maps from PLM Connect portal to the IntelliView 4 display using telematics.

Desiccants Rx based on NDVI maps. PLM Software. Video#21. Canada. Video

You Tube link: https://www.youtube.com/watch?v=fjNkxN7RKnc&list=PL2XV1AyLKkJElDS6WNqJcXdbL9IkHxNOv&index=20

Importing field prescription by telematics. PLM Software. Video#11. Canada. Video

You Tube link: https://www.youtube.com/watch?v=Tbg5uS-kAgzc&list=PL2XV1AyLKkJElDS6WNqJcXdbL9IkHxNOv&index=11

Creation of prescription maps for sunflower sowing in "Agro KMR" LLC. April 2020:
https://www.youtube.com/watch?v=2puq7Q1FM3I&t=4s

Info source: https://en.wikipedia.org/wiki/Variable_Rate_Application

QUIZ:

1. VRA is known to be used in the following areas. (more than one answer)
a. Variable Rate Seeding (r)
b. Variable Rate Fertilizer (r)
c. Variable Rate Desiccants(r)
d. Variable Rate Weed Control(r)

2. Variable rate application can be based on…
a. Map based VRA
b. Sensor based VRA
c. Both(r)

3. What word is undue here?
a. harvest data(r)
b. "on-the-go" sensors
c. variable rate applicator
d. Rx

If you are hiring someone to spread fertilizer, spray or plant for you this season ask for the As-Applied Map. This map will show you what really happened at your farm.

Did the fertilizer spreader really apply the variable rate prescription according to the recommendation or did the machine mal-function? Where is the fungicide check-strip? The only way to know the answers to these questions is from the as-applied map. Like the black box from an airplane as-applied maps tell you what really happened.

If your own equipment can record as you plant, spray or spread set up your machine to save the file so that you can check that your machine is operating properly.

Now we will look at a few examples of As-applied maps.
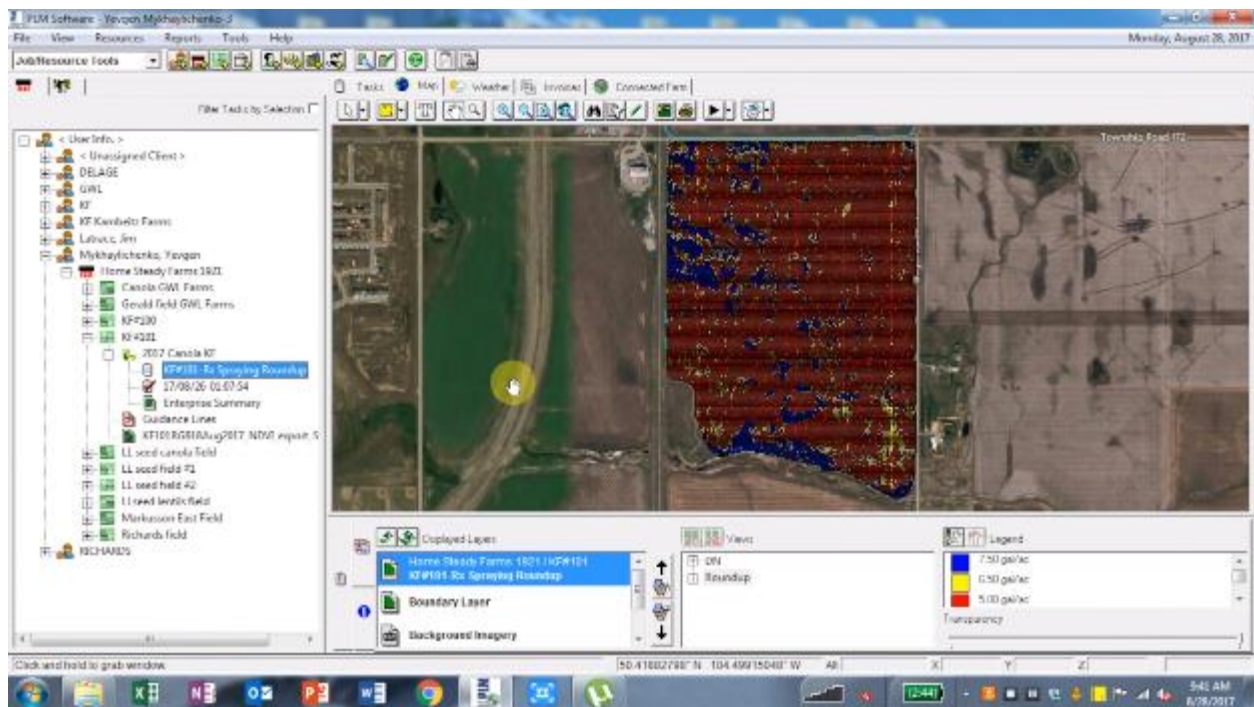
Fig. 7.1. General view of the PLM interface for spraying operations

An example of applying desiccants.

First presented is a VRA map and then as As-applied map. As you can see in comparison, the sprayer was configured and worked correctly.
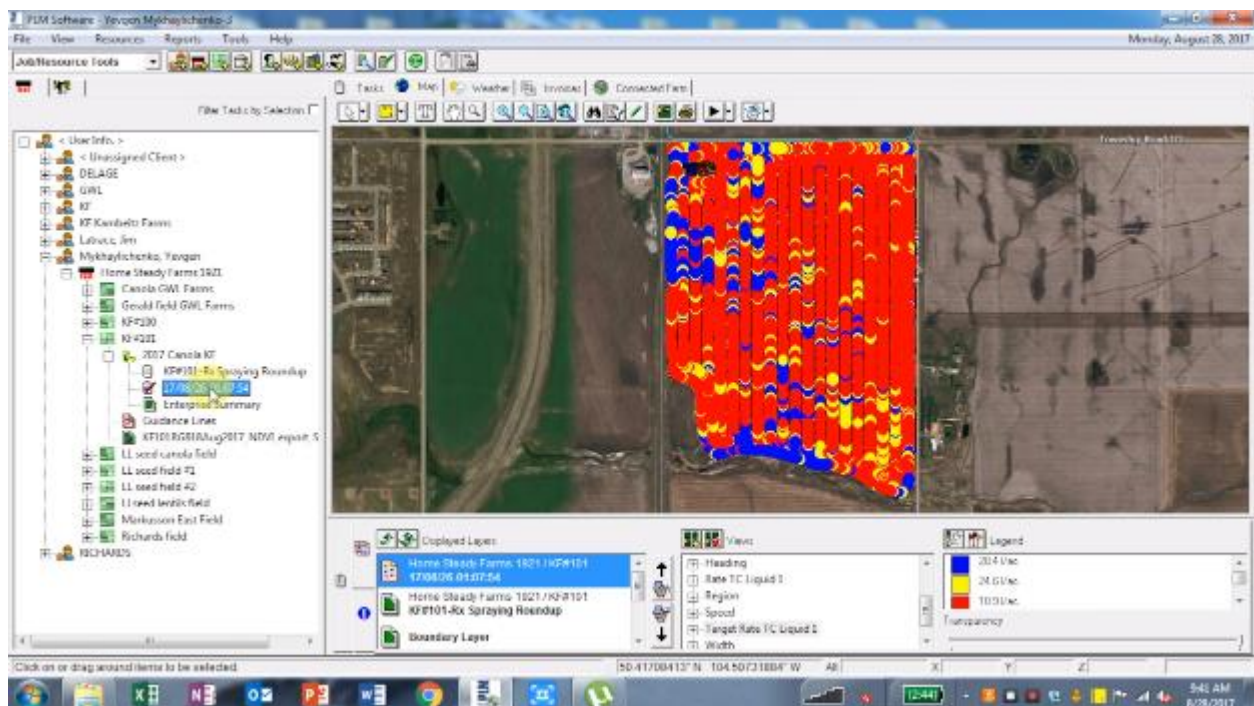
Fig. 7.2. An example of applying roundup with a sprayer
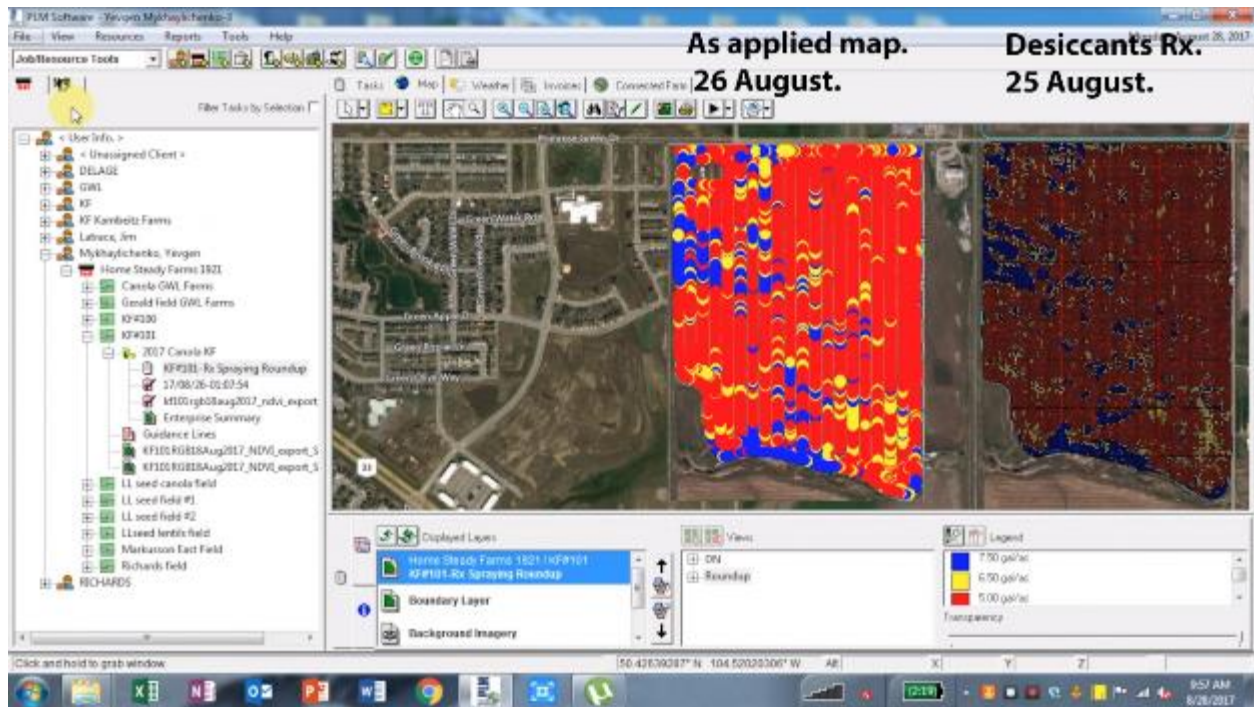
Fig. 7.3. The results of entering the roundup

An example of applying nutrients.

You need to know if your prescription fertilizer application went on correctly.

Above is an example of a 640 acre field. The Zone map in figure 1 and the Prescription map in figure 2. What the controller actually did is on the right in figure 3. This was a TopCon X20 with a 60 foot NH3 applicator operating at 6 to 7 mph. The NH3 was applied at an angle and you can see a little bit of that pattern on the as-applied map on the right.

However, this equipment is configured properly and is working extremely well. Sometimes a few adjustments are required but with a few tweaks, the Prescription map will look almost identical to the As- Applied map.
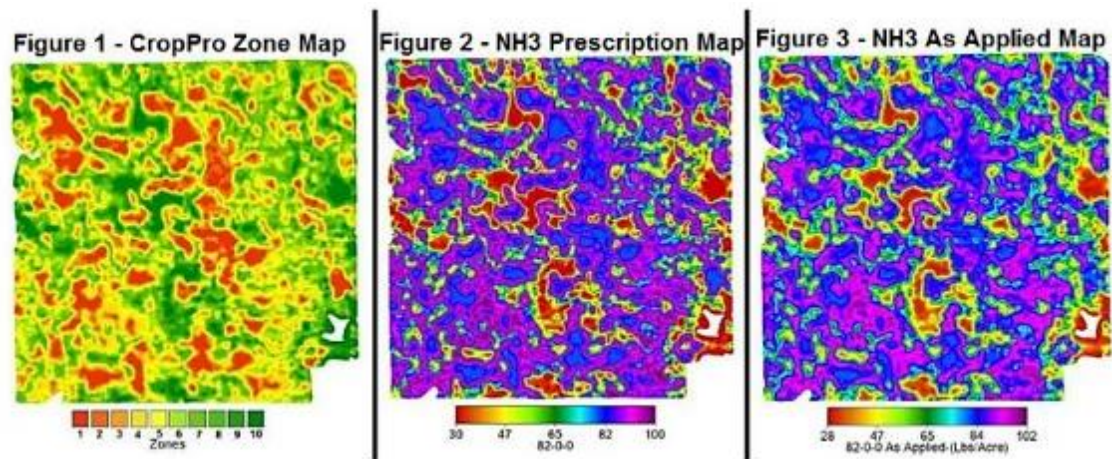
Fig. 7.4. Analytical maps based on the results of application of plant protection products

Info source:

https://www.warrinerag.com/blogs/133-as-applied-maps-find-out-what-really-happened

https://www.croppro.ca/as-applied-maps

2.Analyze data from downloaded "As applied maps".

When planting is over, we look back on how we did at our variable rate management strategies? Did those uniform seeding rates go in as we had intended? That is the value of the as-applied map! Go back to the office download your work into your desktop farm GIS software from your in-cab display via telematics and take the time to assess what actually happened out there.

Why is this important? You will need this map at harvest as guidance to go back out and get those uniform rates as separate loads for cost-benefit analysis later. Best to know (a) yes they actually went down the way I wanted them, and (b) your as-applied map is downloaded to another computer and is stored safely for future use back in the field, and(c) most important, we can update the filed boundaries, because where it was seeded, there it is necessary to apply the sprayer during the season.
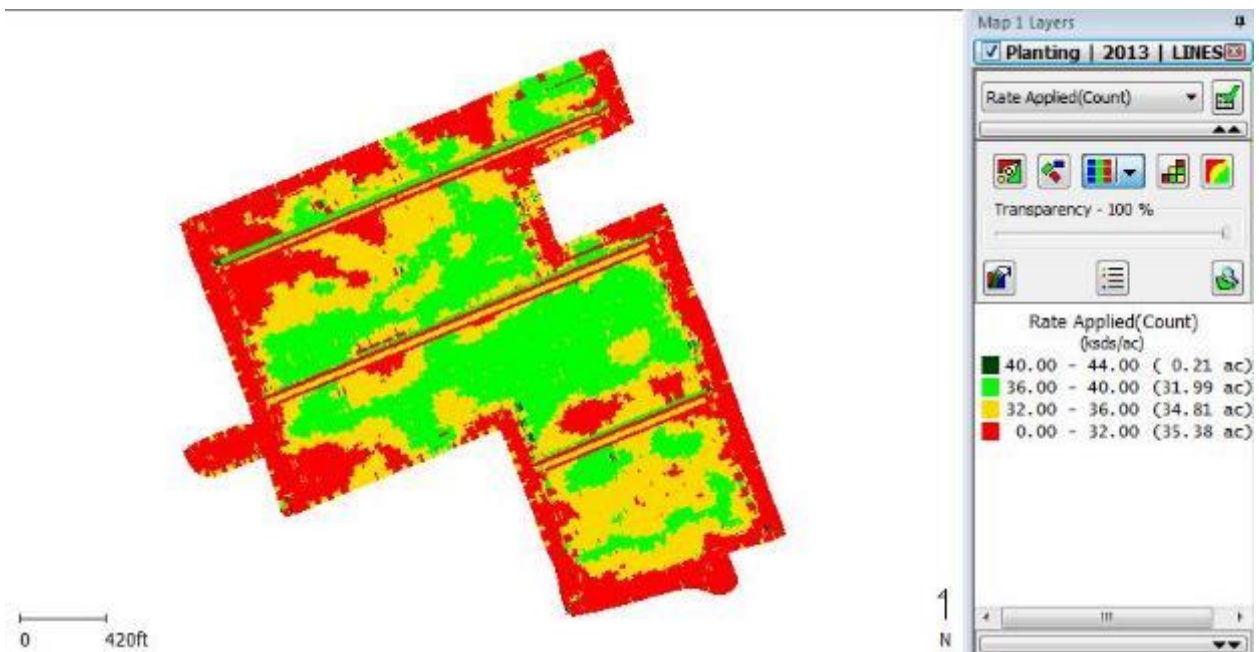
Fig. 7.5. An example of a map with the results of sowing seeds (Planting)

Variable Rate Corn – As-Applied Map: Red is 30, 000 seeds / acre, yellow is 34, 000 seeds / acre, and green is 38, 000 seeds / acre.

What is the purpose of replicated uniform rates? These zones were created from 7 corn years, the process is called normalizing, or multi-temporal yield analysis. After the corn harvest is done, we will analyze the uniform passes by yield zone to see if there was an economic advantage to varying the seeding rate across the field.

At the farm they have a 40 ft planter, but it is capable of split-planting. Therefore, in two passes we were able to get four 20ft uniform rates applied, in three separate (replicated) locations across the field. These uniform rate pairs were established before going into this field. The operator simply toggles out of the prescription (Rx) map and over to the uniform rates when they are required at a specific location in the field.
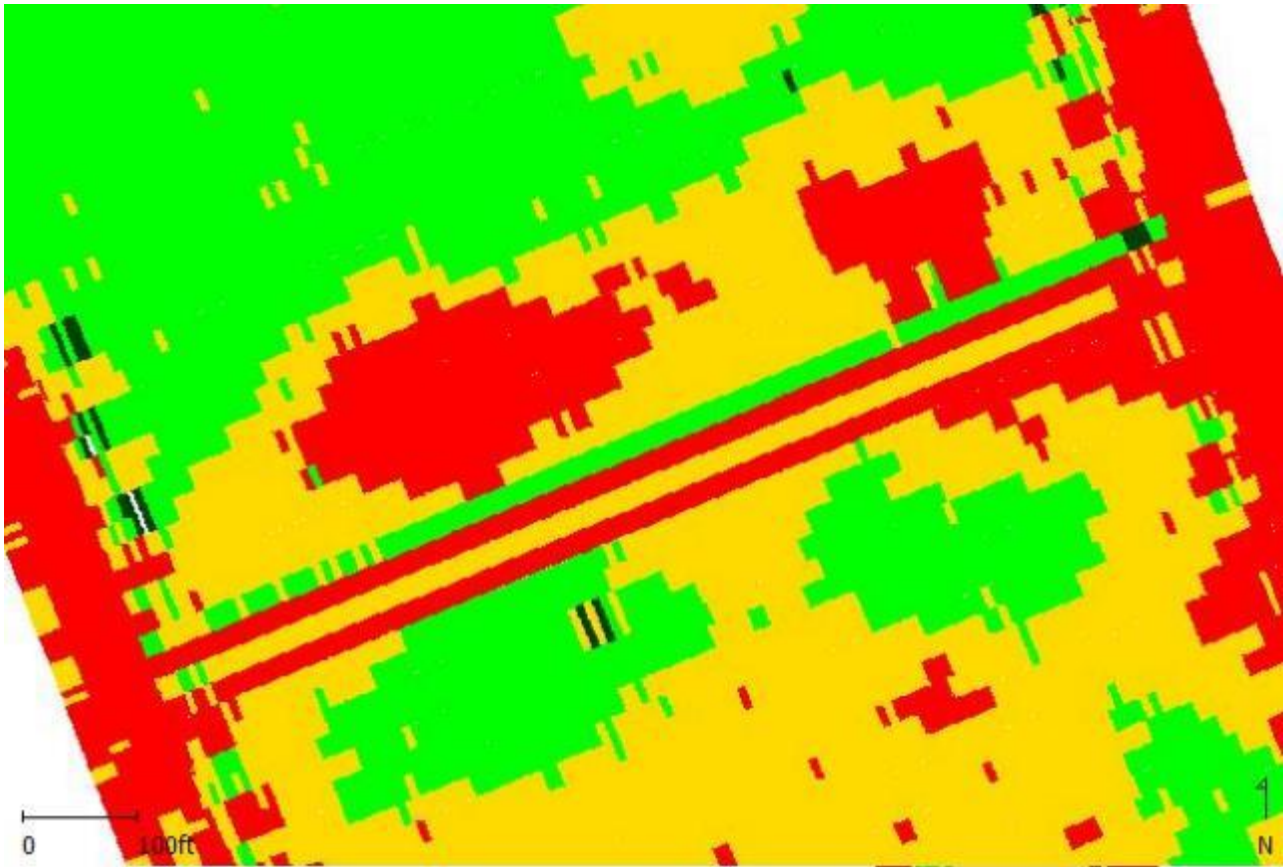
Fig. 7.6. Corn Trials – uniform seeding rate across 3 yield zones (low / medium / high). Split planter achieves 4 uniform rates in two passes: Pass 1: 30, 000 and 34, 000 seeds / acre and Pass 2: 30, 000 and 38, 000 seeds / acre.

What did we learn? Make sure your application map is set to fill the entire field boundary you choose to use this year. This is a small detail in the mapping software, that may not be automatically turned on in the office. In this case we set it to the average conventional seeding rate of 34, 000 seeds per acre. In the interior of the field this would work well if something happened to the guidance system and we needed that default uniform rate. In this field the headlands were fairly uniform, and targeted to 30, 000 seeds / acre. If the operator went outside of the field boundary (e.g. since last year the field was minus a fence row, or the application map didn't fill the map right to the field boundary) the planter would jump from 30, 000 up to 34, 000 seeds / acre. 20-20 hind-sight we would have set the default rate for the headlands to 30, 000 seeds / acre, less work for the planter, and less jumping around. You can always change it back to aver-age conventional rate after the headlands are done.

In the next video, we will see how real-time yield maps are exported using telematics (PLM Connect). The same algorithm for exporting As-applied maps.

Yield maps via telematics. PLM Connect. Video#9. Canada. Video.

You Tube link: https://www.youtube.com/watch?v=B-jYKTulbu8&list=PL2XV1AyLKkJHwBD3FK-gQieF2nVTX6G1j&index=11

Info sources:
https://fieldcropnews.com/2013/06/planting-is-over-how-are-your-as-applied-maps/

QUIZ:

1. What machines can we export As-applied maps from? (more than one answer)

a. Combines
b. Spreaders (r)
c. Planters(r)
d. Sprayers(r)

2. What can we do with planting As-applied maps immediately after seeding? (more than one answer)

a. check if our seeder is set up correctly(r)
b. use them for subsequent creation of herbicides VRA
c. update the field boundaries(r)
d. compare them with last year's yield maps

3. Why is it so important to export the herbicides VRA maps via telematics?
a. collect field information for next season
b. check sprayer display firmware
c. check if the sprayer speed is set correctly
d. you can immediately see the gaps in the work and reapply where necessary(r)

3. Comparing existing and emerging systems for sharing and receiving data.

(e.g.: the old (via cloud to the office desktop and back) and the new (via bluetooth to the in-cab display in real time).

Today we will talk about two data transmission systems. Data sharing technologies are developing every year and the factor of data perception becomes very important. Today's customer needs to see online As- applied maps data while sitting not in the office, but in the vehicle cab itself.

Let's take a look at two options and determine which one is progressive in the current market.

New Holland PLM Connect.

Customers are be able to wirelessly transfer a variety of real-time data between machines and the farm office via the cloud-based PLM Connect portal.

The upgraded PLM Connect features allow machines to be monitored from the farm office, and settings or operating instructions can be sent to an operator in real time. It also further increases the degree of interaction that is possible between the machine working in the field and the farm office, making wireless(cellular) transfer of data, such as yield maps, fuel usage and job status, between the machine and the cloud-based PLM Connect portal possible. The information can then be accessed by the farm manager on a PC or tablet.

Fig. 7.7. How PLM Connect works

PLM Connect further enhances your connectivity with its wireless file-transfer feature that uses the cloud to easily and securely transfer data to and from your machines. This means easier access, or transfer, of data such as guidance lines, boundaries, variable-rate prescriptions, as-applied data, coverage maps, yield and moisture data, etc.

New Holland PLM Connect Transforming Data into Answers. Video.

You Tube link: https://www.google.com/search?q=New+Holland+PLM+Connect+Transforming+Data+into+Answers.+Video&oq=New+Holland+PLM+Connect+Transforming+Data+into+Answers.+Video&gs_lcrp=EgZjaHJvbWUyBggAEEUYOdIBCDMzMzVqMGo5qAIAsAIA&sourceid=chrome&ie=UTF-8#fpstate=ive&vld=cid:ec113fb8,vid:5c_vRRZs_P4,st:0

Climate FieldView

Climate FieldView Drive, a device that provides seamless data connectivity for farmers by easily transferring field data from their equipment into their Climate FieldView™ account. The FieldView Drive connects to a tractor or combine controller area network (CAN) diagnostic port and uses Bluetooth technology to wirelessly map a farmer's data onto an iPad.

Unique Pairing Address
Locate the Drive's unique 12-character address to identify this device during the paring process

9-Pin Diagnostic Port
Plugs into the industry standard 9-pin diagnostic port that's built-in to most agricultural equipment

Status Indicator
The status indicator on the top face is the primary interface and will express the current status of the Drive

Steel Frame
Made with electroplated steel to resist the elements and stand up in the rugged environment

FieldView Drive works with FieldView Plus software to enable farmers to collect, store and view field map data in a single mobile tool in real time. It represents a significant advancement in data management because it provides farmers with the data, they need right in the field to help them make important operating decisions.

FieldView Drive captures key planting data including hybrid and planting population, as well as key harvest data such as yield. When FieldView Drive is partnered with FieldView Plus, data is digitally displayed as a farmer passes through a field,

enabling the farmer to easily understand hybrid performance by field, soil zone and population with side-by-side views of as-planted and yield data.
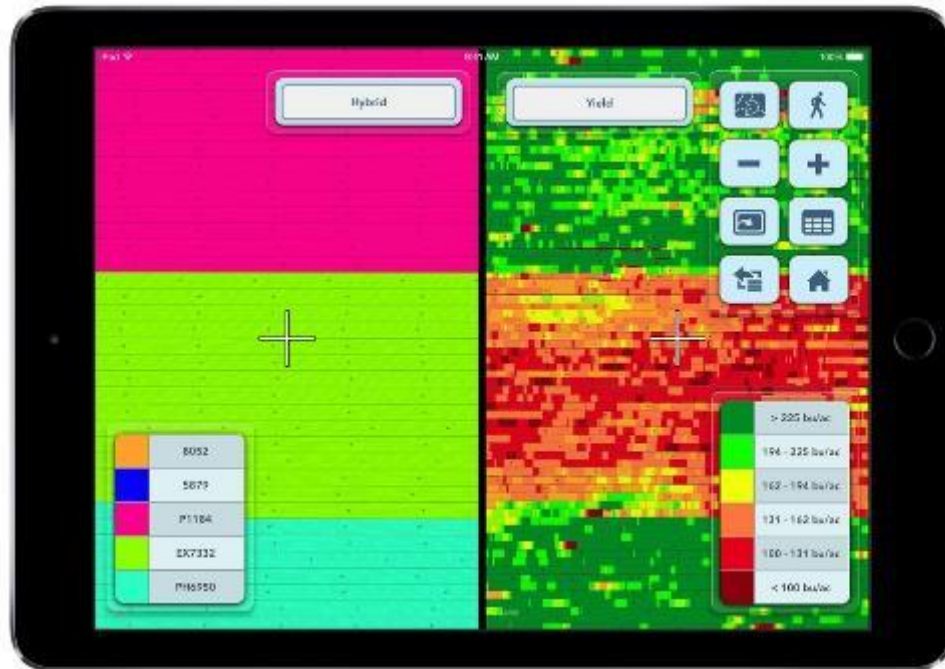
Data from any piece of a farmer's equipment that has a FieldView Drive is automatically synced with the farmer's Climate FieldView account. This seamless integration makes it easy for all of a farmer's employees and trusted advisors with access to the account to stay in the loop. Since the FieldView Drive connection to the farmer's Climate FieldView account is real-time, farmers can stay up-to-date on critical field operations even when they're not in the cab through text alerts, email reports and RemoteView. Data can also easily be shared with trusted advisors to enable fast and easy collaboration.

What is the Climate FieldView™ Platform?

You tube link: https://www.youtube.com/watch?v=zoE8ON8L-cE

Field View Review. Video

You tube link: https://www.youtube.com/watch?v=meHAeym_-HY&t=2s

QUIZ:

1. Can we call data transfer in PLM Connect as wireless?
a. Yes
b. No (r)

2. How many pins are in the Climate FieldView Drive?

a. 6
b. 8
c. 9 (r)
d. 12

3. What wireless data transmission system is used in the Climate FieldView?
a. WiMax
b. Radio
c. WI-FI
d. Bluetooth (r)

Info sources:
https://climate.com/newsroom/climate-fieldview-drive-and-fieldview-plus/16

TOPIC 8
INVESTMENT ANALYSIS FOR INNOVATON PROJECTS

Project Management Institute defines a project as "a temporary endeavor undertaken to produce a unique product, service, or result."
©PMBOK® *Guide*

"A project is a problem scheduled for solution"
©Dr. J.M. Juran

Agenda
Part 1. Project Evaluation
Part 2. Project Evaluation
Part 3. Step-by-step to project evaluation
Part 4. Case

Part 1. Project Evaluation

So, the last lecture of our course will be devoted to how to build projects correctly. This is necessary in order to understand how many and what resources you need to implement the project. And what do you plan to get from the implementation of the project. This also applies to digital farming. You will need to plan what new

technological operations you plan to use, what equipment will be needed for this, how much money and time you need, etc.

A project should have PCST:
- • definite starting and ending points (time)
- • a budget (cost)
- • a clearly defined scope
- • specific performance requirements

Розглянемо, які види проектів існують.

Table 8.1 – Types of projects

By the types	Examples
1. Scope of imple-mentation	Technical, organization, business, social, mixed
2. System network	Mono projects, multi projects, megaprojects (programs)
3. Scale	Small (budget up to 10-15 million $), big (more then 1 billion $)
4. Content	Investment, **innovation**, R&D, educational, mixed…
5. Alternative	Mutually exclusive (by resources), alternative in capital, independent, complementary
6. Duration	Short-term (up to 3-years), medium-term (3-5 years), long-term (more than 5 years)

Stakeholders / participants

Internal

- ▪ Initiator
- ▪ Customer
- ▪ Investor
- ▪ Manager and project team
- ▪ Designer
- ▪ Contractor
- ▪ Provider
- ▪ Consultants …

External

- • Authorities
- • Owners of land plots
- • Consumers of the project's products and services
- • Competitors
- • NGOs
- • Mass-media…

Project environment

- ▪ Political support or lobbying interests
- ▪ Economic climate (market, competition, infrastructure, tax policy ….)
- ▪ Safety (environmental, social, political)

- • The style of leadership
- • Organization of the project
- • Project participants
- • Project team
- • Communications
- • Economic conditions of the project
- • Social conditions of the project

Project Management is the application of knowledge, skills, tools, and techniques to project activities to achieve project requirements.

Main processes of PM: initiating, planning, executing, monitoring and controlling, and closing.

Modern approach: Plan Scope Management

     Plan Schedule Management
     Plan Cost Management
     Plan Stakeholder Management
     Control Stakeholder Management

Iron Triangle of PM vs Flexibility
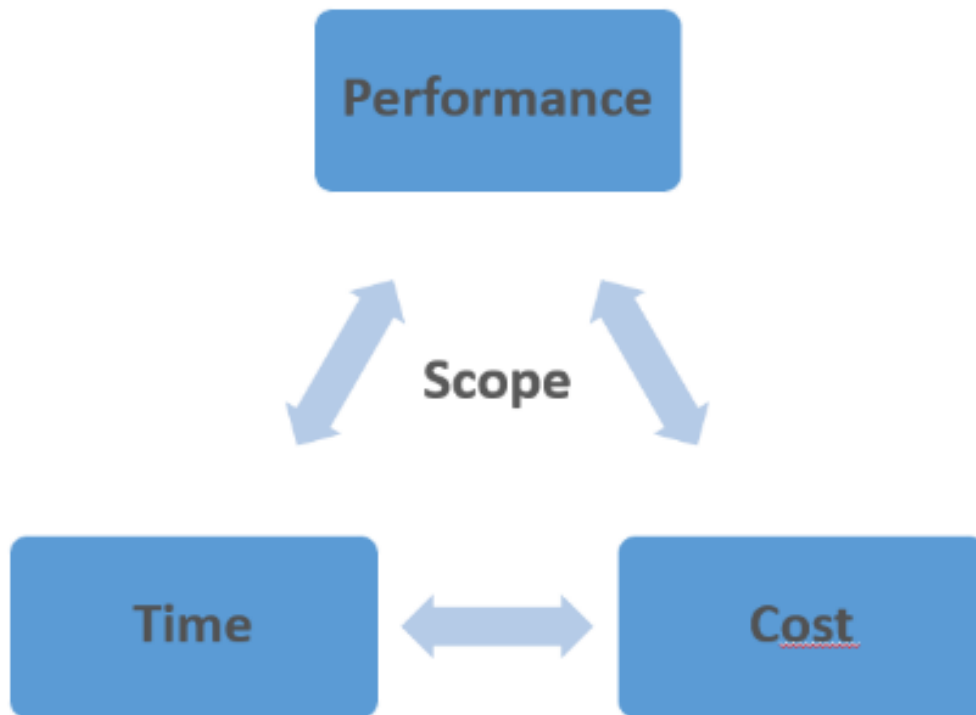
Skills for Project Manager

- Communicative skills
- Organizational skills
- Ability to plan time and budget
- The ability to make decisions
- Ability to negotiate and influence
- Leadership qualities
- Teambuilding

Part 2. Project Evaluation

Мабуть, великий із вас чули таку абревіатуру, як КПІ. Розглянемо цей параметр.

KPI – Key Performance Indicators.

- Economics
- Finance
- Market
- Social
- Environmental

Score Card

Feasibility study
- Preliminary Feasibility study – 0,25-1,5% of project value, *6-12 people-months.*
- Final Feasibility study – 2-10% of project value, *15 people-months.*
- Outsourcing for Feasibility study – special companies provide it - tenders

Feasibility Study structure
1. Idea of the Project
2. Market Analysis and Marketing Strategy
3. Raw materials and other resources
4. Place and Project environment
5. Engineering and Technologies
6. Organization
7. Human resources
8. Project Plan
9. Financial Analysis and evaluation of the investment

Main points for investment analysis are:
- Additional benefits/costs
- Visible/not visible benefits/costs
- Alternative cost of the project

The time value of money

• Present value: The current worth of a future sum of money or stream of cash flows, given a specified rate of return. Future cash flows are "discounted" at the discount rate; the higher the discount rate, the lower the present value of the future cash flows.

• Future value: The value of an asset or cash at a specified date in the future, based on the value of that asset in the present.

- **Compounding** – determination of money future value taking into account the complex interest rate:
$$FV \text{ (future value)} = PV * (1+i)^n$$

- **Discounting** – determination of money present value taking into account the discounting indicator:
$$PV \text{ (present value)} = FV \div (1+i)^n$$

- **Discounting indicator**:
$$Di = 1 \div (1+i)^n$$

  i – discount rate;
  n – number of a year.

The discount rate which is used in financial calculations is usually chosen to be equal to the cost of capital. The cost of capital, in a financial market equilibrium, will be the same as the market rate of return on the financial asset mixture the firm uses to finance capital investment. Some adjustment may be made to the discount rate to take account of risks associated with uncertain cash flows, with other developments.

The discount rates typically applied to different types of companies show significant differences:

Start-ups seeking money: 50–100%
Early start-ups: 40–60%
Late start-ups: 30–50%
Mature companies: 10–25%/

Indicators of Project efficiency

1) Net Present Value (NPV) = *PV of Cash Flow – Investment*

2)   Return on Investment (ROI) $= \dfrac{NPV}{Investment}$

3) Benefit-Cost Ratio (BCR) $= \dfrac{Discounted\ value\ of\ incremental\ benefits}{Discounted\ value\ of\ incremental\ costs}$

4) Payback Period in capital budgeting refers to the period of time required to recoup the funds expended in an investment, or to reach the break-even point.

$$PBP = (t_0\text{-}1) + \frac{I - \sum PV_{(t_0-1)}}{PV_{t_0}}$$

Part 3. Step-by-step to project evaluation

1.   What kind of benefits and costs does your project bring (absolute for projects form the scratch or added value)?

2. Predict and calculate project's benefits:
-    *added income* (increasing of price, increasing in amount of sold products, new markets …)
-    *decreasing product/service cost* (recourse or labor saving, new technology…)
-    *reduction of administrative cost etc.*

3. Estimate project's cost:
- **investment cost** (for fixed assets, capital construction ....);
- **operational cost** (direct and overhead cost).

4. Determine the method of **depreciation** (Straight-line; Double declining balance; Units of production; Sum of years digits)

https://corporatefinanceinstitute.com/resources/knowledge/accounting/types-depreciation-methods/

5. Identify sources of funding and choose a rate of interest for calculating the discount rate:
   - **for own sources** (average deposit rate, inflation index);
   - **for attracted sources** (average rate on loans);
   - **for donor's sources** (Central bank discount rate).

6. Complete the table with the mentioned above information:

№	Indicators	1st year	2nd year	3rd year
1	Benefits (B)			
2	Fixed cost (FC)			
3	Current costs (CC)			
4	Depreciation (D)			
5	Discounting indicator (DI)			
6	Cash Flow of the project = B – FC – CC + D			
7	Discounted Cash Flow = Cash Flow * DI			
8	Discounted Benefits = (B + D) * DI			
9	Discounted Costs = (FC+CC) * DI			

7. Evaluate indicators NPV, BCR, IRR, IP, PBP

The project is considered efficient if:

- the Net Present Value is more then Investments;
- the Payback Period of the project is not longer than project period;
- the BCR is more then 1 (if the preconditions are confirmed).

Part 4. Case – on practical activities!

ADDITIONAL MATERIAL FOR INDEPENDENT PROCESSING
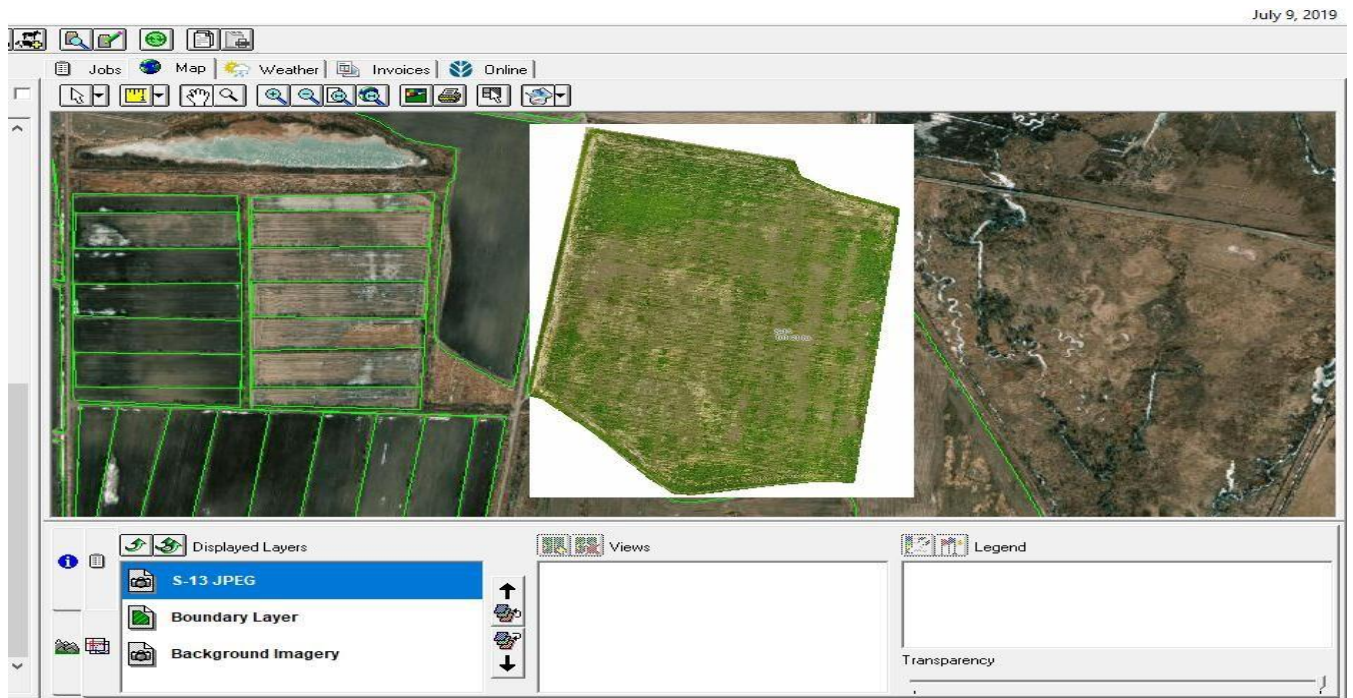
TOPIC 1

DETERMINE THE ECONOMIC BENEFITS
OF USING TELEMATICS ON A FARM

Agenda

1.   Calculate total loss via analysis of the ground speed parameter. (2 hour).

2.   Identify the potential fuel savings using Telematics. (2 hour)

Having a better understand of how, when and where your agricultural equipment is being used can lead to increased productivity on the jobsite. Operator performance can be coached when equipment isn't being operated under normal parameters. Overworking or underutilizing equipment can be better managed by understanding telematics data. Know where each piece of equipment is at all times and how much each one is being used will allow you to better deploy your equipment to the sites where they are most needed.

Today we will learn how much money you can recover from invisible costs. Let's take one of the key parameters for combines-ground speed and consider the following example.

Calculation total loss. PLM Connect. Telematics. Canada. Video

You Tube link: https://www.youtube.com/watch?v=-JE7nntX4Vw&list=PL2XV1AyLKkJHwBD3FK-gQieF2nVTX6G1j&index=9

Info sources: https://www.constructconnect.com/blog/blog-top-10-benefits-of-construction-equipment-telematics

2.Identify the potential fuel savings using Telematics. (2 hour)

Reduce Fuel Consumption

Reducing fuel consumption is one of the biggest money savers telematics systems have been proven to solve. By monitoring idling time versus work time on equipment you can identify which machines are being left on without any work being done and specify which operators are responsible for wasting fuel. Implementing best practices to reduce idling times will result in better fuel efficiency. Reducing idle times can also extend engine life and reduce repair and maintenance costs.

In the following example, we will see how the speed of movement and right choice of the selected gear affect the fuel consumption of the tractor.

Showing potential fuel savings. PLM Connect. Video#10. Canada. Video.

You Tube link:
https://www.youtube.com/watch?v=JKot6m02f70&list=PL2XV1AyLKkJHwBD3FK-gQieF2nVTX6G1j&index=10

Communicate economic benefits of using Telematics to the customer. (2 hours)

Today we will talk about the first meeting with the customer and subsequent communication with him. But for starters, let's highlight what telematics has achieved lately.

Apps support mobile diagnosis using a smartphone or tablet. All relevant engine data and the fault memory can be read out via a Bluetooth connection and sent to the local service partner – online and in real time. On this basis, the service partner decides whether remote service can be used to restore the operability of individual vehicle components online without the necessity of working on site. If a repair is unavoidable, the responsible technician immediately arrives with the required replacement parts and tools. Fleet operators can use the apps to comfortably manage their engines and to determine maintenance windows. All-inclusive packages for machine diagnosis go one step further and additionally include optimisation of the mobile working machines based on the determined data as well as training options for employees.

In this process, remote flash reprogramming comfortably ensures that agricultural machinery and ISOBUS implements are always operated with the latest software. As soon as the farmer receives the push message for new firmware on his smartphone, he confirms that the machine or the engine is ready for the flash reprogramming process and starts the update directly.

Remote monitoring and remote diagnosis alone do not ensure more efficient operation. What is important is the idle time in relation to a machine's activity. Registering the times during which machines are not running at full capacity or could be used elsewhere is important – not only in the construction industry. IT-supported fleet and order management has long since become an established part of the daily routine of farmers and contractors who cultivate their land with multiple machines and in various locations. A clearly arranged map provides them with an overview of their fields at all times, allows them to display the current position of each machine and enables them to monitor work progress.

High-performance telematics modules combine satellite navigation with mobile communications. Further wireless interfaces such as Wi-Fi or Bluetooth are optionally available. These modules undertake all of the functions required for the real-time-acquisition, evaluation and transfer of the specific machine data. They operate autonomously and are able to cooperate with various control units. Regardless of whether a combine harvester, a forage harvester or a silage trailer is involved – older harvesting machines can also be connected to the fleet management system using flexibly configurable telematics modules.

An important task of the specialist in precision farming and telematics is communication with the customer. The algorithm of actions, as well as communication and interaction with the customer itself, should be very simple. Remember, that a farmer is a universal soldier who knows:
- how to collect information about his farm and where to store it;
-when to perform maintenance of combines;
-at what humidity to start harvesting wheat, peas, lentils…;
-at what price and at what time to sell the crops and so on.
Algorithm:
1. Make an appointment with a client at his farm and check the entire existing fleet of equipment;
2. Make a list of all precision agriculture equipment (antennas, displays, modems, software) from all tractors, combines, sprayers, seeders, spreaders, even those that the customer is not going to connect to telematics. This will help you to see the full picture of his enterprise today and in 2-3 years;
3. If it is a single-brand fleet of equipment, then offer different types and terms of subscriptions for data transfer;

4. If it is a multi-brand fleet of equipment, then offer and show in which software (portal) the information and data will be collected from all units. Explain the advantages and disadvantages of single-and multi-brand fleets;

5. Once you have decided which telematics model (single or multi-brand) the customer will use, install a trial telematics modem for several weeks. Show in practice how to activate and work with telematics on a laptop, tablet or smartphone. Set up the login and password to enter the portal;

6. Focus the customer's attention on the key telematics parameters and those parameters that are primarily of interest to the customer. If the customer is ready to move to the next level, then you can show him how to send and receive files with VRA maps, field and operator names, guidance lines etc.

7. When the customer Liked the work of telematics, discuss with him a plan of action for the next 2-3 years at least. Also, offer cooperation between him and the nearest agriculture equipment dealer, who could have direct access to the equipment fleet and respond in a timely manner to scheduled maintenance and error codes received on displays;

8. Explain to the customer that the same telematics kits and subscription can also be used in sprayers, tractors and combines (if it a single-brand fleet) during the crop year.

If you need to give an example of the benefits of using telematics on a farm when there is already a certain high level of data collection, then you can show the following video.

On August 01, pea harvesting began. Eight New Holland CR9.90 combines with file transfer function. Each is connected to the PLM Connect Essential telematics package. The customer has been collecting the history of his fields for 4 years. On the third day of the harvesting start, the customer realizes that he exports data from all combines, but receives data from only seven. You can clearly see this on the yield map. When checking all USB sticks, it was found that USB from combine #6 was corrupted and interfered with data transfer to the Cloud (PLM server). The fault has been fixed. Thus, telematics indirectly helped to detect a break in data transfer and saved field information for the next 30,000 acres.

Yield maps via telematics. PLM Connect. Video#9. Canada. Video.

You Tube link: https://www.youtube.com/watch?v=B-jYKTulbu8&list=PL2XV1AyLKkJHwBD3FK-gQieF2nVTX6G1j&index=11

Info sources:
https://www.agritechnica.com/en/systems-components/assisted-farming-engineering-agriculture-through-smart-solutions/from-remote-maintenance-to-telematics

E.   Manage data usage and communication among various roles such as the field operator/ farm manager/ service manager (Ag equipment dealer) in real time. (9 hrs)

1.   Manage alarm settings and error codes. (1hr+2hr)

Your vehicles are crucial to your fleet, and to the success of your business. Advanced engine diagnostics help fleet managers keep tabs on vehicle health and performance through alerts, vehicle inspection reports, and charts that indicate potential risks. This information helps to prevent emergencies, reduce maintenance expenses, and prolong the life of each vehicle.

Some features of diagnostic reporting include:
-Excessive hard braking and hard stops alerts to reduce wear and tear;
-Vehicle fault codes so engine issues can be diagnosed before a breakdown;
-Diagnostic reports detailing every failure item;
-Current engine status;

With accurate engine diagnostic reports, farm managers and service manager (Ag equipment dealer) are able to receive important information about the fleet, allowing for improved overall efficiency while on the field.

Fleets can monitor engine diagnostic trouble code (DTC) alerts, giving managers access to information such as engine functions like battery voltage, coolant temperature, powertrain malfunctions, intake valve issues. The ability to utilize real-time vehicle diagnostics is immeasurable, with fault code data instantly delivered to fleet managers, either farm manager or dealer service manager, and dispatchers to help them schedule shop time and maintenance resources in advance to reduce vehicle downtime.

One of the main tasks of a telematics specialist is to predict all possible breakdowns and downtime. The specialist should set up a system of interaction between the farm manager and the dealer service manager in such a way as to minimize telephone conversations and to exchange data online. In this case, the specialist must configure and provide access for the dealer service manager to the telematics portal of the farm.
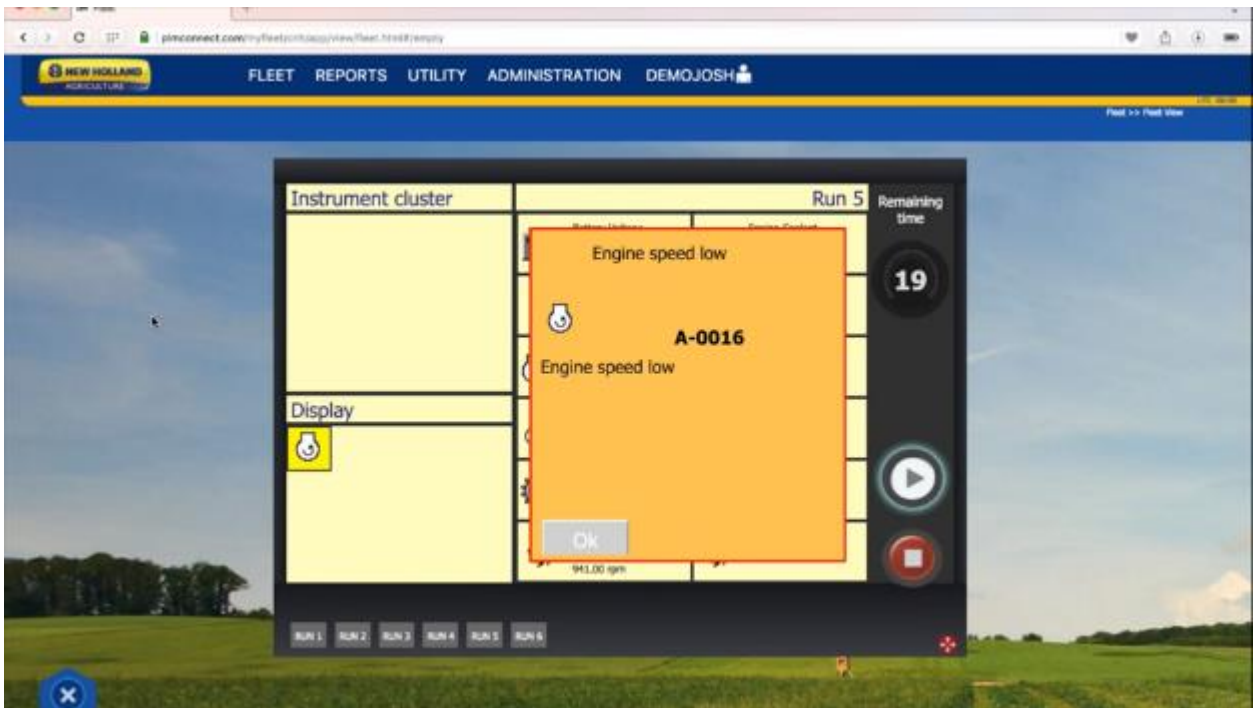
As an example, we will go to the AFS Connect portal and pull out Alarm data.
Reports - Performance - Alarms
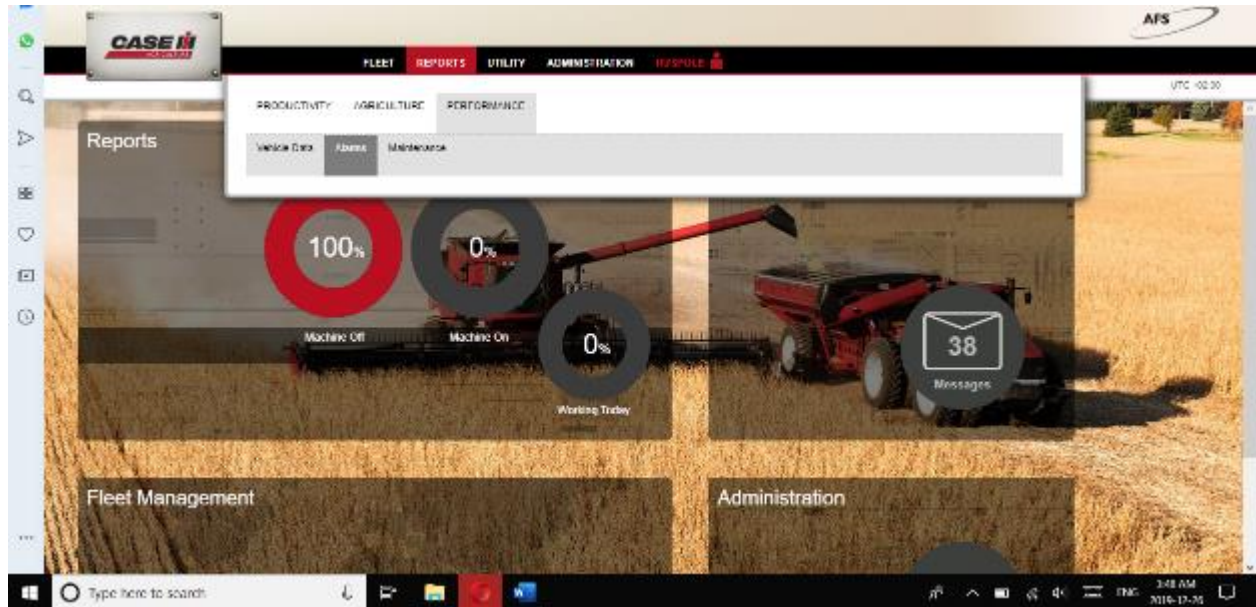
Select dates and vehicle. Click on the Generate report button.

Click on XLS button to generate Excel file.

Info sources:

https://www.verizonconnect.com/resources/article/fleet-telematics-reporting-capabilities-to-improve-fleet-management/

https://www.ttnews.com/articles/importance-predictive-maintenance-telematics
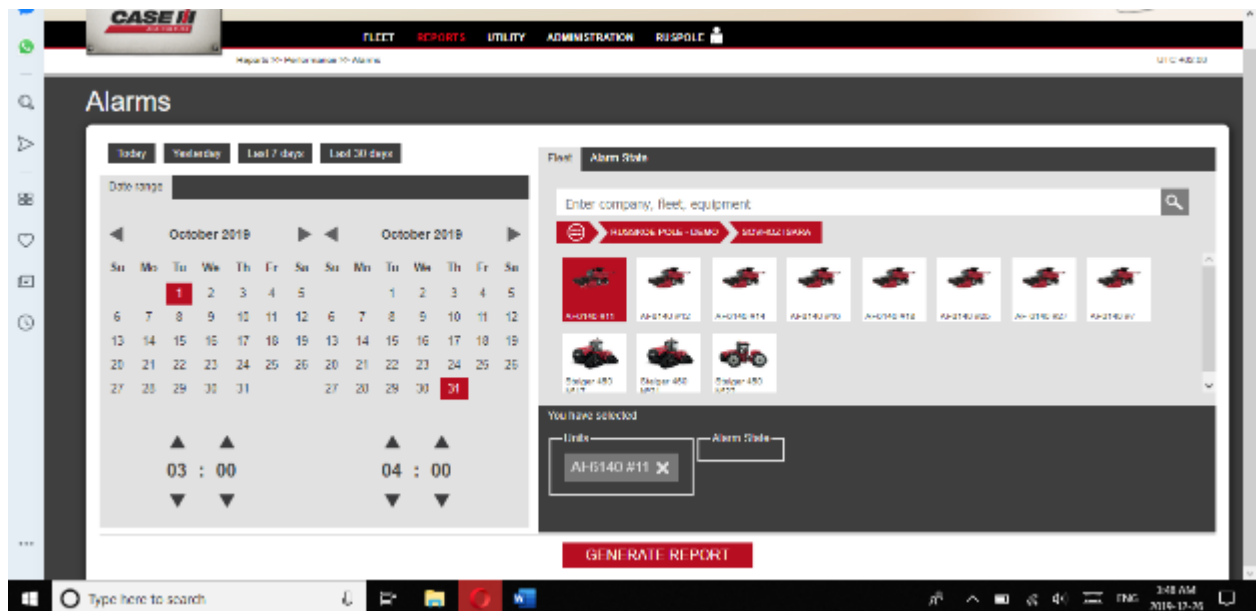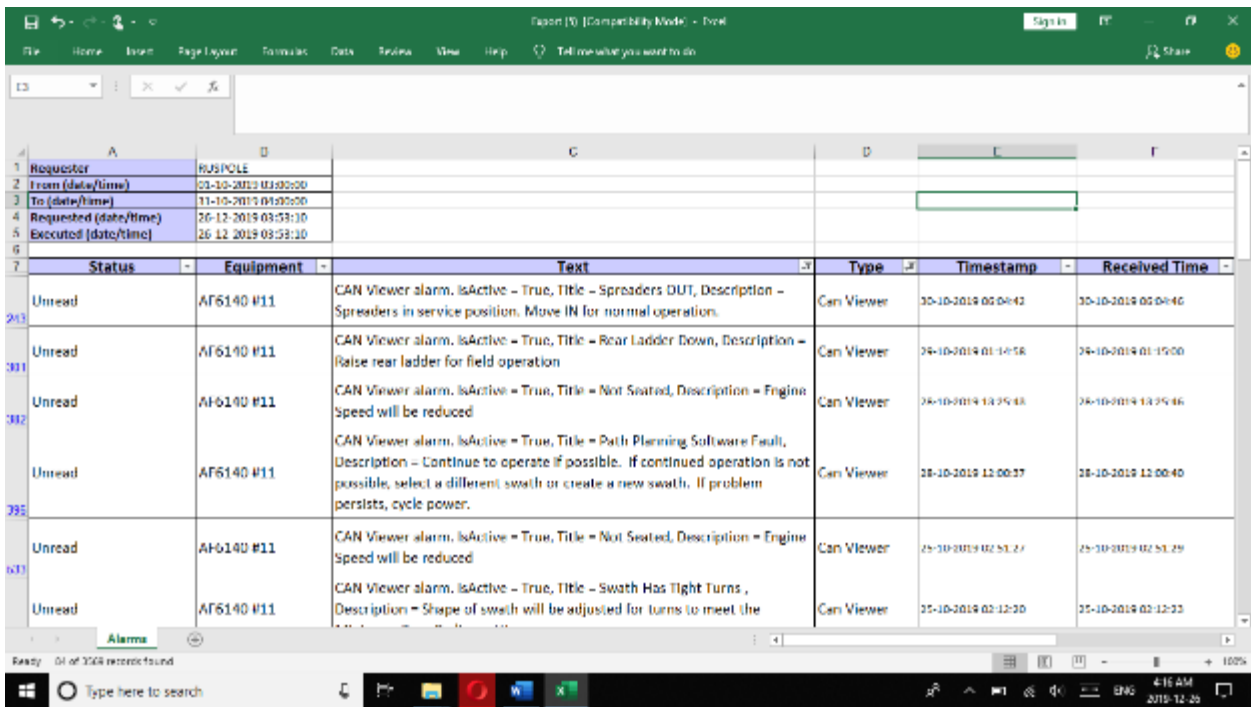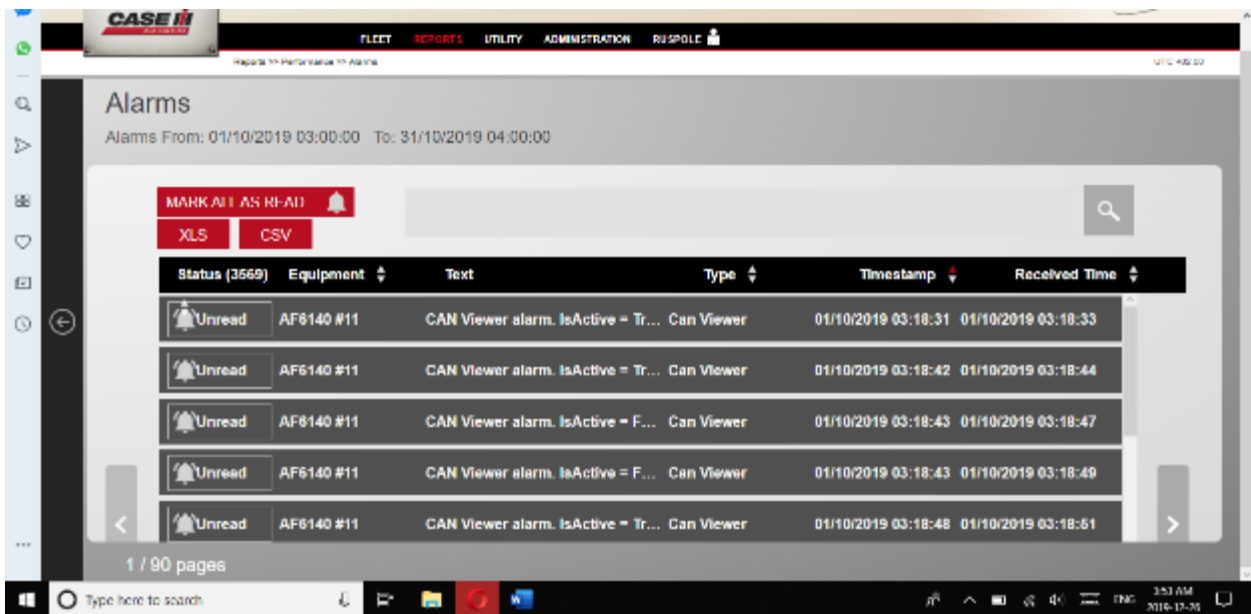
https://www.worktruckonline.com/157106/maintenance-safety-and-compli-ance-aided-by-telematics

QUIZ:

1. What features of diagnostic reporting do include? (more than one answer)

a. vehicle fault codes (r)
b. diagnostic reports (r)
c. curfew
d. geo-fence

2. When monitoring engine diagnostic trouble codes, which engine functions will the fleet manager get access to? (more than one answer)

a. tire pressure
b. battery voltage (r)
c. concave clearance
d. coolant temperature(r)

2.   Manage (read and set) Controller Area Network (CAN) parameters. (1 hr+1hr)

New Holland knows that there are many complexities to manage within your farm operation, and making sure your equipment stays running at peak utilization is key. PLM Connect enables remote monitoring of detailed machine information contained on the machine's CANBUS. This means you can partner with your New Holland dealer to proactively prevent maintenance issues, or quickly resolve issues in the field, ensuring that you get maximum productivity from your machines and that they are always running during the most critical times.

Fleets can reduce accidents through active detection and notification of possible dangers. If an employee is driving erratically, fleet managers can be notified in real-time, giving them the ability to reach out to the driver and find out what is happening. They might be distracted by their cell phone, suffering from a mechanical or physical ailment, or just be hurrying to get to the next location — situations that can be corrected before they lead to an accident.

In order to set up CAN parameters, you need to go to the telematics portal in the CAN Viewer section.
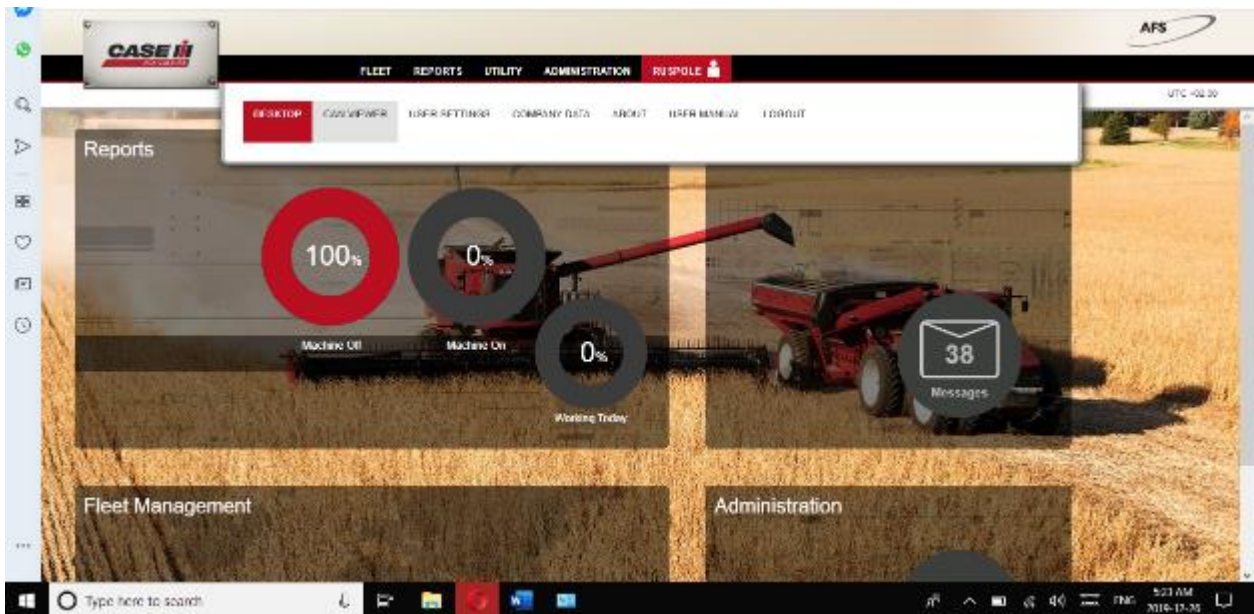
Check the boxes next to the selected parameters in each Run Screen and click on Save button.
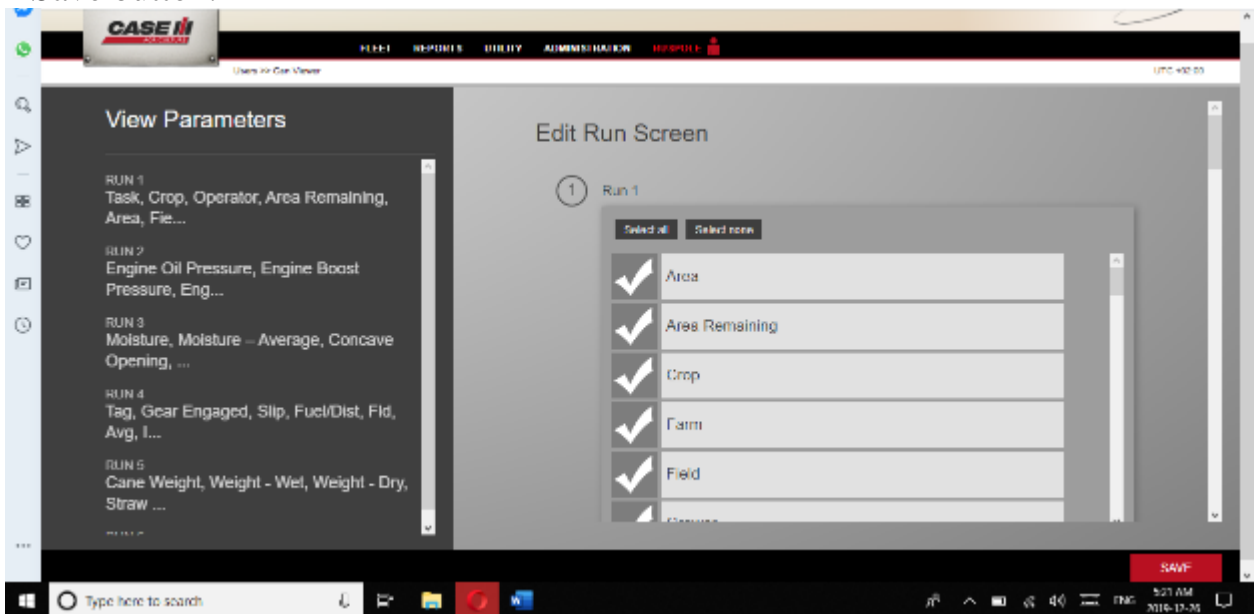
To check the correctness of the selected parameters, you need to go to Fleet Management and click on a vehicle icon. Then click on the CAN Viewer function and check the Run Screens on the new page.
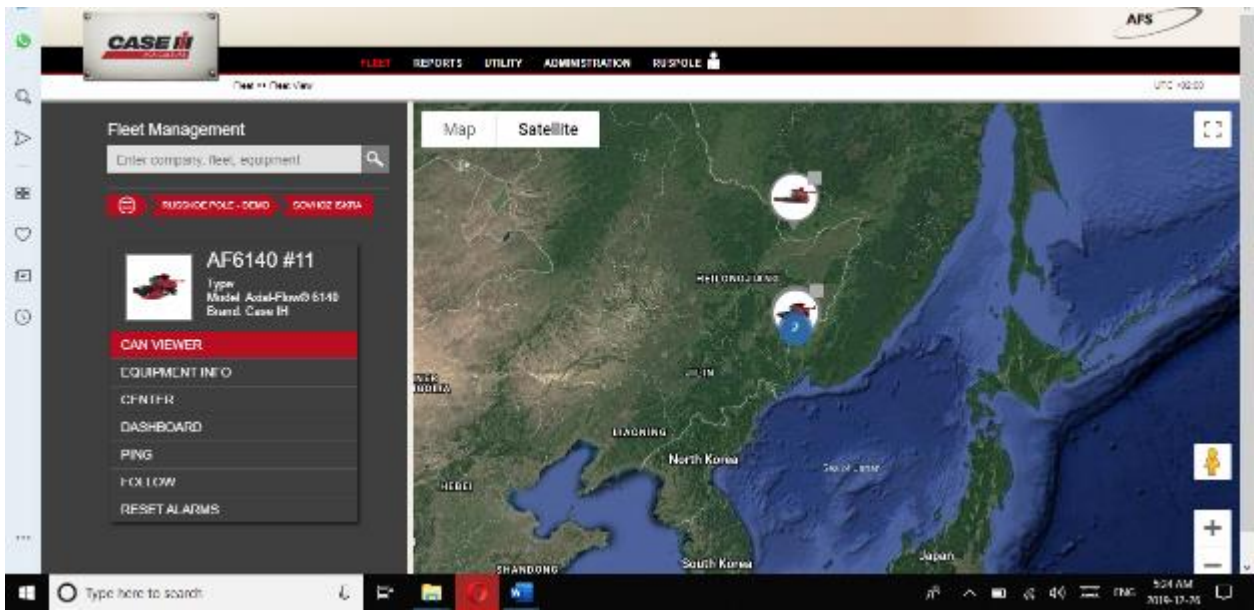
CAN Viewer function of telematics. PLM Connect. Video#7. Canada. Video.

You Tube link:
https://www.youtube.com/watch?v=CtX0DNYDhyA&list=PL2XV1AyLKkJHwBD3FK-gQieF2nVTX6G1j&index=7
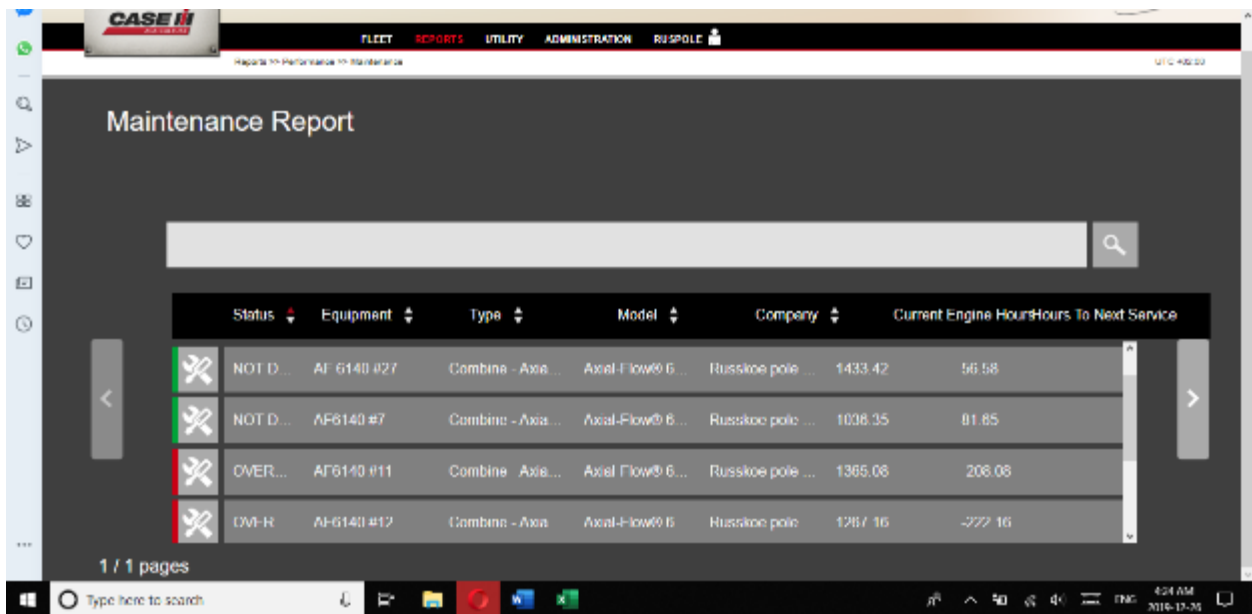
3.   Manage maintenance notifications. (1hr+1hr)

Telematics systems can act as virtual odometers for scheduling preventive maintenance. These odometer readings are exported directly from the engine control unit (ECU) and can then be automatically sent to the fleet's telematics dashboard, giving fleets the ability to schedule vehicle maintenance more precisely, reduce overall maintenance costs, and decrease fleet downtime.

Aside from the monetary savings, using telematics to keep up with preventive maintenance and keep an eye on each vehicle can also increase fuel efficiency, reduce greenhouse gas emissions, increase uptime and productivity, maintain vehicle safety, and help you stay in compliance with vehicle inspections.

QUIZ:

1. Odometer readings are exported directly from?

a. sensors
b. engine control unit(r)
c. display
d. NAV controller

2. Do all error codes have their own code numbers?

a. Yes

b. No(r)

Info sources:

https://agriculture.newholland.com/apac/en-au/precision-land-management/products/data-management-telematics/plm-connect-essential

TOPIC 2
MANAGE VEHICLE DATA READING.
(1 hr+1hr)

Data collected by the telematics device are sent in a packaged format to a data center. The data then gets decoded.

A vast amount of data can be collected via the telematics device and other connected hardware or sensors, such as position, speed, trip distance/time, idling, fuel consumption, vehicle faults, battery voltage, and other engine data.

In the case of PLM or AFS Connect, this information is stored in the cloud and brought into a fleet management portal, accessible from a desktop computer or a mobile device like a smartphone or tablet. Using the portal, users are able to view and export reports and gain business intelligence such as the first 5 vehicles that are due for scheduled maintenance.
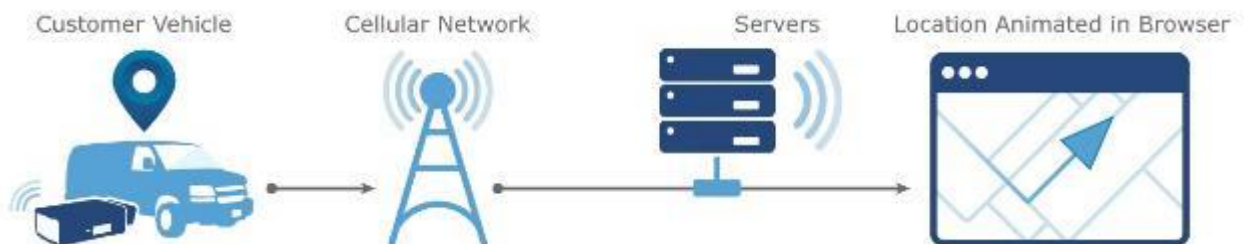
As an example, we will go to the AFS Connect portal and pull out data for the following parameters: Engine hours and Engine load.

Reports - Performance - Vehicle data
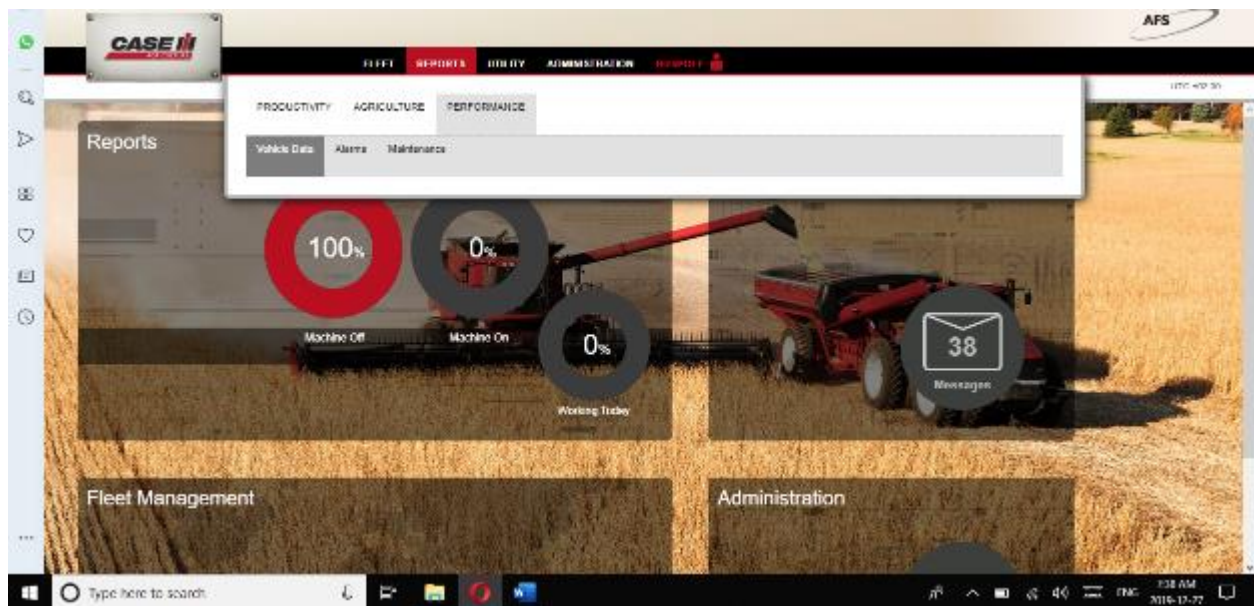
Select dates and vehicle. Click on the Generate report button.
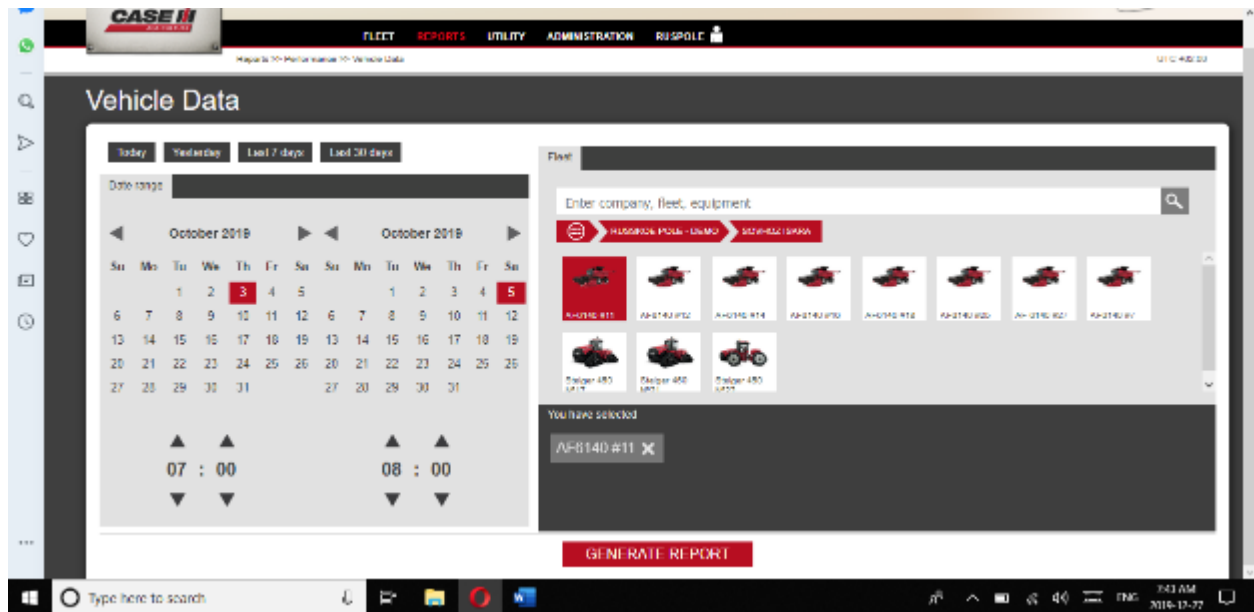
Select parameters from the list.

Click on XLS button to generate Excel file.

Info sources: https://www.geotab.com/blog/what-is-telematics/

QUIZ:

1.Which data transfer path is correct?
a. Vehicle - Cellular network - Data center - Portal(r)
b. Vehicle - Data center - Cellular network - Portal
c. Cellular network - Vehicle - Data center - Portal
d. Data center – Vehicle – Cellular network - Portal

2. What word is undue here?
a. vehicle data
b. data center
c. battery voltage
d. guidance lines(r)

F.   Manage telematics usage in single- and multi-brand fleets. (9.5 hours)
1.   Differentiate between single- and multi-brand fleets. (1 hr + 1.5 hr)
How to differentiate between single- and multi-brand fleets in the enterprise?
        You have probably already come across the fact that farmers like to experiment and find the best option for choosing their equipment. Quite rarely you can find a farm where there is only one agricultural brand, if we are talking about tractors, combines, seeders, sprayers and spreaders. Usually the picture is as follows: Case IH tractors, CLAAS combines, John Deere sprayers and Bourgault seeders or vice versa.

        A **single-brand fleet** is all the existing equipment at the enterprise and all the additional elements (displays and software) of only one brand. No aftermarket.
        Single-brand fleet example.
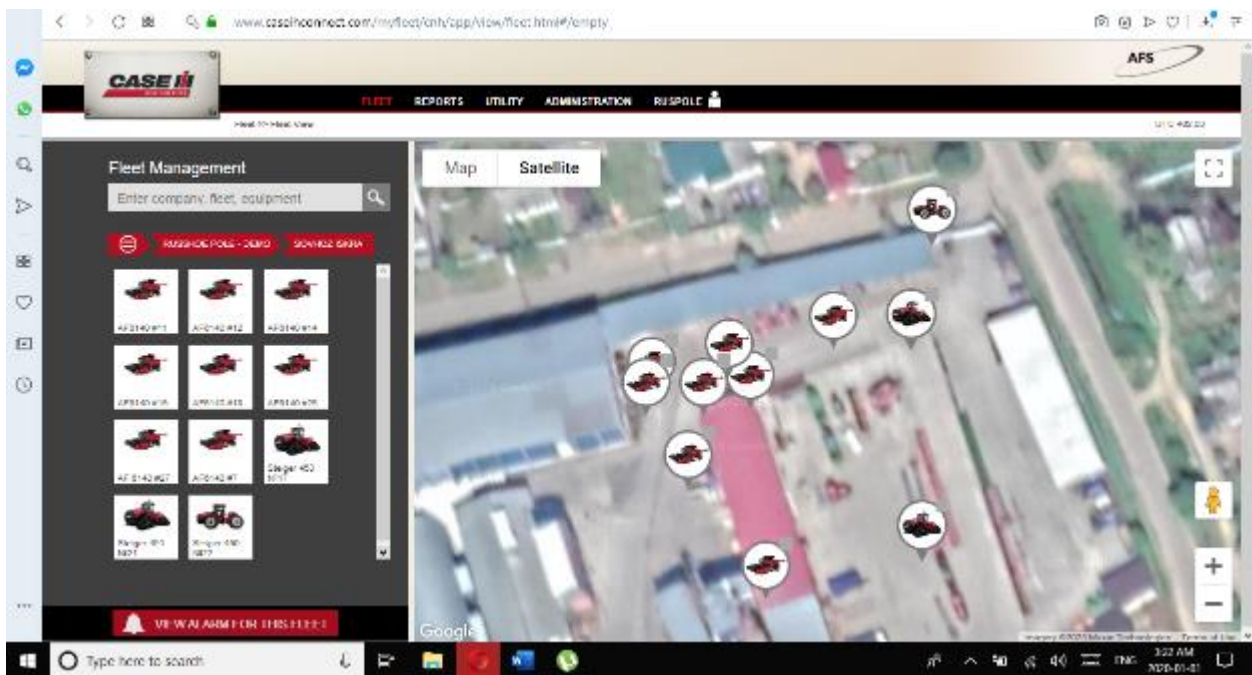
If taken in percentage terms, then in Western Canada 25% of single-brand farms and 75% of multi-brand.

Can we still call it a single-brand fleet, when all the tractors and combines on a farm are Case IH, for instance, and seeders are John Deere?

If the seeders are connected to tractor AFS Pro 700 displays, work through ISOBUS, transfer data to the VT (virtual terminal), and accordingly to the telematics portal AFS Connect, then yes, this fleet can be called a single-brand fleet.
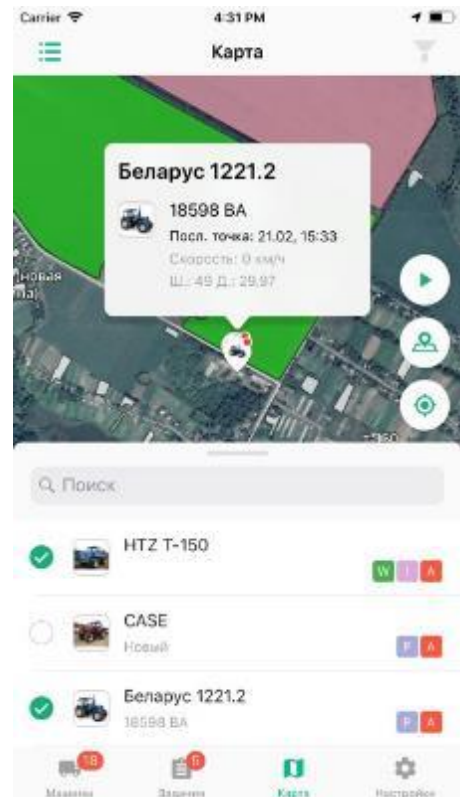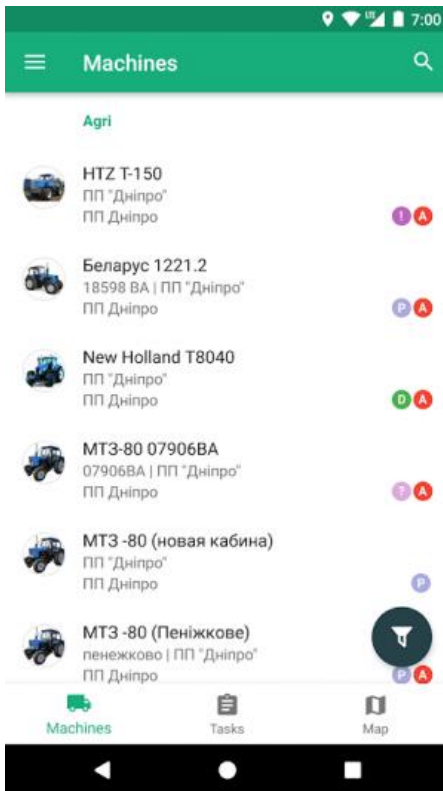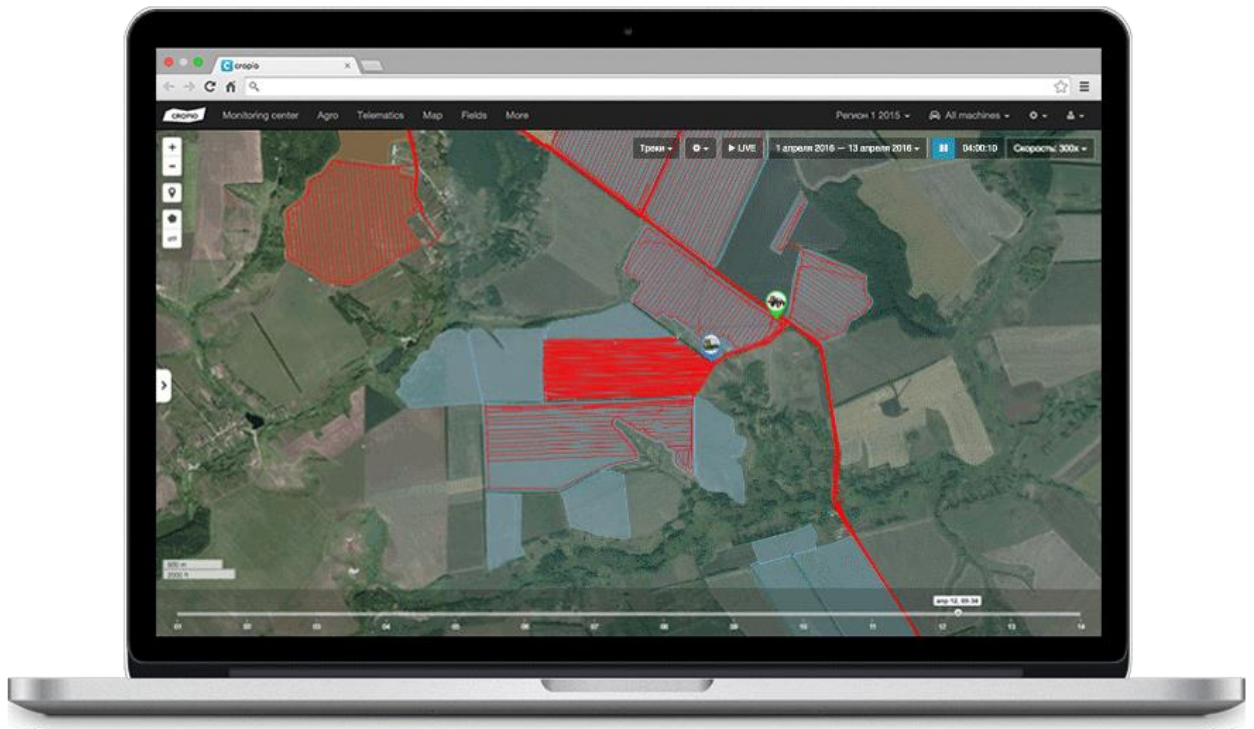
Advantages:

-easy and faster to set up;

-direct connection to the ECM (engine control module), that allows to read error codes and transfer files (Rx map, field information, guidance lines etc.);

-provision of services from one producer (ag dealer);

Disadvantages:

-monopoly price for telematics equipment and subscription;

-sometimes not very friendly interface.

A **multi-brand fleet** is when machines operate under a variety of brands at one enterprise, including displays and software.

Multi-brand fleet example.

Advantages:
-friendly interface;
-usually 25-40% cheaper than original single-brand telematics;

-ability to unite different brands in one enterprise and on one software;

Disadvantages:
-no access to the ECM, that allows to read error codes and transfer files (Rx map, field information, guidance lines etc.);
-dependence on many different producers, in particular on the providing of services;

Although, in recent years, the situation with the function of transferring data to the display of tractors and combines in multi-brand fleets has changed. Companies appeared such as Ag Bridge and Farmobile, whose devices are capable of implementing the file transferring function. However, these companies remain little know due to insufficient marketing of their products and a lack of qualified specialists who could professionally teach customers.

Grower Connections: How it Works

AS-PLANTED
AS-APPLIED
AS-HARVESTED
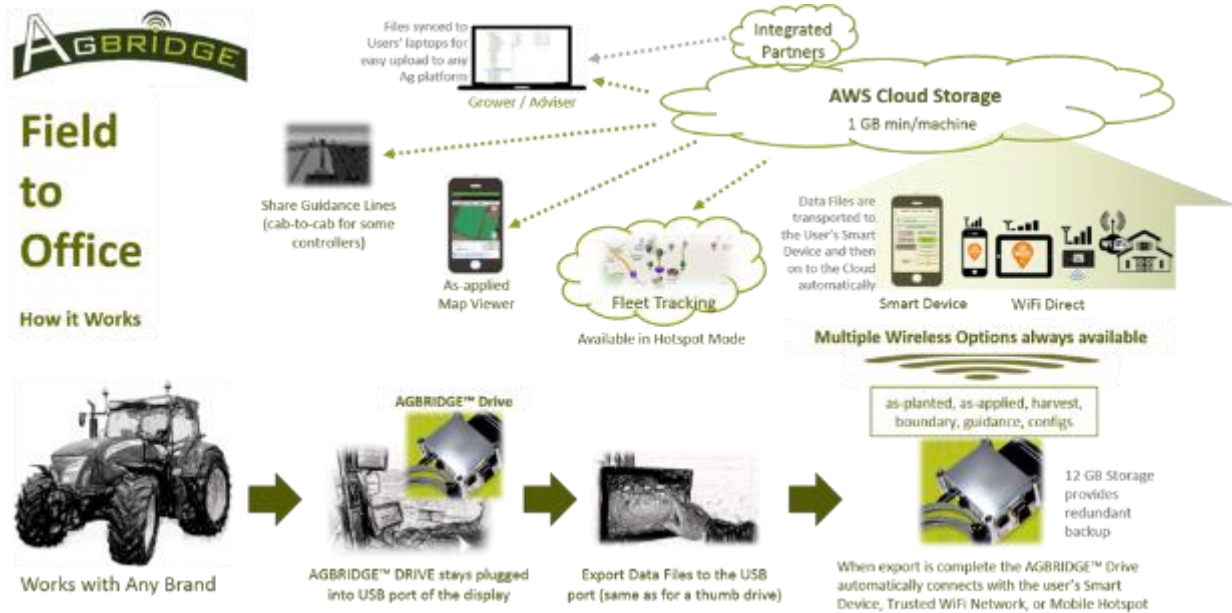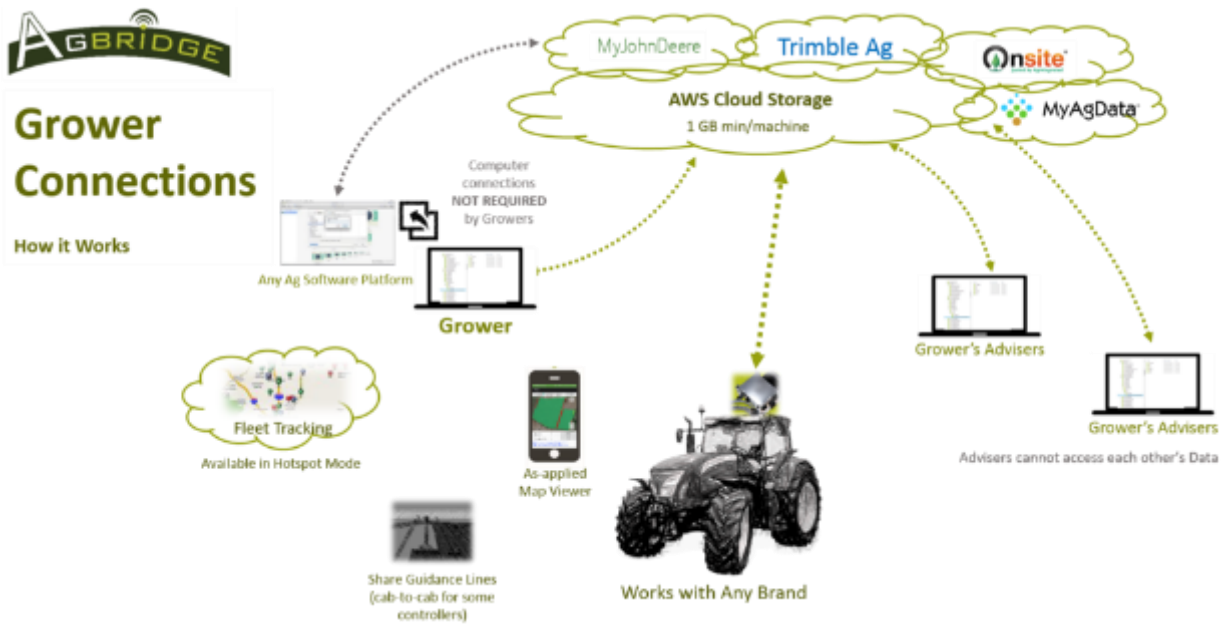
2. Define API connections (Application Programming Interface). (30 min)

API stands for **Application Programming Interface**. An API is a software intermediary that allows two applications to talk to each other. In other words, an API

is the messenger that delivers your request to the provider that you're requesting it from and then delivers the response back to you.

An API defines functionalities that are independent of their respective implementations, which allows those implementations and definitions to vary without compromising each other. Therefore, a good API makes it easier to develop a program by providing the building blocks.

What is an API? Video.

You Tube link: https://www.youtube.com/watch?v=s7wmiS2mSXY
Info source: https://blogs.mulesoft.com/biz/tech-ramblings-biz/what-are-apis-how-do-apis-work/

3.   Explore main telematics producers with API connections. (2 hr+1 hr)
Today we will talk about the main telematics producers with API Connections. Let's see what third-party companies they work with and is it so easy to work with API as we think?

CLAAS API Connections.

CLAAS has developed the new CLAAS API to provide an interface between TELEMATICS and third-party Farm Management Information Systems (FMIS) – making it much simpler for farmers to use their chosen software solution for planning and documentation.

Data exchange with TELEMATICS

The CLAAS API enables Farm Management Systems to easily exchange data with TELEMATICS. The open standard interface with defined processes and support mechanisms is available to all interested suppliers of Farm Management Systems. To connect their TELEMATICS system to their chosen FMIS, farmers simply have to enable data exchange in TELEMATICS. A simple connection dialogue box is provided to assist them. Once this process is complete, data are exchanged between the connected systems automatically. This makes documentation tasks easier for the farmer and avoids errors and data losses.

TELEMATICS is a digital data transfer system which continuously retrieves and records work data, tracks and yield data from connected CLAAS combine harvesters, forage harvesters and tractors. All data are transmitted via the mobile phone network from the machines to the server, where they are processed and stored. Farmers can access and evaluate their data online via the TELEMATICS website using a farm PC, laptop or smartphone.

The "automatic documentation" add-on module automatically assigns recorded data to the fields which have been worked.

The CLAAS API enables field boundaries, for example, to be synchronised with TELEMATICS. This allows them to be maintained centrally in one system. Automatic documentation data on consumption, time and yield for individual fields can then be transferred to the Field Management System.

Several partners on board

In preparation for launching the CLAAS API, several FMIS suppliers have already enabled the data exchange system:

-365FarmNet

-Cropio

-Trimble
-CLIMATE FieldView
-OMNIA (H. L. Hutchinson Ltd.)
-mySOYL (SOYL a division of Frontier Agriculture)
-SEGES CROPMANAGER
-MyEasyFarm
-Biogaspower (LivingLogic)

JohnDeere API.

The MyJohnDeere API enables client applications to securely pull file, organization, user, and partnership data from MyJohnDeere. With this API, you can develop apps that allow farmers, dealers, organizations, and partners to access and share information on the MyJohnDeere portal via PCs, tablets, and smartphones.

MyJohnDeere API connects your apps with the MyJohnDeere cloud. This API uses the wireless data transfer capability provided by the combination of cloud services, machine telematics, and a JDLink™ subscription

Features

-Upload and download files to and from the MyJohnDeere cloud.

-Transfer files from the MyJohnDeere cloud to JDLink™-enabled John Deere machines.

-Securely share files between MyJohnDeere organizations.

Note: No one can access a customer's files unless the customer has granted them the appropriate permissions in MyJohnDeere.
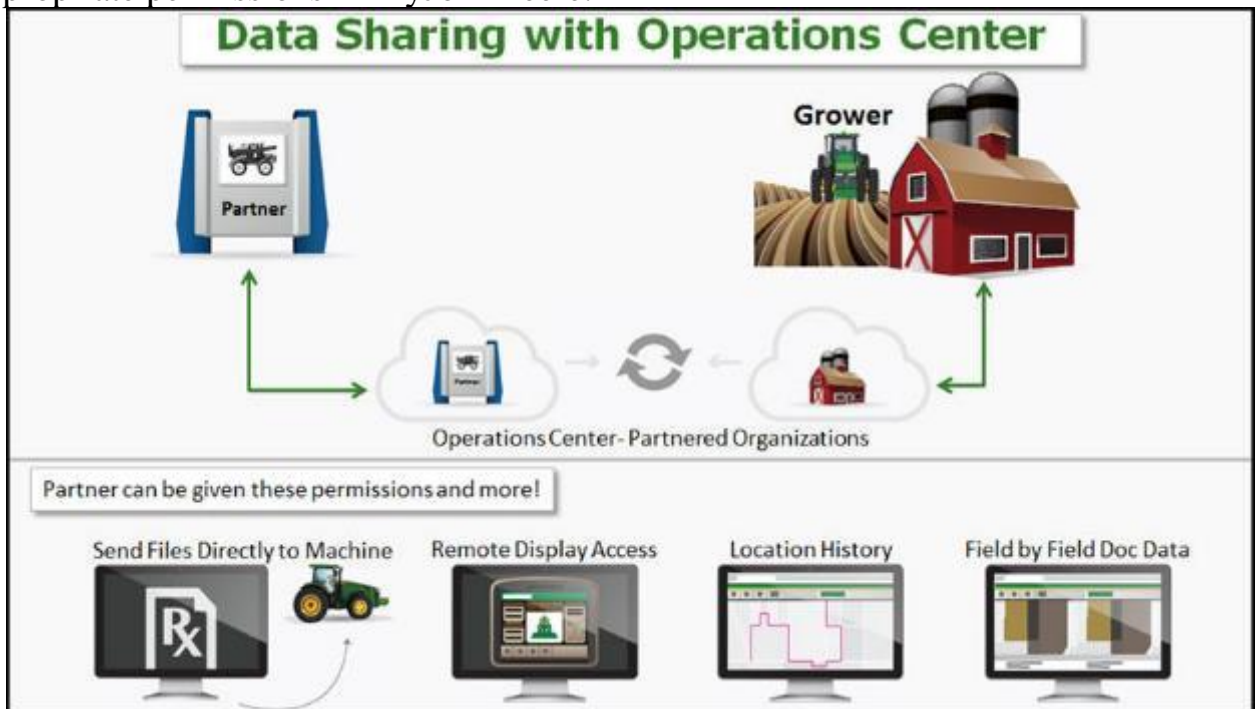
My JohnDeere API - Files & Field Operations. Video.

You Tube link: https://www.youtube.com/watch?v=DLZOk-nvOWM
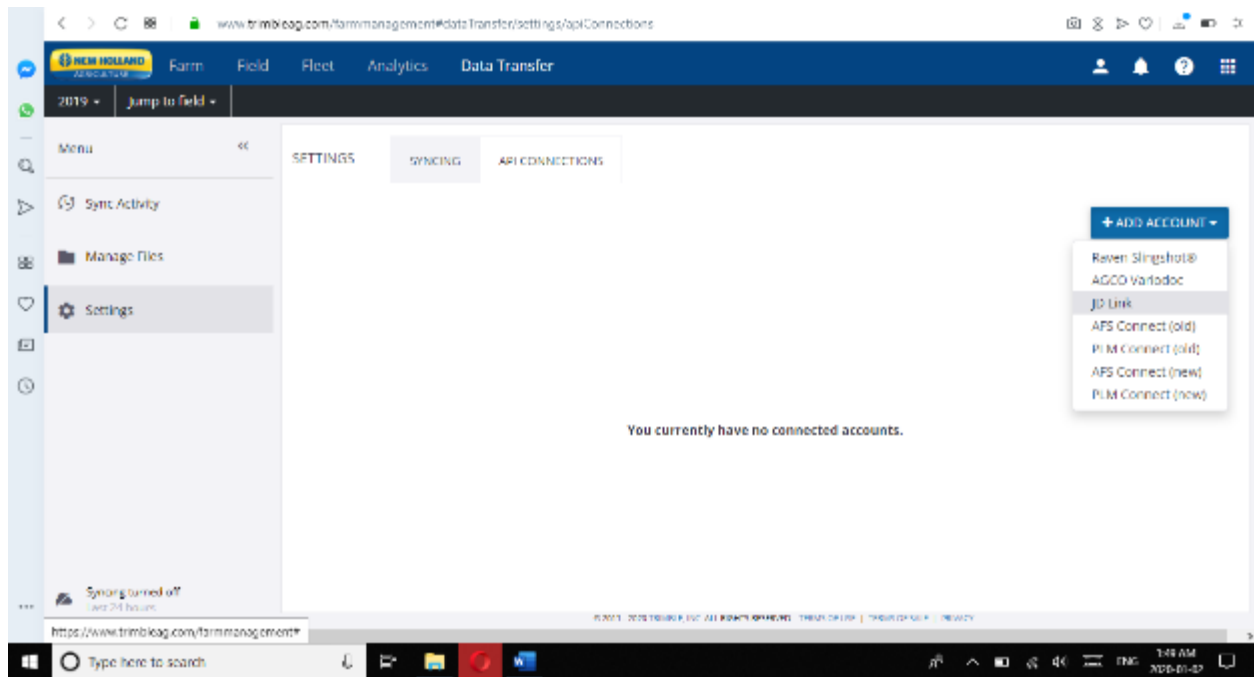
Trimble. New Holland. Case IH API.

Since 2017, CNH Industrial (Case IH and New Holland) and Trimble announced that they are enabling wireless connectivity between Trimble® Ag Software and New Holland Precision Land Management (PLM) Connect and Case IH Advanced Farming Systems (AFS) Connect telematics platforms in North America. Users of PLM and AFS Connect have the ability to share their agronomic data from their management portal directly to and from Trimble Ag Software in addition to other previously announced API's.

New API Partners

New Holland and Case IH equipment owners and operators can connect their accounts with these agriculture-focused third-party companies to make use of their data or receive field information:

• Trimble® Ag Software
• Farmers Edge™
• AgDNA
• Cropio
• Farmers Business Network℠
• Mapshots AgStudio & Granular

Once your vehicle displays are connected to Trimble Ag Software by serial number or through an API that shares data with your third-party account, your information is automatically pulled into the online account from your fleet activities.

Info sources:

https://www.claas-group.com/press-corporate-communications/press-re-leases/claas-api-connects-to-farm-management-information-systems/2110698

https://developer.deere.com/#!help&doc=HELPoverview.htm

https://agriculture.newholland.com/nar/en-us/about-us/whats-up/news-events/2019/new-holland-announces-enhancements-to-plm-connceted-offering

https://agriculture.trimble.com/support-article/view-use-vehicle-data-online/

MANAGE THE PRINCIPLE OF DATA EXCHANGE IN MULTI-BRAND FLEET. (2HR + 1.5HR)

First, we will check how to add third-party vehicle and then take a look at how to pull out files from the same vehicle using the Trimble Ag API example.

Add third-party vehicle data by API connection

Get instant access to vehicle data in your third-party account(s) with Trimble Ag Software's built in API connection. Trimble API makes it easy for organization administrators to set up a wireless link with Trimble partners, so that you have all of your farm's precision data in one place.

1.Log in to Trimble Ag Software online
2.Click the Data Transfer tab (top menu)
3.Select **Settings** from the left navigation menu to modify the default options are checked (recommended) to:
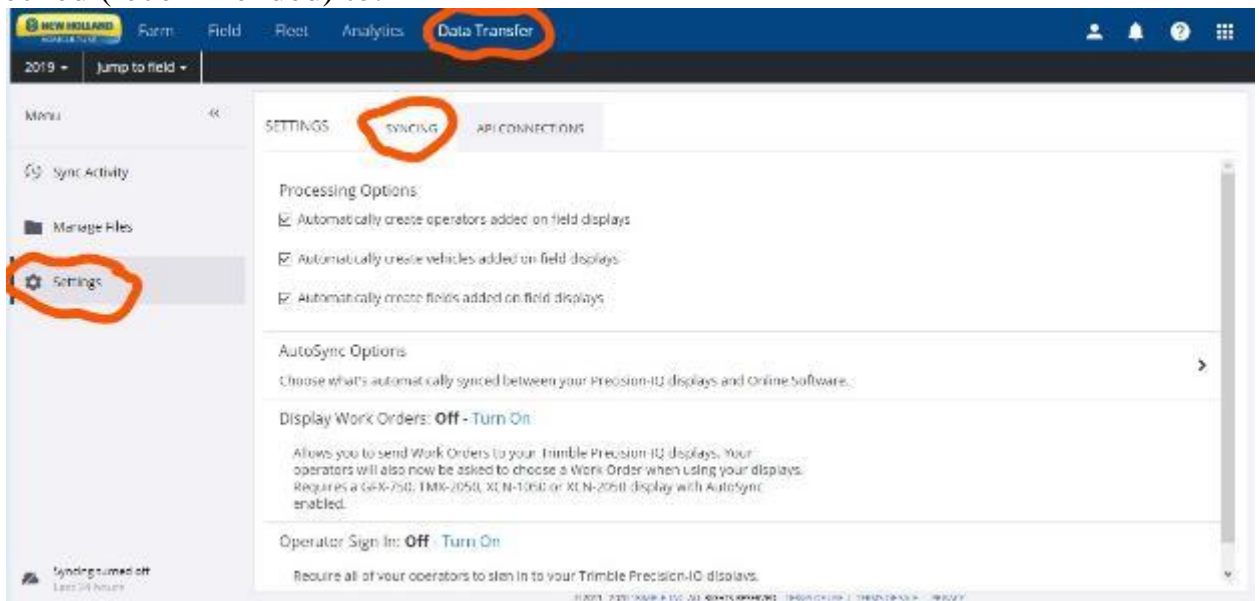
4.On the **Syncing** tab, click the checkboxes to modify the sync options from the recommended default (shown above) to **Automatically Create Operators added on Field Displays**, **Automatically Create Vehicles added on Field Displays** and **Automatically Create Fields added on Field Displays.**
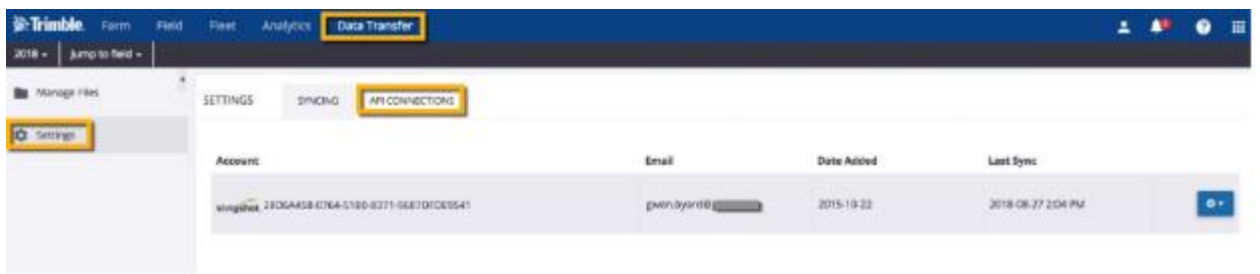5.Click on the API Connections tab
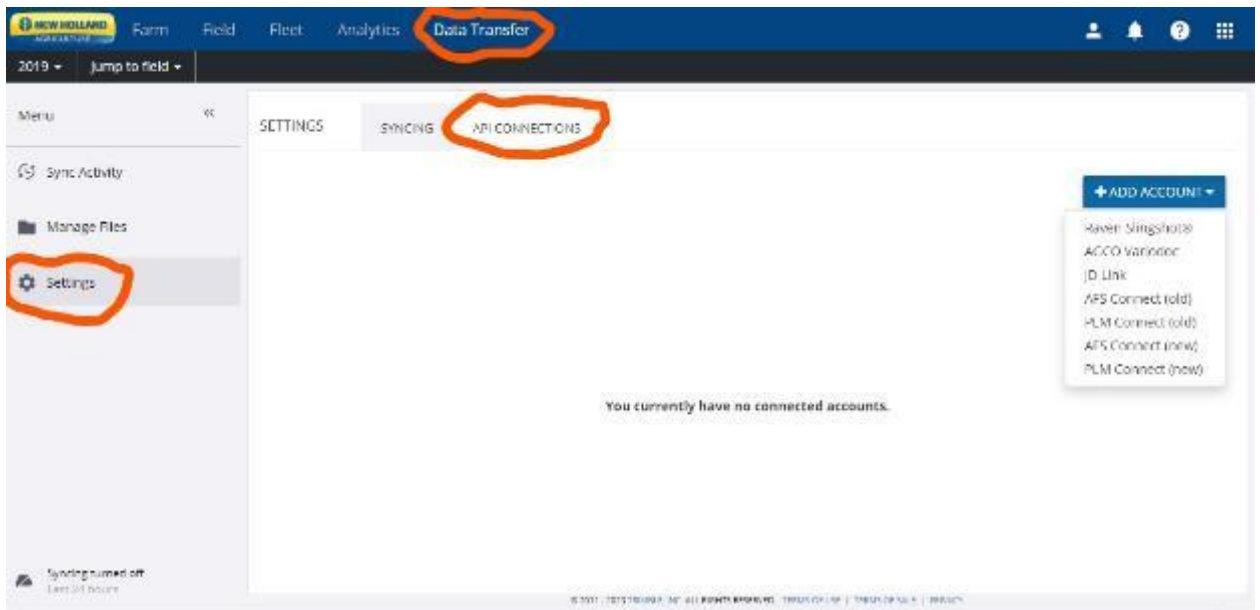
6.Click +Add Account

7.Select an account from the list*: Raven Slingshot, AGCO Variodoc, JD Link, AFS Connect or PLM Connect (prior to connecting to Raven Slingshot, contact Raven to purchase an API key at a cost of approximately $100)

8.A new web page will open with the login page for your third-party account, where you can enter your credentials and sign in to your third-party account

9.Trimble Ag Software will display a message "Linking to your account"

10.When the API connection is complete, your third-party account will be listed on the API Connections tab and any associated vehicles and data can be viewed from your Trimble Ag Software account

How to Use API Connections | Online Training | Trimble Ag Software. Video.

You Tube link: https://www.youtube.com/watch?v=UhMVjlsGI14

Info sources: https://agriculture.trimble.com/support-article/add-vehicle-data-api-connection/

QUIZ:

1.What is API?
a. Application programming interface (r)
b. Application portal interface
c. Application programming internet
d. Assigned programming interface

2. What word is undue here?
a. vehicle display
b. API
c. satellite(r)
d. telematics

3. Can we still call it a single-brand fleet, when all the tractors and combines on a farm are John Deere with Greenstar 2630 display, for instance, but GPS antennas are Trimble AG-15?
a. Yes (r)
b. No

4. What you need to know when adding a third-party vehicle to the Trimble Ag Software? (more than one answer)
a. vehicle display serial number(r)
b. login and password of third-party account(r)
c. GPS antenna serial number
d. task controller unlock code

* MANAGE means definition, creation, troubleshooting etc.

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