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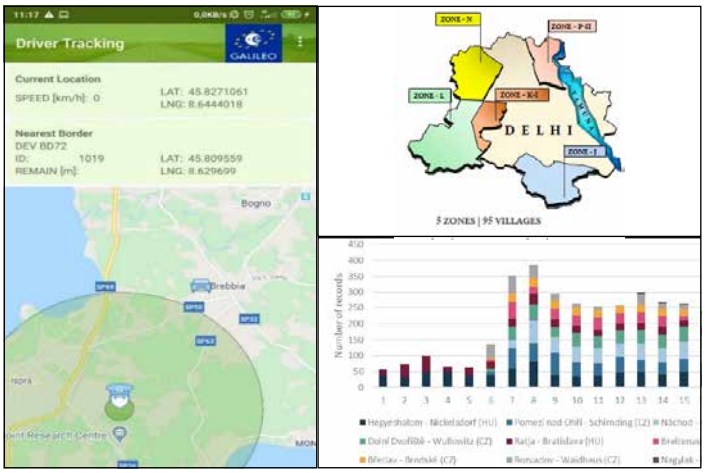

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When V stands for Vaccine

As the gloom that has engulfed since last year persists,

And the prolonged agony borders the endurance limit,

The buzz around Covid-19 vaccine naturally enthralls.

Billions await with hope for a dose (or two as reported)

Even though the efficacy of the vaccine is still being tested and optimized.

The experts grapple with distribution strategies,

Given the scale of the numbers and challenges to reach out to each one of us.

The existing infrastructure needs upgrade and also to be scaled up,

In terms of cold storage capacity (some vaccines reportedly need storage in -70^0C)

Transportation from inter-continental to far away villages,

Trained manpower, funds, finances, etc.

To reach out to the last person

For whom availability, accessibility and affordability remain a challange.

Not to mention about the business and the business rivalries,

Politics and the politics behind,

And the mindset that has the propensity to smell opportunities in crisis.

Despite all, the mere existence of the vaccine

Will provide the impetus to move and to move on.

Bal Krishna, Editor
bal@mycoordinates.org

Galileo Green Lane

An app to optimize the border crossing time during the Covid-19 crisis

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Market Segment Leader for ITS and Automotive at the European GNSS Agency (GSA)

1. Introduction

In the first phase of the Covid-19 crisis, many countries of the European Union (EU) introduced severe measures limiting the free movement of persons and goods across borders. The objective of these measures was the contention of the spreading of the virus and the impact this would have on public health. The entry bans at the internal land borders and the restrictions on drivers entering in some Member States (MSs) affected land-based services, and in particular road services, which represent 75% of freight transport. Indeed, such measures caused an increase in the border crossing time which, at certain internal EU borders, was longer than 24 hours, even for medical supplies (1).

With the purpose to allow efficient movement of essential goods, the European Commission (EC) has required MSs to identify relevant border-crossing points on the trans-European transport network (TEN-T). These 'green lane' border crossing points shall be open to all freight vehicles. The Commission also recommended that the crossing time in any internal border, including all the necessary checks and health screening, should not take more than 15 minutes (1). The creation of the green lane border network has contributed to guarantee the supply chain, which is of crucial importance for the functioning of the EU's internal market and its effective response to the public health crisis.

To provide a prompt response and help manage this crisis, the EU GNSS Agency (GSA) launched an ad-hoc R&D project to support the development and dissemination of an Android app, called Galileo Green Lane (GGL), aimed to monitor the border crossing times and queues length at the TEN-T border crossing points. Specifically, the tool allows to monitor the movement of freight vehicles on the road and record the crossings times at the borders, exploiting Global Navigation Satellite System (GNSS)-based navigation and in particular, Galileo.

A GSA project consortium composed of three companies, FoxCom, SixFold, and Spacetec Partners, oversaw the design, development and dissemination of the app. The Joint Research Centre (JRC)

To provide a prompt response and help manage this crisis, the EU GNSS Agency (GSA) launched an ad-hoc R&D project to support the development and dissemination of an Android app, called Galileo Green Lane (GGL), aimed to monitor the border crossing times and queues length at the TEN-T border crossing points

Data acquired on phones (records from officials and geo-fencing data) are saved on the GGL server (localization coordinates are only used for processing within the geo-fencing algorithm and are deleted after 7 days). These data are sent to Sixfold to process and calculate the overall delays at the border crossing points

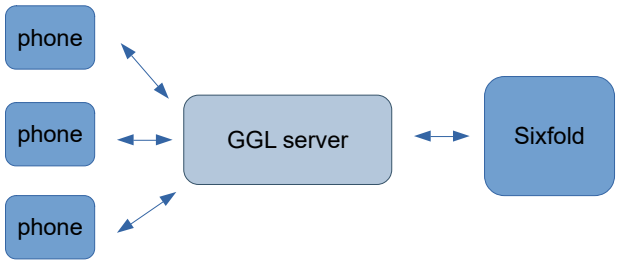

Figure 1: General structure of GGL

Figure 2: Interface for truck drivers

Figure 3: Interface for officials

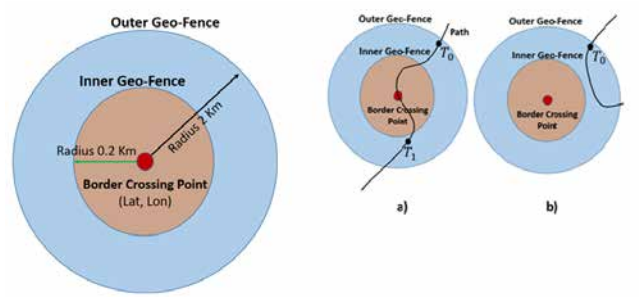

Figure 4: (Left side) Galileo Green Lane circular fences; (Right Side) Galileo Green Lane path cases: case a): the user enters in the geo-fencing area and crosses the border; case b): the user enters in the geo-fencing area without crossing the border .

of the EC supported the consortium during the deployment and validation phases. This article describes the app and showcases its practical usage from April to July 2020.

The paper is structured as follows: Section 2 provides an overview of the app, Section 3 describes the geo-fencing algorithm adopted by the app, Section 4 describes how the GNSS raw data provided by the phone were used for an initial assessment of the app, Section 5 provides details on the app pilot phase, Section 6 analyses some of the data recorded by the app server and Section 7 provides some conclusions.

2. Galileo Green Lane mobile app overview

The GGL mobile app has two main purposes.

The first purpose is to collect relevant data about the traffic situation and queue time at selected border crossing points (in both directions). There are two ways of collecting these data.

1. Border officials take data records about the overall situation and queue time at border crossing points. These records consist of information about the expected queue time, comments from the official about the situation, and a photo of the current situation at the border crossing.
2. A geo-fencing algorithm (described in Section 3) automatically estimates queue time by drivers with the GGL app driving through the border crossing point.

These data are sent to the server for further processing.

The second purpose of GGL is to inform drivers (users of application) about the situation at all TEN-T border crossing points. A driver can access a map of Europe in the app, where all TEN-T border crossing points are displayed. Each border crossing point has information about the expected queue time in both directions. This enables the driver to select the optimal route.

There are two groups of GGL users. Truck drivers, who use the GGL app to get information about the current situation at border crossing points, and border officials, who use the GGL app to report on the situation at their border crossing. These data get combined and forwarded to the servers of Sixfold for further processing and visualisation.

Figure 1 describes the general structure of GGL. There are three main parts.

- The mobile application running on phones which is used by officials to collect data or by truck drivers to select the optimal route and log driver geo-fenced data.
- The GGL server which stores and provides data from phones and data about the situation at TEN-T border crossing points.
- The Sixfold server which calculates and provides delays on border-crossing points, and then processes that data for further visualisation.

Data acquired on phones (records from officials and geo-fencing data) are saved on the GGL server (localization coordinates are only used for processing within the geo-fencing algorithm and are deleted after 7 days). These data are sent to Sixfold to process and calculate the overall delays at the border crossing points. These delays are sent back to the GGL server (every 15 minutes) and then distributed back to the phones. The delays at border crossing points are presented on the map view to users (drivers).

Figure 2 shows the Map view screen. Driver coordinates, speed and nearest border crossing point are shown at the top of the screen. The rest of the screen shows the actual position of the driver (car object) and the position of the nearest border crossing. The user is able to scroll around the map to see other border crossing points. By tapping the crossing itself, information about the current queue times in both directions will appear.

Figure 3 shows the screen for border officials. The official can switch the direction of crossing to indicate the flow of traffic. Below this information, three buttons describe the traffic situation, whether it is Green (traffic < 15 mins), Yellow (15 mins < traffic < 60 mins) or Red (60+ mins). The official has to select one of them to make a new record. The official can then optionally add a comment or take a photo of the situation. The entire record is sent to server by pressing the Send button.

The mobile app consists of a map view screen for the truck driver, a screen for border officials, a settings screen to set default app parameters, a help screen and an about screen.

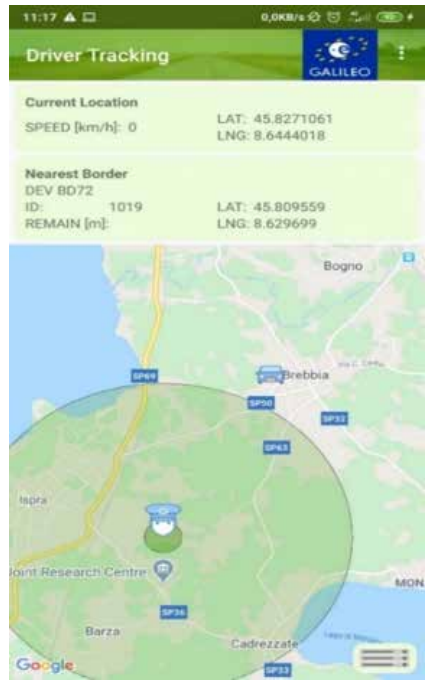

Figure 5: Galileo Green Lane screen-shoot: driver user interface, showing the nearest border and the circles used to compute the time to cross the border

3. Galileo Green Lane geo-fencing algorithm

As introduced in Section 2, the GGL estimation of the queue time at each border is based on the definition of a geo-fencing area around the border.

The term geo-fence refers to a virtual perimeter built around a geographic area or point. Currently, most geo-fencing applications are used to send notifications/warnings when area boundaries are not respected. Indeed, geo-fencing techniques enable monitoring of areas surrounded by a virtual fence, while the monitoring process allows the automatic detections when tracked mobile objects enter or exit these areas. In general, the main problem is the determination of the inclusion of the user location into the fence. Determining the inclusion of a point in a polygon, the geo-fencing perimeter, is a geometric problem that can be used using different methods, as detailed, for example in (2),(3),(4),(5).

In the GGL case, the geo-fencing algorithm, that is the core of app, is based on the circular method, namely the fences are built using two concentric circumferences, as shown in Figure 4 (Left side). The inner geo-fence has a radius of 0.2 km while the external one has a radius of 2 km.

The geo-fencing algorithm allows the computation of the border crossing time by first defining the start and end of the geo-fencing path. It marks the start of the path as soon the user enters in the outer circle, while it marks the path end in the two following cases represented in Figure 4 (Right side)

1. When the user leaves the inner circle after having entered in it in Figure 4
2. When the user leaves the outer circle without entering in the inner circle in Figure 4 (case b)

In the first case the border is marked as crossed, while in the second case the border results uncrossed. Along the path, the user positioning data are recorded every 5 seconds. The time necessary to cross the border is estimated using Eq 1. The parameter is computed as the difference of the time at the start point of the path (in the right side of Figure 4) and the time at the end of the path (in the right side of Figure 5).

In the GGL case, the geo-fencing algorithm, that is the core of app, is based on the circular method, namely the fences are built using two concentric circumferences

In preparation for an EU-wide release in May, a pilot testing period was initiated with Hungary and the Czech Republic. Both countries piloted the solution for a 15-day period, with Hungary testing at 3 borders (with Austria, Romania, and Slovakia), and the Czech Republic testing at 6 borders (with Austria, Germany, Poland, and Slovakia).

$$BTC = T_1 - T_0 \qquad (1)$$

This parameter is fundamental to evaluate the implementation of the EC guidelines. In addition, this temporal indicator provides information on the presence of a queue at the border. The BCT is impacted by the identification of the two time instants T_1 and T_0. An erroneous estimate of T_0, too far from the outer border, could cause an underestimate of the BCT creating a miss detection of possible queues. On the other hand, the erroneous evaluation of T_1, too far from the edge of the inner fence, could lead to an overestimation of the BCT, creating a false alert. These issues are mitigated using the contribution of the officials at the border and using a consistency check on the path. The latter consists in checking that the path length is not too big/small with the purpose to avoid the path length overestimation/ underestimation and make the algorithm robust. In Figure 5, a GGL screenshot displays the nearest border and the external and inner circles defined by the geo-fencing algorithm, as discussed above.

4. Testing the Galileo Green Lane app using GNSS raw data

Before the start of the official pilot test phase launched on the 23rd of April 2020, several dynamic tests were carried out to assess the performance and robustness of the app.

The tests were carried out by exploiting three different Android smartphones with the Galileo Green Lane app enabled, namely a Xiaomi Mi9, a Xiaomi MiA1 and a Samsung S8. The test vehicles with the smartphones on board transited in proximity of different EU border crossing points.

In some cases, the vehicles crossed the borders while for some tests they performed a turn without crossing it. In this way it was possible to test if the app could correctly detect the border crossing event without ambiguity.

The above Android smartphones were also enabled to collect raw GNSS measurement through one of the several applications currently available for this purpose, namely Geo++ (6).

This application allows logging raw GNSS data and to access GNSS navigation messages, carrier, code measurements and other information. Then the measurements were post-processed using an online raw measurement processor implementing Single Point Positioning (SPP) (7) to obtain a positioning solution with a 1 Hz data rate.

The reference solution generated using the raw GNSS data has a higher frequency with respect to the

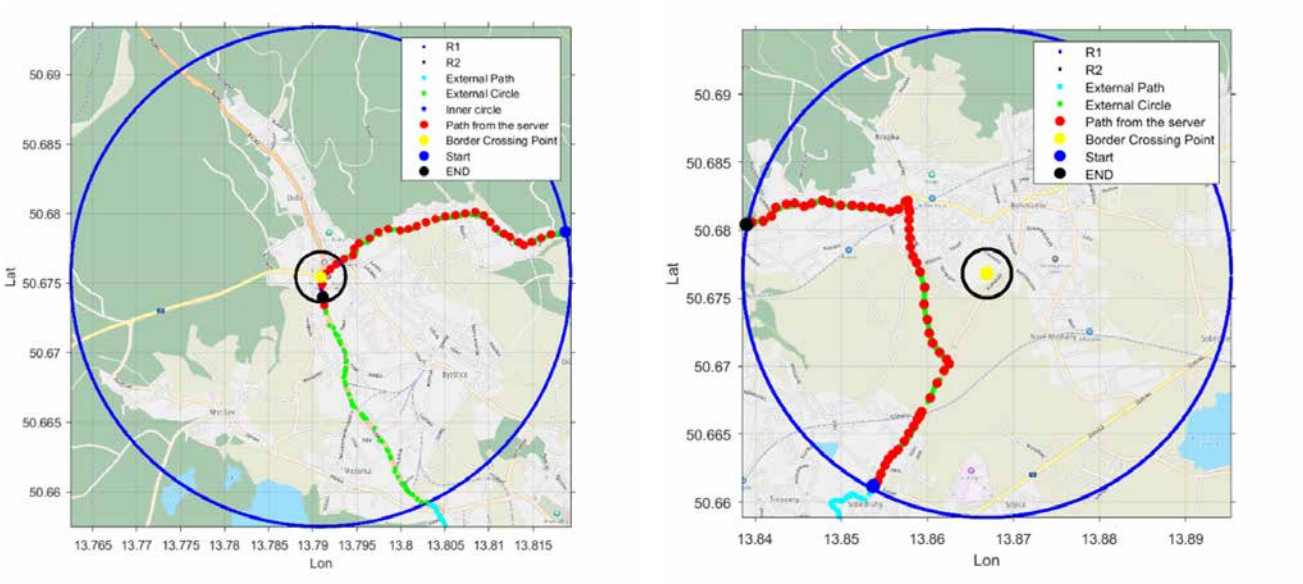

Figure 6: Trial tests at the border between Breitenau (Germany) and KrásnýLes (Czech Republic): (Left side) the vehicle is crossing the border; (Right side) the vehicle is entering in the geo-fencing area without crossing the border

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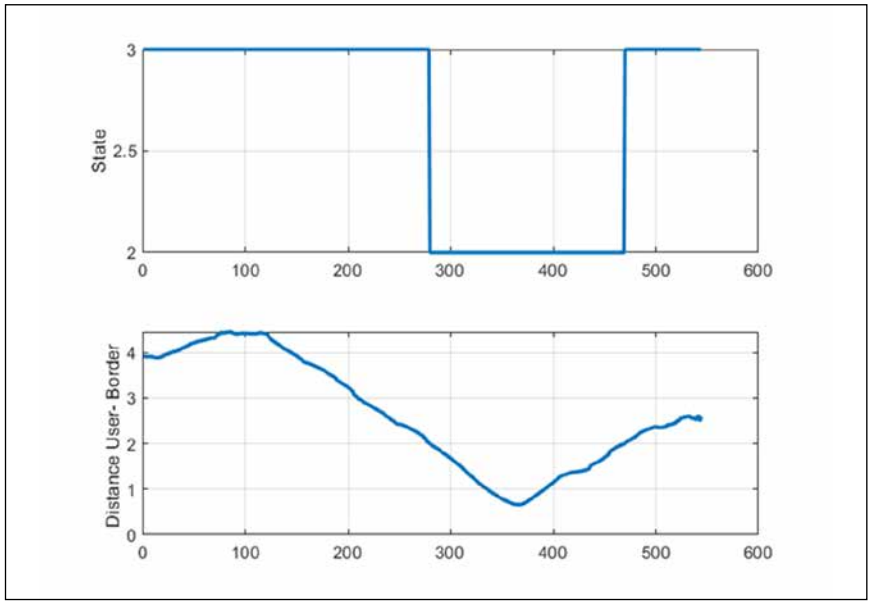

Figure 7: (Upper side) Variable indicating the user position in the geo-fencing area (State = 3 indicates that the user is outside the geo-fencing area, State = 2 indicates that the user is inside the external circle and outside the inner circle, State = 1 indicates that the user is inside the inner circle); (Lower side) Distance of the user from the border crossing point

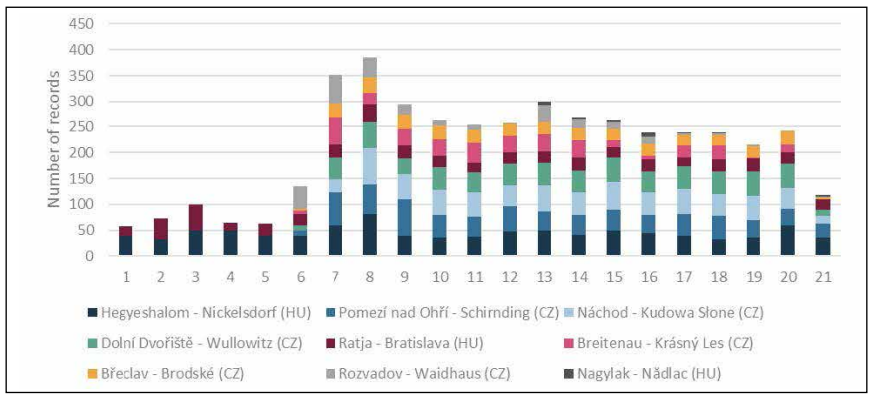

Figure 8: Total number of records received from border officials using the GGL app

Figure 9: Borders where users of the Galileo Green Lane app have been recorded. The numbers represent the identification associate to each border.

position data used by the Galileo Green Lane Mobile application, that are collected every 5 seconds, namely with a frequency rate of 0.2 Hz.

After processing the GNSS raw data, the time tagged positions of the phone were extracted and used as input to the geo-fencing algorithm adopted by the app.

As sample case and to showcase the operation mode of the geo-fencing algorithm, the results of two tests performed at the border between Germany and Czech Republic are reported in Figure 6. On the left side the results of a test with a vehicle crossing the border is shown, while on the right side the case of a vehicle entering in the geo-fencing area without crossing the border is reported. The last test was performed to assess the robustness of the algorithm in recognizing the border crossing event in case of ambiguous situations.

The paths estimated by the app, and stored on the backup server, are overlapped to the reference path identified by using the higher rate data.

As mentioned in Section 2, the external and inner geo-fencing circles have a ray of 2 km and 0.2km and in Figure 6 they are indicated in blue and black, respectively. The reference path, estimated from the GNSS raw data, is indicated in green when the user is inside the external geo-fencing circle (and outside the inner circle) while it becomes blue when the user is inside the inner circle. The start and end path points identified by the geo-fencing algorithm are also marked. Finally, the border crossing point is represented in yellow.

From Figure 6 we can observe the good agreement between the reference trajectory and the results provided by the app, which is in red and labelled as “Path from the server”

The high date rate were used also to check the user position with respect to

Figure 10: Map of the number of users at each border for all the 13 weeks under analysis

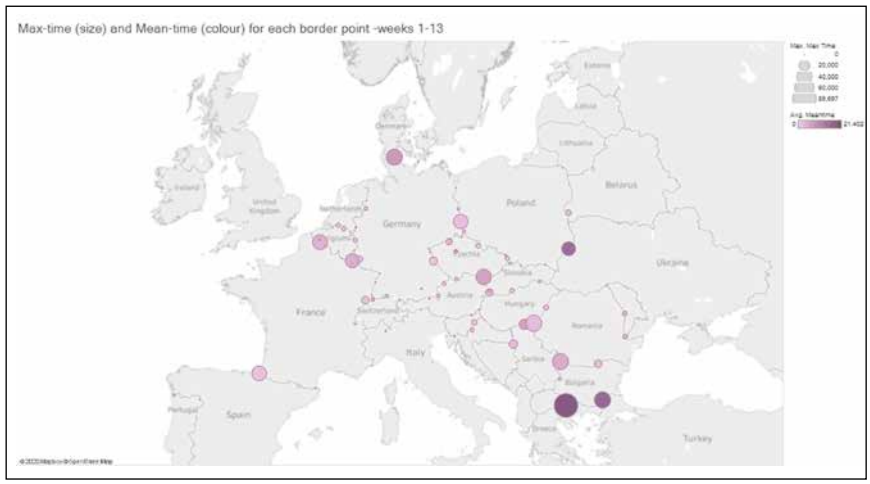

Figure 11: Map of the maximum and mean queue time at each border for all the 13 weeks under analysis

the geo-fencing area. For this purpose a flag indicated as "State" is provided after processing the high rate data. The latter can assume the following values

- State = 3 (the user is outside the geo-fencing area)
- State = 2 (the user is inside the external geofencing circle but outside the inner circle)
- State = 1 (the user is inside the inner circle)

In the upper part of Figure 7 the state variable is plotted for the last case corresponding to the uncrossed border point while in the lower part the distance of the user from the border crossing point is shown. We can see that the variable is first equal to 3, when the user is outside the geo-fencing area and then it becomes equal to 2 when the track enters into the external circle and indeed the distance of the user from the border is below 2 km. Afterward, the variable is again equal to 3 indicating that the user left the external geofencing circle without entering in the inner circle and indeed the distance of the user from the border is above 2km. This confirms the result provided by the app indicating that the border has not been crossed.

5. Pilot phase

In preparation for an EU-wide release in May, a pilot testing period was initiated with Hungary and the Czech Republic. Both countries piloted the solution for a 15-day period, with Hungary testing at 3 borders (with Austria, Romania, and Slovakia), and the Czech Republic testing at 6 borders (with Austria, Germany, Poland, and Slovakia). Additionally, the truck driver app was tested with drivers at several border points.

The pilot testing lasted for 15 days in both countries, and during this pilot phase, border authorities were expected to:

- Report on the border situation every 30 minutes
- Instruct officials on duty to use the application and report on the borders
- Ensure the safety of the smartphone device

During the pilot, a total of 4,031 records were received from the Czech and Hungarian border officials. The total number of record received from border official using the GGL app is shown in Figure 8 for the different borders.

On the truck driver side, 517 geo-fencing records were received from 164 drivers crossing 79 border points spanning 26 countries: Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, France, Germany, Greece, Hungary, Italy, Lithuania, Luxembourg, Netherlands, Norway, Moldova, Poland, Portugal, Romania, Serbia, Spain, Slovakia, Slovenia, Sweden, Switzerland, and Turkey

6. Analysis of the Galileo Green Lane server's data

From the beginning of the pilot test phase, the GGL backup server stored the data of all users exploiting the app at the different borders on a weekly basis. Specifically, the server stored a file with all recorded geo-fencing paths, the associated border, the path length and the time necessary to complete the path as estimated by the app. After every week, the data were removed for privacy reasons.

Therefore, the weekly data available on the server represented a fundamental resource to monitor the performance of the app and identify any issue in a timely fashion.

Moreover, the data provided by the GGL server has also been exploited to analyse the traffic flow at the different borders and the users exploiting the app for 13 weeks, starting from the 19th of April to 22nd of July 2020. The borders where the app was used are shown along with the identification numbers associated to each border. Identification numbers larger than 1000 indicate test border crossing points. From Figure 9 we can observe the widespread diffusion of the app all over Europe.

The number of app users has been evaluated by counting the sum of the different phone identification codes provided by the server and corresponding to paths with border crossing. A map with circles of size changing according to the number of users is reported in Figure 10. The map has been created considering the aggregated data of the period under analysis, allows visualising the borders where the number of users was higher for the period under analysis. In particular, we can see that two borders crossing points between Spain and France show the biggest number of users on the entire period of observation. They are first the border between Hendaye and Irún/Behobia and then the one between Le Perthus and La Jonquera, indicated in Figure 10 with the id 49 and 2, respectively.

As expected, in general, for all borders, the number of users was bigger during the first seven weeks, namely until the second week of June. This is likely due to the fact that in the second half of June in many EU countries the Covid crisis situation improved and the measures restrictive for the circulation of people and goods were relaxed. As results of the general improvement, the app users decreased.

For all weeks, also the mean and maximum queue time at each border have been evaluated. The statistics can be visualized on the map in Figure 10 where the max queue time is represented by the size of the circle while the mean time is represented by the colour intensity. From the map, we can see that there are borders where the average queue time is above 15 minutes, they are, for example, the borders between Bulgaria and Greece/Turkey, indicated in Figure 11 by the id 5 and 56, respectively. This is also the case for the border between Poland and Ukraine marked with the id 29. At these borders even if the number of users is not higher than the one of other borders, the mean queue time is higher. This could be caused by more time-consuming check procedures applied at these borders.

the results presented prove that this app has successfully monitored the crossing times and queues length at the green lane crossing points. It has also shown to provide border officials and transporters with real time update on the status of the traffic at the border crossing points, allowing them to identify the borders under higher load and thus find alternative routes

7. Conclusions

The Galileo Green Lane app, presented in this article, represents an important tool to manage the traffic at the TEN-T borders during the coronavirus crisis.

Indeed, the results presented prove that this app has successfully monitored the crossing times and queues length at the green lane crossing points. It has also shown to provide border officials and transporters with real time update on the status of the traffic at the border crossing points, allowing them to identify the borders under higher load and thus find alternative routes. Last but not least, the app enabled users to see the overall EU border situation in real-time and contribute to the online status by reporting the traffic at their border at regular intervals.

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Application of distance technologies in education during COVID-19

The experience in implementing distance technologies for teaching C++ programming students of the Moscow University of Geodesy and Cartography

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Introduction

Over the past 10 years, the Moscow University of Geodesy and Cartography (MIIGAiK) has been conducting a pedagogical experiment in teaching students of cartography and geodesy to program in C++ using a specifically developed training course. An important and distinctive feature of this training course from others [1 - 4] is the wide use of material on cartography and geodesy for teaching programming. All training examples and programs are aimed at solving certain practical problems of cartography and geodesy accessible to junior students. All program development homework is also based on real-world tasks from the field of cartography and geodesy.

The author is convinced that specialized training in programming based on solving cartographic and geodetic problems will prepare students for the effective use of the knowledge gained in programming their further work on the geodetic specialty. Currently, more than 70 educational programs that illustrate the main sections of the C++ programming language have been developed. These programs are centered around tasks from the course of general geodesy and cartography, which is read to students in parallel with the C++ programming course. All training programs have a small number of instructions (usually no more than 50 lines) and are comprehensible for junior students learning the basics of geodesy and cartography.

The CORONAVIRUS/COVID-19 pandemic had a significant impact on the programming training of cartographers and surveyors. In the spring of 2020, the educational process at the MIIGAiK was reorganized as distance learning and the academic semester and examination session was held remotely. This article analyzes the experience of distance learning for students obtained during the spring of 2020. It presents a typical educational computer program illustrating the features of the course “C++ for students of cartography and geodesy.”

All training examples and programs are aimed at solving certain practical problems of cartography and geodesy accessible to junior students. All program development homework is also based on real-world tasks from the field of cartography and geodesy

Experience of teaching programming remotely in the face of pandemic

The experience gained in e-learning allows formulating important features of the educational process in these conditions. The role of video lectures in the educational process has significantly increased, and now this is an indisputable fact. Many teachers prepared their lectures

in the video format. For this purpose, programs such as Zoom, Mind, MOODLE and other were used. Zoom and Mind allow conducting video lectures, both interactively and in the mode of pre-recording a lecture on a computer disk. Training courses based on video lectures provide substantial assistance to students in mastering the training material. Nowadays, the process of preparing and recording video lectures continues, and the video database is being filled with lecture material for all training courses.

If we try to compare video lectures and conventional ones in terms of efficiency and convenience of acquiring knowledge, it turns out that face-to-face lectures do not always possess a leading position. The main advantage of a video lecture is the ability to stop the lecture, "pause" it to analyze some complex issues, think it over, and examine in detail what the lecturer said. It is no secret that the large amount of information presented by the lecturer exhausts students and makes the assimilation of educational material by the end of the lecture superficial and ineffective. The video lecture can be stopped at any time, a student has an option to relax and further continue studying the material. It is also possible to re-listen and watch the video lecture at the end of the training course to remind the material before passing the exam.

A video lecture allows the student to repeatedly listen and watch the material being studied and solve problems at the moment they appear, and not after the end of the lecture, as it is often the case in conventional lectures. This is crucial because it allows restoring the logical chain of reasoning of the lecturer, and not losing the thread of the lecture. We also note that lectures, even by an experienced lecturer, can contain erratum and unnecessary technical issues. Such insignificant fragments can be removed from the lecture during the editing of the videos which will make them more consistent and accessible to the audience.

A significant disadvantage of conventional lectures held in large lecture halls is inconvenient seating places for some students. Some seats in classrooms are far from the board, or the screen, or uncomfortable for some other reason. This makes it difficult for students at such places to fully perceive the lecture material. The noise in the lecture hall, the presence of an annoying neighbor significantly reduces the efficiency of the learning process. Here, video lectures have a significant advantage, since they allow the student to choose the right time to digest the material in order to acquire it on a wider and deeper scale. With the help of videos, it is possible to gain knowledge while being in a comfortable environment and at the student's convenience.

The main advantage of a video lecture is the ability to stop the lecture, "pause" it to analyze some complex issues, think it over, and examine in detail what the lecturer said. It is no secret that the large amount of information presented by the lecturer exhausts students and makes the assimilation of educational material by the end of the lecture superficial and ineffective

However, distance learning has also several disadvantages. How can a teacher control the process of studying and taking in the material by a student? A simple solution to this issue is the student's completion of a summary based on the video lecture materials, for example, in traditional paper form. For example, a lecturer may ask a student to take a synopsis of the course content presented in a video and to answer a series of questions. Further, the work has to be handed to the teacher via email for checking purposes. Obviously, this method of knowledge checking is more time-consuming than a face-to-face conversation between a teacher and a student.

An important element of monitoring students' performance while studying remotely is checking homework and assessing the efficiency of process of digesting of educational materials. Of course, the old and proven trick to check the individual answers might be efficient. The results received per e-mail might be processed manually. However, this method of checking and assessing the results of homework and tests is not the best and loads the teacher with routine work. With this method of checking students' performance, it is possible to use a multi-point grading scale. But the assessment will encroach upon the teacher's time, especially if there are a large number of students in the group. In this case it would be possible to change the assessment system to a two-point one and to use the criteria: "passed" and "not passed".

The use of computer programs, for example MOODLE, allows testing and assessment of homework in an automated manner. For such programs, a set of questions and tasks for homework must be prepared first. Such files could be uploaded to a remote server and links to them could be placed next to the link to the video lecture. This will help students test their knowledge during the study and let the teacher off from the routine work of checking homework. On the other hand, such an assessment system and testing programs can accumulate grades received by students to conduct the exam session remotely.

Testing programs reduce unnecessary tension in the "student-teacher" group and, together with the correct formulation of questions, ensure an adequate assessment

It is no secret that in C++ programming the most difficult is to take the first steps, figure out how to install a compiler, how to write and run a program, how to find and fix program bugs. Distance learning complicates the process for students who start programming from scratch even more. Therefore, the teacher should pay special attention to the low-performing student

of students' knowledge. In the case of using automated knowledge assessment systems, the need to load new tests and questions into the system quite often would arise. It is to be done to exclude electronic cheating when answers can be copied from one file and pasted into another file.

Let us draw your attention to the issue of the distance work of a teacher in large groups, in which the number of students sometimes reaches 30 people. The effective organization of the distance learning process in such large groups requires specific work algorithms. In e-learning, the role of the study group as a highly organized entity of joint activities, communication, and relationships is growing. In this case, a course leader is a key person since he represents the group and acts on its behalf. A course leader helps the teacher to inform students about the home task and the test results.

Although it is widely known and is a trivial fact, we emphasize the role of a socially mature and active course leader as an important figure in the process of distance learning. An inanimate course leader means that a group has mistaken in making its choice. Often such a person pulls back the whole group. The active and energetic one contributes to a positive psychological climate in the group and helps the teacher and students to achieve their goals and objectives.

Usually, to carry out monitoring, the management of the educational institution requires that the information exchange between the teacher and the students is carried out in a certain educational information environment. If video or voice communication is not provided by such an environment, it seriously complicates the teacher's work and reduces his effectiveness.

Communication between the teacher and the group of students via e-mail requires the teacher to think carefully about the text of the emails, which should be informative, short and at the same time quite strict. If the teacher adheres to the positions of the Classic School, the style of communication with a large number of emoji-pictures is not supposed suitable. Such a "free" style breaks down the psychological barrier between the learner and the teacher. In terms of the educational process, the teacher has a higher position in a hierarchy. The acquisition of knowledge by a student is a laborious process, which can be compared to climbing a mountain and the presence of a barrier helps the student to determine goals, strive to gain knowledge, evaluate his knowledge and overcome this barrier. However, each teacher has the right to choose the style of communication he likes and considers the best.

Distance seminars are an important element of e-learning. They should be held at a strictly defined timetable; it is not advisable many time to schedule the seminar to another time or another day. The appearance of a teacher at a certain and fixed time in the network or chat maintains the discipline of the group and puts the training in a strict framework. It is possible that the course leader has not appeared in the group chat at some class. How to act in the case when the seminar is conducted in communication mode through voice communication? To whom should the message be addressed? If the teacher addresses a message to the course leader, and he is absent, then the students of the group could remain silent due to modesty. This behavior of students can embarrass the inexperienced teacher. At the same time, the teacher should keep in mind such a scenario. The way out of this situation is to appeal to all students of the group with the words: "Whoever, who has read or heard my message, please, answer me ...". A "kind soul" is sure to be found for such a call, and contact with the group, working without a course leader, will be restored.

Nevertheless there are some other difficulties the teacher should beware of. The problem which any teacher of programming is always facing is to pupils who don't keep pace with the rest in group. It is no secret that in C++ programming the most difficult is to take the first steps, figure out how to install a compiler, how to write and run a program, how to find and fix program bugs. Distance learning complicates the process for students who start programming from scratch even more. Therefore, the teacher should pay special attention to the low-performing student.

Let us demonstrate one more technically useful method which could be implemented while teaching in remote mode. Steady contact with students, receiving homework tasks, tests, and seminar exercises by e-mail will require the registration of several electronic mailboxes and addresses to work with students of different courses and groups. However, this does not completely solve the problem of working with a growing number of mails, and the mailboxes become full after a while. In such a deluge of letters, it can be difficult to find the right one. To reduce the number of messages, it would be useful to combine messages, photos, and scans from one student into one single file. This can be done, for example, by means of Adobe Acrobat. By introducing students to the

```
01:  #include <iostream>
02: using namespace std;
03:
04: int main (void)
05: {
06:  int  degrees, minutes, seconds;
07:  long double rest, angleInRadianTerms;
08:
09:  cout << "Enter the angle in radian: ";
10:  cin >> angleInRadianTerms;
11:
12:  long double degreesWithFractionalPart =
12:                              angleInRadianTerms*180/M_PI;
13:  degrees = (int)degreesWithFractionalPart;
14:  rest = (degreesWithFractionalPart - degrees)*60;
15:  minutes = (int)rest;
16:
17:  long double secondsWithFractionalPart = (rest-minutes)*60;
18:  seconds = (int)secondsWithFractionalPart;
19:
20:  cout <<"Angle is: "<< degrees << char(248) << minutes
20:       <<"\'" << secondsWithFractionalPart << "\" "<< endl;
20:
21:  (((rest-minutes)*60)-seconds) >= 0.5  ?  seconds++ : seconds;
22:  (seconds == 60) ?   minutes++ , seconds = 0 : minutes;
23:  (minutes == 60) ?   degrees++ , minutes = 0 : degrees;
24:
25:  cout <<"Round value of Angle with error 0.5\" is: "
25:       << degrees << char(248) << minutes <<"\'"
25:       << seconds << "\"" << endl;
26:
27:  return 0;
```

Figure 1. Listing of the program for converting radians to degrees, minutes, and seconds

procedure of combining files via Adobe Acrobat and offering students the same type of signature format for such PDF files, it is possible to significantly reduce the number of emails in the box and make message processing less time-consuming.

Having considered the features of e-learning in the spring of 2020, let us turn to the analysis of the curriculum tailored for future cartographers and surveyors studying the C++ programming language.

Articulation of the problem

The developed program converts radians into degrees, minutes, and seconds. Through the keyboard, the user enters the angle value in radians. The program converts to degrees with a fractional part. The formula is as follows: *deg* = *rad* * 180 / π, where *deg* is the angle value in degrees with a fractional part, *rad* is the original angle value in radians. For each radian value entered, the program displays the corresponding value for degrees, minutes, and seconds. First, the screen displays the angle in degrees, minutes, and seconds with a fractional part, and then the same data, but the number of seconds is rounded to an integer. Usually, the *roud* function is used to solve this problem, however, since it is the training program and is intended for an initial programming course, using the function would be wrong from a pedagogical point of view. Learning operators in a programming course always precedes the study of functions. Let us take a closer look at the code of the program.

Each of the curricula used in the "C++ for Cartographers and Surveyors" course has explanatory text intended for students to learn what a computer program does and how it works. This clarification of the above program is provided.

Discussion of the results

Each of the curricula used in the "C++ for Cartographers and Surveyors" course has explanatory text intended for students to learn what a computer program does and how it works. This clarification of the above program is provided.

The *main* function is presented in lines 04-28. The main function defines the following variables: *degrees*, *minutes*, and *seconds*. They are used to store the angle values, separately in degrees, minutes, and seconds. The *angleOfTurnInRadian* and *rest* variables are needed to keep angle value in radians and perform intermediate calculations. These variables are of a *long double* type so that seconds are calculated with increased precision. In lines 09 -10, the user enters the value of the angle in radians through the keyboard.

The *degreesWithFractionalPart* and *secondsWithFractionalPart* variables for values of degrees and seconds, containing fractional part, are also *long double*. In line 12 the value of the angle in degrees with the fractional part is calculated. To define π the named constant M_PI is used. Line 13 takes the integer part of the resulting number of degrees using the explicit cast operator. The integer part of the number is taken from the *long double* variable, and the integer number of degrees is assigned to the *degrees* variable. Line 14 uses the *rest* variable to calculate the value of the minutes with a fractional part, and from the resulting value, the integer part of the arc minutes is taken and is assigned to the *minutes* variable. Line 17 evaluates the variable *secondsWithFractionalPart* to hold the value of seconds with a fractional part. Similarly, the integer part of the number from the variable *secondsWithFractionalPart* is taken and the integer value of seconds is assigned to the *seconds* variable. Then, in line 20, the obtained values of degrees,

Table 1. Program testing results

No.	Value of an angle in radians	Value of an angle in degrees, minutes and seconds	
		Value of seconds with fractional part	Value of seconds rounded off to the whole
1	1	57°17'44.8062"	57°17'45"
2	3.14159	179°59'59.4527"	179°59'59"
3	3.141592	179°59'59.8652"	180°00'00"
4	0	0°00'00"	0°00'00"

minutes, and seconds with a fractional part are displayed on the screen.

Since the integer of *seconds* was obtained by discarding the fractional part of the value of seconds, such an action cannot be recognized as rounding the number. The program performs rounding without using the standard rounding function (lines 21-23). The rounding algorithm is as follows. If, when receiving an integer value of angular seconds, a number greater than 0.5" or equal to it was discarded, then the value of seconds is increased by 1". To do this, in line 21 the ternary conditional operator (? :), which increments the variable *seconds* ++ is used. If the expression in parentheses is true, then the value of seconds is increased by 1, otherwise, the number of seconds does not change

```
((((rest-minutes)*60)-
seconds) >= 0.5) ?
seconds++ : seconds;
```

If the number of angular seconds is increased to 60", then this variable becomes equal to 0 and the value of the *minutes* variable is increased by 1′.

```
(seconds == 60)
?   minutes++, seconds
= 0 : minutes;
```

Lines 22 and 23 use two special C++ operators: the ternary operator (? :) and the comma operator (,). An example of a conditional operator is presented in the above-given instructions. Operator (? :) works as follows. First, the expression *(seconds == 60)* is evaluated and if it is true, then the expression *minutes*++ is calculated. The result of such calculations is the result of the conditional ternary operator. Otherwise, the expression separated by the "colon" sign is calculated, that is, *minutes* and it will be the result of the conditional operator. It must be noted that this statement contains the (,) operator. The purpose of the comma operator is to perform a sequence of operations. In line 22 the *minutes* variable is increased by 1 and the value of *seconds* variable is reset.

Line 23 uses a similar data processing algorithm. When the number of minutes is increased by 1′, the value of angular minutes has reached 60′, the value of *degrees* is increased by 1°, and the value of angular minutes is reset to zero. Line 25 displays the angle value rounded off to an error of 0.5 ″ in degrees, minutes, and seconds. This is where the program stops.

Testing of the program

Let us test the program. Having compiled and running the program, the initial data from the column "Angle in radians" of Table 1 will be sequentially entered. As the result, the data presented in the table columns "Value of seconds with fractional part" and "Value of seconds rounded off to the whole" will be received.

The result obtained demonstrates the principle of program functioning under the condition when different data are input. Based upon the table, the rounding performed by the program has an error not exceeding 0.5".

Conclusions

The analysis of the application of remote technologies to teach students programming in C++ under the conditions of CORONAVIRUS/COVID-19 is performed. The positive and negative aspects of using video lectures via Zoom, Mind, and other distance learning services, such as MOODLE, are considered. The features of the organization of the educational process and the risks associated with learning programming remotely are discussed. Recommendations to improve the efficiency of the process of teaching programming under the conditions of the remote work of a teacher are given.

The curriculum for students learning the basics of C++ programming and application of that knowledge to cartography and geodesy is considered. The program converts radians to degrees, minutes and seconds. The program is intended for studying such sections of programming as "Expressions and Operators of C++". A detailed analysis of the program code is carried out and the test results, which can be used in a training workshop on programming, are presented.

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Data is gold. Make it ornament!

All commotion, beginning from the unprecedented lockdowns, strict protocols demanding social distancing, derailing of the economy and the fear of catching the virus ...

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The entire social media, intelligentsia, the new world and technical journals are flooded with data and information on Covid-19 ever since the onslaught of the Pandemic, early this year. All commotion, beginning from the unprecedented lockdowns, strict protocols demanding social distancing, derailing of the economy and the fear of catching the virus … led to a situation on uncertainty. So much so, the agency concerned had to defer the conduct of sacrosanct decennial Census of population, due to be published in 2021.

Plethora of data was being generated elsewhere, everywhere, in every form. The number of tests conducted, the number of confirmed cases, the deaths, the misery, the loss of employment, the 'urban' streets being taken over by the 'wild' and so on. Apart from converting hotels and other large buildings into 'make shift' hospitals and quarantine facilities, the Indian Government also came up with innovative idea of converting railway coaches into quarantine centres, which could be moved to remote rural areas when required.

The data emerging during these times, though not much organised and structured, can be decoded and studied to make some meaningful insights to the Pandemic and planning for the future.

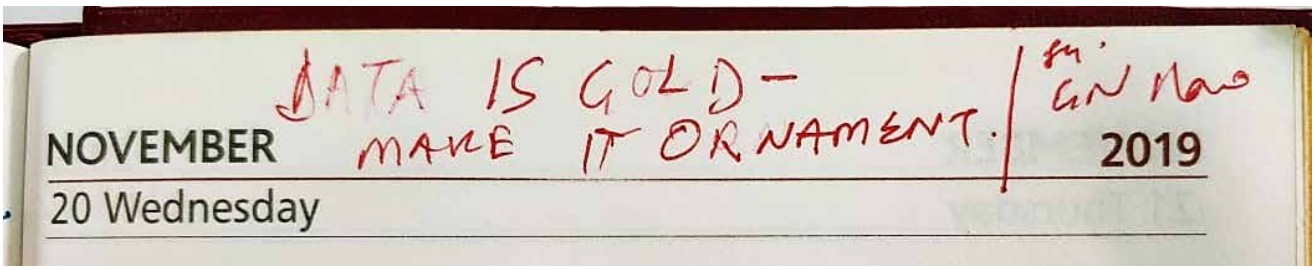
The 'reverse migration', not experienced before in the living memory in India, raised questions... the need for regional planning, currently almost absent both form the National and (State) scenario. It is a double whammy.. . the manufacturing sector (in major cities) is opening up without the labour to work.. and labour has reverse-migrated to small towns and villages without employment.

All migrants, going back, were screened at three places, a data base must have been created. If and when available, this will provide huge opportunity to study their demographic and movement patterns at a National/ regional scale. Whether or not they carried the Covid-19 virus from urban to rural areas can also be studied when data on that becomes available. In terms of migrant labour, why and how they defied the initial lockdowns.. wanting to go home, complemented with socio-economic-political pressures to make arrangements for their travel back home by making available special buses, *shramik* express trains.., amidst the fear that they may have become the carriers of virus from 'urban' to 'rural' or rurban areas. So on a national map, if we are able to show the bulk of 'from' areas and 'to' areas, the complete pattern of 'reverse migration' and possibly the travel trail of Covid-19 could be traced.

This leads to a further question. How, after all, the 'from' cities became the 'hotspots'. Some correlation of

Plethora of data was being generated elsewhere, everywhere, in every form. The number of tests conducted, the number of confirmed cases, the deaths, the misery, the loss of employment, the 'urban' streets being taken over by the 'wild' and so on.

The data emerging during these times, though not much organised and structured, can be decoded and studied to make some meaningful insights to the Pandemic and planning for the future.



Sorry, the equations have reversed. 'Market' has come home! The 'work' has come home! The 'school' has come home!

National hotspot cities in terms of their population size, density, demographics, percentage population living in slums and squatters, deaths per million resident population, etc. can provide some insight, as well guide what needs to be done to prevent such situation in future.

At a more local scale, how certain areas of cities became 'containment zones'. What areas do these represent in terms of planning structure, density, typical road widths, demographics, congestion, etc.

Will it lead to revisiting norms and standards for minimum plot sizes, residential units, FAR and densities? Is mixed land use one of the major culprits? Or, simply the irresponsible behaviour at the community level is to be blamed? Will it also mean more per cent land use for hospitals and less for educational and office considering much can be 'worked from home'?

The Pandemic and the following protocols also saw the term 'Social Distancing' coined. In effect, it only calls for 'physical distancing'. On the contrary, it has been converted (unintentionally) into an opportunity for 'Social Bonding'.

The increase in usage of social media, much enhanced number and duration of telephone calls, WhatsApp calls and messages, video-conferencing, Google meets, etc., say during last six months, is a strong enough proof. Families have made WhatsApp groups to share their daily lives and exchange of greetings and knowing the wellbeing of each other.

A lot of business and social meetings were conducted without having to travel, and thus saving all the time, resources, stress and receiving a relatively less polluted and less congested city environment. The increased 'online shopping' and 'delivery' has changed the rules of the game. Most planning norms and theory (e.g., Christaller's Central Place Theory and Clarence Parry's Neighbourhood Concept) is based on distance to market and work, etc. Sorry, the equations have reversed. 'Market' has come home! The 'work' has come home! The 'school' has come home!

An insight to all the data can certainly be beneficial in planning for the distribution of medicine and inoculation, when available for mass dispensing.

It is also possible that all stakeholders forget everything post recovery, and then, it is life as usual.

Nonetheless, an insight to all the data can certainly be beneficial in planning for the distribution of medicine and inoculation, when available for mass dispensing. Should it start with the 'hotspot' cities? Should it be first targeted towards 'containment zones'? Do the rural areas not require the vaccine urgently?

There is plenty of data and plenty of possibilities to explore, make sense and meaningful discourse for the future. I am reminded of Sh. G. N. Rao, IAS (Retd.), Convenor of the Expert Committee to suggest Comprehensive Development Strategy for the entire State of Andhra Pradesh, India, including Capital - of which I was a member. In one of the meetings of the Committee, he took my personal-office diary from me and wrote in his hand, "Data is Gold. Make it Ornament" (refer image above). That was a few weeks before the Covid-19 struck. I believe, the Covid-19 has given us the Goldmine. Let us make ornaments.

Digital blockchain for land pooling in Delhi

The land pooling process involves certain radical changes in land administration, which should be digital, blockchain based land administration domain model

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Abstract

The Master Plan of Delhi-2021 (MPD-2021) has envisaged a paradigm shift in land assembly, and stipulates optimum use of land and land pooling policy for the new sub-cities. It involves the preparation of land pooling and land use plans, physical and social infrastructure and transport network plans along with equitable access to land resource, housing, services, jobs, etc. Land management involves several stakeholders, public and private institutions which require horizontal and vertical coordination by a combination of land pooling, regularisation, Transferable Development Rights, Accommodation Reservation and Transit Oriented Development. This needs radical changes in land administration, which are digital and blockchain, whereby land titling ensures social equity, jobs and land sharing.

Introduction

Land is the basis of human development, shelter and infrastructure services.

Fig. 1: 1911- Delhi Durbar-King George V lays Foundation Stone of Imperial Delhi. Land Acquisition under LA Act 1894 Proposed for 43,187 Acres, (9371 acres for Imperial Delhi) by H.C. Beadon, LAC

Traditional planning in India entailed large scale appropriation of rural lands for urban housing, commercial centres, industries, roads and highways, airports, recreational, educational and health facilities, etc. The agitations and various court cases, e.g. at Rewari (proposed development hub under DMIC project), Bhatta Parsaul and Jewar Airport, Greater NOIDA and Singur SEZ (WB), etc. highlight the widespread discontentment against coercive land acquisition.

The Government in 2013 replaced the Land Acquisition Act, 1894 by Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act. As a result, the practice of compulsory land acquisition is being replaced by the concept of land sharing. Private Sector Participation (PSP) and Public-Private Partnership (PPP) in land assembly and development are being increasingly adopted in view of a) difficulty in land acquisition, b) to generate private sector resources by a market led approach, and c) land monetization so as to improve the finances for land and infrastructure development for the growing demands of urbanization.

Five million refugees came to India after partition in 1947, for which the Ministry of Refugees (later Ministry of Rehabilitation) took up the housing schemes (36 rehabilitation colonies), markets and industrial areas. Licensing system was a unique feature which made these accessible to the poor refugees with low/no investment. The Delhi Development Authority was established in 1957 as planning and development agency. It adopted the system of leasehold

tenure, licensing and renting of subsidized and low cost shops, sites and services.

Master Plan for Delhi -1962: To accommodate the increase of population from 2.3 m in 1961 to 5.7 million in 1981, the urban area was projected to increase from 20,000 Ha to 44,000 Ha. As such, the policy of large-scale land acquisition, development and disposal was framed, under which 90,111 acres of land was acquired.

Issues in compulsory land acquisition

The compulsory acquisition of land has raised various issues:

- Poor, Obsolete Land records
- Dissatisfaction of the landowners regarding compensation
- Delays in land acquisition
- Litigation with respect to acquisition, encroachments and compensation
- Huge public investments for land acquisition and development
- Encroachments on acquired public lands
- Lack of adequate land for social housing, infrastructure services, work centres, public-semi-public facilities, etc.
- Poor not having access and right to the city
- Huge administrative work
- Problems of equity, transparency
- Political - bureaucratic tussles
- Lack of digitized property transactions
- Lack of enforcement against unauthorized, colonization, construction, squatting, encroachments
- Tenure and legal issues

The liberalization of the Indian economy (1992) gave a thrust to urban development and the private sector entered in a big way in real estate, housing and infrastructure projects, including ports and airports, rail freight corridors and Special Economic Zones (SEZs). The emergence of transport corridors with a substantial increase in industrial investment, services, flow of goods and people along them has been a significant feature of spatial

Major antecedents of land policy in Delhi	
1894	Land Acquisition Act
1912-15	Land Acquisition for Imperial Capital (43187 acres, including 9371 acres for Imperial Delhi)
1947	Independent India, five million refugees came to India (about 5 lakhs to Delhi)
1957	Delhi Municipal Corporation formed under DMC Act, and Delhi Development Authority under DD Act
1961	Large Scale Land Acquisition, Development and Disposal Policy
1962	Delhi Master Plan (1962-81)
1973	DUAC Act
1975-76	Emergency, massive slum clearance, relocation, urban renewal schemes
1985	NCR Planning Board Act
1986	Environment Protection Act
1992	73rd and 74th Constitutional Amendment Acts
2005-06	High Court/Supreme Court orders for Unauthorised Colonies/Villages Tajinder Khanna Committee on Delhi's Planning and Development P.P. Shrivastava Committee on Delhi's Villages K K Mathur Committee on Unauthorised Colonies and Farm Houses
2007	MPD-2021 notified, Land Pooling Policy
2011	Delhi Geo-Spatial Data Infrastructure Act, 2011
2013	Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation & Resettlement Act
2015	Madhukar Gupta Committee on DD Act
2016	Unified Building Byelaws
2016	RERA Act
2018	Land Pooling Policy and Regulations Notified
2018	NCTD (Recognition of Property Rights in Unauthorised Colonies) Regulations Notified
2020	NCAER-Land Records and Services Report
2020	Covid 19- Loss of 200 million jobs of migrants, Real Estate slump, Work from Home trend

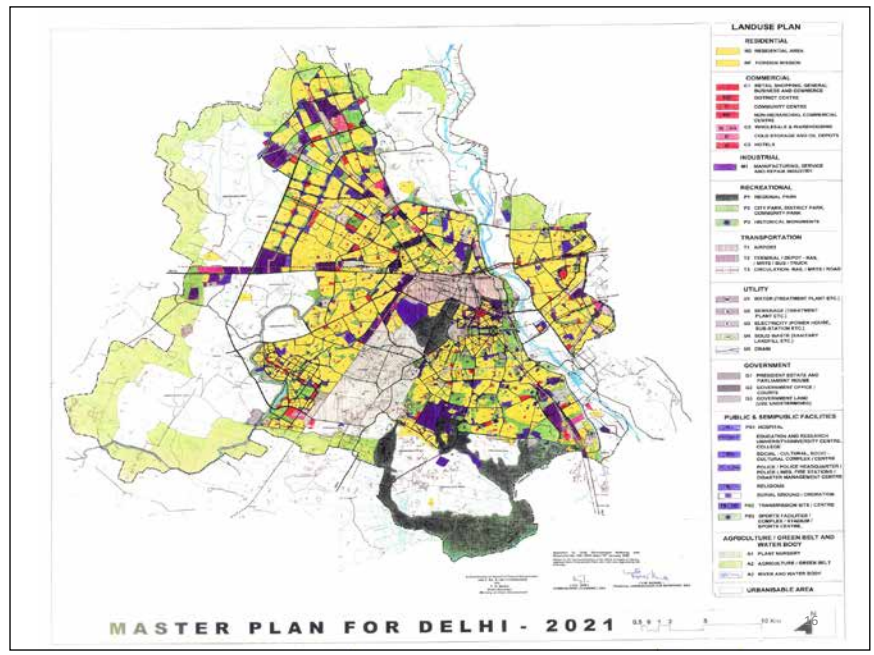

Fig. 2: Master Plan for Delhi-2021
Source: Delhi Development Authority (2007)

change in recent years. The "Golden Quadrilateral" network of National Highways linking Delhi, Mumbai, Chennai and Kolkata as well as North-South and East-West Corridors, promote this type of growth. One of the recent initiatives is 1,483 kilometre long, Delhi-Mumbai (Western) Industrial Corridor

Fig. 3: Urban Extension/Sub -Cities in Delhi 2021 under Land Pooling Policy
Source: Delhi Development Authority

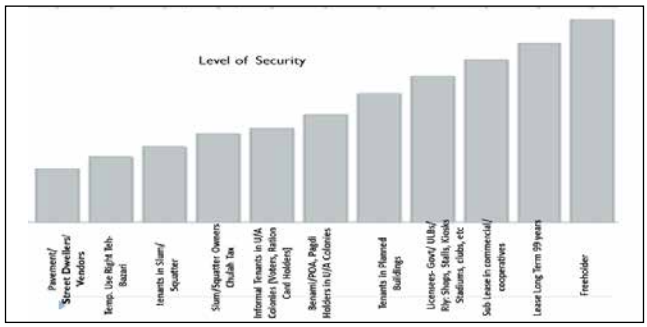

Fig. 4: Property titles and tenure rights

(DMIC) and 1,279 kilometer long Delhi-Kolkata (Eastern) Rail Freight Corridor. To mobilise private sector and institutional resources and get multiplier effect from budgetary allocations, a facilitating approach is being adopted by the government.

Land is a State subject and various State Governments in India have adopted their own land policies. Realising the potential of urban sector in economic development, the privatisation of urban development is being increasingly adopted by the state governments, which aims at the following:

- Land value, capture by conversion of agricultural land for urban uses, Transportation Reinvestment Zones (TRZ), etc.
- Obtaining the gains of private sector efficiency
- Introducing competition in the supply of housing and other developments;
- Opening up new areas of business and creating jobs.
- Better use of lands in improving the overall economy.

DDA partnership models

The DDA and Delhi Government have adopted the model of in-situ development for resettlement of slum dwellers. The DDA's main contribution is the land, whereas private developers bear expenses for construction and site development. For financial viability, the Master Plan for Delhi 2021 (MPD-2021) for slum development allows a density of 600 to 900 dwelling units per hectare and an FAR of 400, with 10% of floor area for commercial use. The market sale housing shall not exceed 40% of the total FAR. The Kathputli Resettlement Scheme at Shadipur (near East Patel Nagar) is a prime example of such scheme.

The DDA in 2006 adopted a PPP model for the Commonwealth Games Village, covering 11 Ha, adjacent to Akshardham Temple. Construction of 1168 flats was offered by the DDA to the bidder against upfront payment and constructing the Commonwealth Games Village flats together with site development, parking and services. The DDA and developer share ratio was 2: 3 flats. Several other PPP schemes are being taken up by the CPWD and L&DO, such as redevelopment of Kidwai Nagar, Sarojni Nagar, R.K. Puram, Nauroji Nagar, etc.

Property titles and tenure rights

As a result of centuries of land administration, Delhi witnesses various forms of land rights-both formal (deed, title, license, etc.) and informal (street vendors, slums, squatters, teh-bazari, etc.). Benami, pagdi and power of attorney are quite common that are something between formal and informal tenures. Chulah tax was imposed by the British rulers in certain villages in Delhi mainly to exert political pressures on the locals. Overall, the system of land tenure/rights is quite complex and vulnerable to fraud. The most vulnerable are the properties in 2000 odd unauthorised colonies, where the land largely belongs to the government, is disputed or under acquisition. The Government in 2019 issued NCTD (Regularisation of Property Rights in Unauthorised Colonies) Regulations. According to the NCAER (2020), the status of land records and services in Delhi is as given below:

Gaps in Land records and services

• Records of Rights	Poor, Obsolete
• Spatial Records	Very Poor, Manual
• Digitised Cadastral Maps	53% of Villages
• Digital Registration Process	Very Poor
• Quality of Land Records, Updation and Land Use	Very Poor

Lack of digital Land Information System and practice of power of attorney are the major hurdles in implementation of the Land Pooling Model. This needs the adoption of information communication technologies (ICT) based digital ledgers for data management, Land Admin Domain Model (LADM), geographic information system (GIS), electronic data capture, web-based applications, satellite/Total Station/

Drone surveys, national spatial data infrastructure (NSDI) and e-governance.

Land Pooling Model of Delhi Development Authority

Land pooling model envisages that an equal portion of land is deducted from every agricultural plot as contribution of land for physical and social infrastructure. This method, also known as a Town Planning Scheme, had its roots in "land pooling" in Germany and is being followed in Australia, Japan, Thailand, Taiwan and South Korea. This involves:

i. Land Pooling and Return without payment of compensation for land retrieved for common infrastructure,
ii. Relaying of pooled land,
iii. Carrying out infrastructure work and subdivision of land,
iv. Re-allotted part of developed land back to the owners, and
v. Selling part of developed land to meet the cost of development.

The method minimises public expenditure in the development of raw land and ensures sharing of value addition of land with the original owners. The process brings public and private investments in infrastructure development and obviates financial transactions which are typically difficult.

The Master Plan of Delhi-2021 (MPD-2021) has envisaged a paradigm shift in land assembly, which stipulates optimum use of brownfield land and land pooling policy for the proposed five new sub-cities. These sub-cities would accommodate a total population of 95 lakhs, which includes about 33 lakh existing population. The total area under five sub-cities is 66,657 ha, which includes regional park/ forests/ water bodies, mandatory agricultural green belt (54 border villages measuring about 11,000 ha), existing built-up areas/ villages/ unauthorised colonies, etc. (about 7681 ha) and land reservations for power plants, services, utilities, solid waste, sewerage, etc. Out of total urbanisable area of 42,334 ha, an area of about 27,628 ha is estimated to be available for new developments. Of this about 50 per cent would be available for residential development, 15-20 per cent for greens, 10-12 per cent for transportation and 7 to 9 per cent for commercial and industrial uses. About one-fourth of the proposed urban area comprises facility corridors, mainly having integrated transit corridors, commercial, public and semi-public facilities, government and institutional uses. The zonal plans of all five zones in urban extensions of Delhi have been notified. The Land Pooling Model is based on the following guiding principles:

1. Basis of Pooling: Pooling of land will be done on the basis of sectors as delineated in the Zonal Development Plan
2. Minimum Area Requirement: Minimum 70% contiguous land of the developable area within the sector, free of encroachment, is required to be pooled to make the sector eligible for development
3. Land Holding Break-up: Of the pooled land, land owner/consortium will retain 60% and hold remaining 40% to be surrendered as and when required to the DDA/service agencies
4. Development by Consortium: 60% land to be utilized by consortium/ land owners for development of residential, commercial, public and semi-public facilities as per the policy
5. Implementation Plan: Consortium will mutually decide a formula among land owners for redistribution of developed land/build space as part of implementation plan and convey the same to the DDA
6. External Development Charges: External Development Charges (EDC) shall be applicable on entire area of pooled land to cover the actual cost of providing city-level infrastructure
7. Separate Developer Entity: Landowners/group of landowners with minimum 2 hectare of pooled land can choose to work as separate Developer Entities (DEs).
8. FAR for Group Housing and City Level Commercial and PSP shall be as per as MPD 2021 norms. 15% of FAR for EWS housing shall be given over and above the permissible FAR.

The Land Pooling Policy of the DDA was notified by the MOHUA in Gazette of India dated 11th October 2018 under section 11A of the DD Act and the Regulations were notified on 24th October 2018 by the DDA under section 57 of the DD Act. It is to be examined that the land pooling Policy is consistent with the Delhi Development Act, LARR and other legislations.

It is necessary to ensure availability of transport corridors and basic services, without causing displacement. As far as possible, land pooling and return transactions should be digital and on the spot. This will save the land-owners and developers from anxiety and will reduce administrative work, court cases, land transfer hassles, land security and vigilance. It will be necessary to create zonal land banks for return of land to poolers and also to develop Master Plan Roads (30 m and above), trunk services and facility corridors. This would enable the service agencies to plan essential public, infrastructure services, such as roads, utilities, power, ESS, water works, main sewers and drains, which are developed by different agencies/ departments. Without these services, land pooling would not work.

Redevelopment potentials

The variety of urban developments, such as existing settlements, unauthorised colonies, and slums, need a hybrid land policy with focus on optimum use of land with better services.

In Delhi, following is the rough estimate of the extent of built-up residential areas:

- 36000 acres –planned residential area
- 12000 acres –unauthorized / regularized colonies
- 1000 acres – government land available for social housing
- 2390 acres –slums & JJ clusters
- 6000 acres –resettlement colonies

These offer scope for densification of built-up areas and amalgamation of small plots for Group Housing (minimum 1670 sm) with common greens and parking and enhanced FAR (400 or 1.5 times the plotted development). This involves upgradation of infrastructure services, facilities and open spaces.

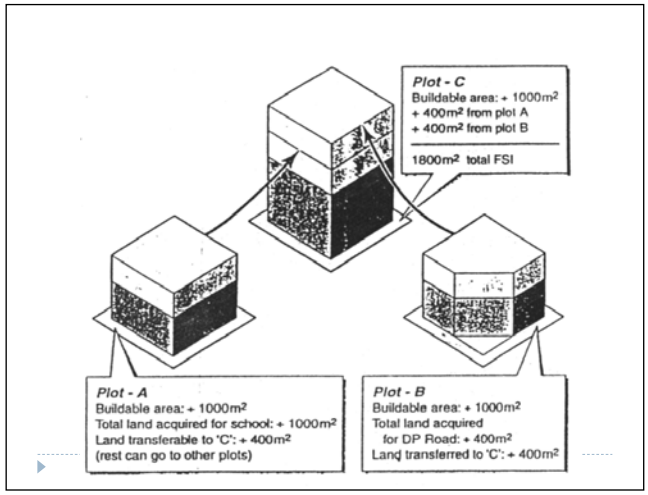

Fig 5: The Concept of Transferable Development Right

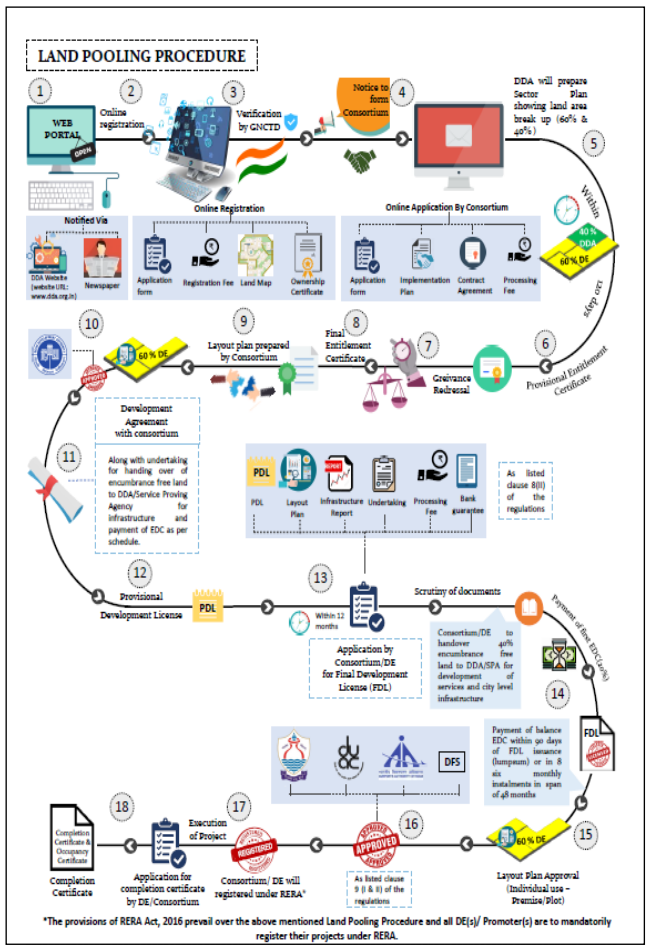

Fig. 6: Land Pooling Procedure (DDA)
Source: Delhi Development Authority

The redevelopment strategy cannot work without simplifying approval process. Mixed land use, incentives of higher density, extra FAR and Transferable Development Rights are necessary in these tasks. Digital property titles and transactions would greatly facilitate the process since many properties do not bear clear titles.

For sustainable and successful land pooling, the following initiatives are essential:

Digital ledgers and blockchain: A digital ledger is a geographically distributed database that is shared and synchronized across a network of the participants. It has a blockchain structure where the data is stored in blocks, linked and secured by cryptography for handling identities, contracts and assets. The blockchain is an electronic transactions system. It is based on a hash algorithm that converts data into a block.

There are three types of blockchain: public, consortium and private blockchain. A public blockchain allows anyone in a network to be involved in the process of adding blocks. A consortium blockchain requires participants to be from an organization. A private blockchain is operated by a particular organization. Every user receives a unique public key and a unique private key. These two keys can be used for privacy and authentication. Thus, a blockchain is a chain of digital signatures that are joined together in clusters with a specific block.

Broadly land registration is title based and deed-based systems. In the deed-based system of registration, a deed or a transaction of land is registered. This deed is proof of a land transaction but not the legal right. As such a transferee must trace the ownership of the land back to its root and establish if the transferor is a rightful claimant. The title-based system is the legal land right the rightful claimant for the spatial extent of the property right are registered. Deed and title-based systems of land registration are the result of centuries of optimising land administration systems. The deed-based system is vulnerable to fraud where the chain of transactions is broken. The title-based system aims to curb such frauds.

Digital Blockchain system for land registration is indispensable for land pooling schemes in order to curb the frauds and power of attorney transactions, which are very common in urban extensions.

LADM framework

The Land Administration Domain Model (LADM) is an International Standard (IS) of the International Organisation for Standardization, as ISO 19152. It covers basic information related to components of land administration and includes agreements on administrative and spatial data, land rights and source documents (e.g. deeds or survey plans), and forms of tenures-customary tenure, government land, and privately held land.

As such, LADM is capable of depicting the Land Administration System and different forms of land grabbing. The LADM defines the Spatial Units and different forms of property (commonly held, public or private). The differentiation is valid for converting private lands for public use (roads, infra services, facilities, parks, etc.) by taking over contiguous parcels of lands and readjustment of ownerships of remaining private lands (say 60% of original extent). The LADM, as such, assigns the class. It contains the Rights, Restrictions and Responsibilities. (Annex F of ISO 2012), which can be the basis of land adjustment and registration. For land pooling two specialised classes, one for public based regulation (AL_ Infrastructure Reserve), and the other for Land Registration, where the ownership rights and the publicly imposed restrictions are registered for each case.

Integrated and inclusive development should address the issues of environmental sustainability, city expansion, restructuring, development controls and land use. The poor and informal sectors have a claim on equitable access to resource- land housing, services, jobs, etc. Redevelopment of old, unplanned areas, unauthorized colonies and slum rehabilitation can be ensured by incentivized development rights. and infrastructure services, such as water, power and drainage, transportation. These involve several stakeholders, public and private institutions which require horizontal and vertical coordination. This can be achieved by digital platform, i.e. blockchain.

In the context of heterogeneous urban character, it is necessary to adopt a hybrid approach for a land pooling, composite redevelopment and densification. The strategy of sustainable development focuses upon public greens, social facilities and utilities with minimum consumption of land.

The concept of excess condemnation can be employed to serve the twin objectives of providing a public road, highway or such facility and generate revenue by the acquisition of additional lands which are directly affected by such provision. The adjacent area is developed by the local body, the land value of which increases as a result of facility/road, and it accrues to the local body, rather than to individuals. The concept of property development along major public transport corridors/MRTS has been adopted in Delhi with grant of 50% additional FAR. This helps building up of a land bank of the local body.

The concept of white zoning: Planning norms, density, FAR and flexible land use zoning can open up new avenues for using the land as a resource for urban turnaround. It is essential to optimise utilization of urban land vis-a-vis Floor Area Ratio and residential density along with mixed land use and flexible zoning known as white zoning in Singapore. It allows flexibility in land use. Depending upon the feasibility of land use and floor area permissibility, the developer pays the land use and FAR charges. This strengthens the financial base of urban local body to provide services and amenities. The Old City, unplanned areas and major corridors can be taken up for white zoning. This way the old, dilapidated areas are renewed and upgraded with a wider participation of the owners and without need for acquisition of virgin, unserviced lands.

Transit oriented development: Relatively low and uniform Floor Area Ratios (FAR) have distorted urban land market by promoting sprawl, increasing transportation and infrastructure overheads. It is necessary that the FARs are rationalised to permit higher density development in the areas with adequate infrastructure and public transportation capacities, both existing and future. Gains in property values can be recouped for infrastructure development. Land Value Capture and Land Based Transportation by Transit Oriented Development are the new frontiers of infrastructure financing.

The tools of Land Pooling and Readjustment, Excess Condemnation, Accommodation Reservation, Transferable Development Rights, etc. can be effectively used for infrastructure development, while promoting private sector participation. In the built up areas, in-situ redevelopment can be promoted by grant of development rights, including incentive FAR.

Transferable development right: Transferable Development Right enables the land acquisition for public purpose without monetary compensation, but by way of grant of additional FAR /FSI. This helps in obtaining lands for road widening, new roads, development of parks, playgrounds, civic amenities, etc.

Accommodation reservation: The Accommodation Reservation is a form of in-situ TDR which allows the land owners to develop the sites reserved for road widening or an amenity in the development plan using full permissible FSI/FAR on the plot. This way the reservations for social housing, parks, utilities, retail markets, dispensaries, etc. are implemented on private lands without the need to acquire the land by payment of compensation.

Spatial, Financial and Infrastructure Integration: Land management involves coordination among the local, state and central governments with horizontal and vertical linkages among planning, engineering, finance, legal, housing and management departments. Coordinated spatial, financial and infrastructure planning can be achieved by Capital Investment Folio (CIF), similar to what was developed for the Metro Manila Commission. This helps in coordinating the spatial plans with infrastructure investment strategies and allocating responsibilities. This also considers sustainability factors, e.g. form of urban expansion, which minimizes energy use, minimize development on high value agricultural land, avoid vulnerable groundwater resources and optimize use of land (e.g. mixed use areas, redevelopment and redensification, multiple use of buildings, etc.).

Infrastructure bundling: Urban projects, such as slum redevelopment, roads, and airports are being increasingly financed through award of land for market to partly compensate the cost of development. Slum Rehabilitation at Kathputli colony, Delhi, IGI Airport, New Delhi, Redevelopment of the New Delhi Railway Station, Sports City/F-1 Racing Track, Yamuna Expressway (UP) and Ganga Expressway in Uttar Pradesh are some of the examples of such projects where the cost of infrastructure development is part-funded by the award of land rights.

Betterment levy and land value capture: For the sake of equity and fair distribution of public resources, the concept of betterment levy obliges the land owners to return a part of land value addition or profit that results from public investments. Betterment levies help to finance urban development and public services by the ULB and service agencies.

The infrastructure development can be financed through the recovery of EDC, conversion charges, FAR charges, Betterment levy, etc. However, to ensure the availability of infrastructure and corridors prior to real estate development, it is necessary to separate the surrender/ return of land and payment of EDC, Betterment levy, Conversion Charges, FAR Charges, etc. vis-à-vis grant of development right and change of land use. The land owners can be given a choice or a combination of cash and development right.

Implementation and regulatory process

The private sector participation in land pooling and its development involves various regulatory functions, such as given below:

- Working out the rules, regulations, procedures and guidelines, grant of licenses, for private sector participation in real estate, land assembly, planning, infrastructure development, redevelopment, housing, etc.
- Spatial Data Infrastructure (SDI) /

Table 1: Land assembly and development management tasks

Tasks	Specific actions
a) Advanced and coordinated development of the transport networks, main roads, infrastructure services, etc.	• Availability of land for transport and services networks/corridors. • Service agencies should prepare plans of land requirement and Service Plans. • Preparation of detailed sector plans. • Preparation of DPR for PPP projects, • Work programming of agencies responsible for land management, engineering, planning, and utilities. • Preparation of a land information system, digitise land data/ ownership details land management program, land regulation and transfer, etc • Working out External and Internal development cost estimates and financing structure/sources. • Action Plan and programmes combining Land Value Capture, Plan Funds, EDC, Betterment Levy, etc.
b) Acquisition of land for development of public, social and government uses/ facilities.	• Availability of land for utilities/grids/roads/service corridors • Funding-development charges, EDC, Betterment levy. • Planning and development of Facilities Corridors and public open spaces. • Launching land pooling/ adjustment/return projects.
c) Immediate transfer/ return of land holdings to the land pool participants and its registration	• Publication of area-wise plans and program for land pooling • Government land bank for spot exchange/adjustment of land with land poolers • Notification of lands under LARR Act for facility corridors/Master Plan Roads and of those not participating in land pooling • Promotion, persuasion and information sharing on web (planning, land infrastructure, finances, etc.). • Land management/acquisition option under TDR and Reservations. • Launch Land Pooling projects.
d) Timely and orderly planning of land into roads, facilities, open space and building plots (with title documents) and grant of planning permission	• Monitoring of demand, supply and use of housing plots. • Subdivision regulations linked to the land use zoning. • Efficient administration of development regulations, planning permission, TDR/AR, and Land Banking • SDI/digitised land/property information. • Online/one window planning permission.
e) Increased supply of low-cost housing and redevelopment & redensification of existing urban zones	• Implementing Redevelopment Guidelines, promoting TOD, taking up pilot projects. • Grant of ownership to eligible /repolarised households in slums, unauthorised colonies, etc. on the basis of clusters (a minimum composite area of 1670 sq.m) which can be taken up for redevelopment into group housing with enhanced FAR 400 with one-third as soft parking/common greens, etc. 10% of FAR for commercial activities • Encouraging private lands to redevelop and infill development • Allocating share of land from land pooling projects for social housing • In-situ upgrading of slums and squatter settlements
f) Coordinated and speedy development	• Time-lines, Action programmes, quality control and monitoring. • Streamlining approval procedures • Financing Plan and management • Building Materials, Codes and Specifications. • Category-wise pre-selection of the experts/ consultants and contractors for award of work on pre-determined approved rates, without the need of time-consuming tendering, EOI, etc for each project. • Timely recovery of EDC/development, conversion, FAR, Betterment, Levy, Service charges, etc. • To assist PPP/ Cooperatives/ Community to take up land pooling, Redevelopment, Regularization of illegal settlements, conferring land titles/registration/licenses.

Source: Jain A.K., (2014), Revisiting Land Acquisition and Urban Process, Readworthy Publishers, New Delhi

computerization of land records, on-line, one window approval of plans.
- Compulsory acquisition of land which effect the composite land pooling, and infrastructure development
- Procedures for grant/revoke of licenses, approvals and planning permissions.
- Model agreement and MOU with land owners for land pooling, preparation and approval of the plans of land pooling/assembly and land return.
- Issue of Transfer of Development Right and Accommodation Reservation Certificates.
- Enforcement and monitoring of regulation for private /PPP developer, housing and service agencies, etc. including progress of work and financial transactions.
- Regulations/procedures to oversee the compliance of the legal, administrative and financial commitments.
- Financing and accounting procedures.
- Procedures to deal with appeals, grievances and complaints.

The land policy needs simultaneous process reforms for better control over time, bridging the gap between demand and supply, overcoming delays and cost overruns, time-bound planning and effective monitoring. Technological interface vis-a-vis energy, water and environment with reference to standards and specifications, infrastructure, construction, maintenance is a major consideration. There is a need to adopt new contracting procedures for efficiency, quality of service, delivery and transparency. Table 1 gives a list of the actionable tasks.

The partnership strategy may not succeed without complimentary organisational innovation and reforms, which have to ensure sustainable and inclusive urban development. This needs a hybrid regulatory framework that integrates the physical, economic, and social development. There is a need to revisit the existing procedures, development control norms and space standards keeping in view the growing economy, land crunch, and changing needs of the people. This may need the setting up of a Land Pooling Regulatory Authority to regulate the process of land assembly/pooling and development, redevelopment, housing, etc. and to oversee the compliance of the legal, administrative and financial commitments.

Conclusions

The land pooling process involves certain radical changes in land administration, which should be digital, blockchain based land administration domain model. The purpose of new model is to make the land titles as a tool of right to the city, social equity, jobs and transparency. The focus has to be on sustainable development and inclusion for which it is necessary to revive the property licensing for small shelter, shops, kiosks, clubs, facilities, etc. This means a review the auction policy, rationalization of the reserve pricing and conversion charges. For optimum use of the land, it is necessary to take up the redevelopment and land recycling. The system of land use zoning should be flexible. To ensure a composite, compact and dense urban pattern with safe building, parking, common space and access of emergency vehicles, the reservations of public greens, transport, physical and social infrastructure are crucial. This needs a closer spatial-institutional-financial integration. For a sound legal back-up, the land pooling policy should be consistent with the Delhi Development Act 1957, LARR Act 2013, Transfer of Property Act 1882, Revenue Act 1963 and Registration Act 1908.

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GSA releases the 3rd GNSS user technology report

The European GNSS Agency (GSA) has just released its latest GNSS User Technology Report, providing a comprehensive analysis of latest GNSS trends and developments. With contributions from leading GNSS receiver and chipset manufacturers, the report serves as a valuable tool to support planning and decision-making with regards to developing, purchasing and using GNSS technology. Published biennially since 2016, the User Technology Report has become a point of reference for the GNSS industry, research and policy-makers.

The third edition of the report begins with a chapter devoted to technology trends common to all segments, be it on the receiver design, position processing or signal processing side. It also discusses protection measures against GNSS jamming and spoofing, such as authentication, including what - in combination with GNSS - 5G and other technologies and sensors can do. With multi-constellation now being the norm, the industry is moving towards the wide adoption of multifrequency receivers even for usually power- and cost-constrained consumer solutions. The Galileo E5 is becoming the preferred frequency with about 20% of all receiver models in the market already using it.

The report is built around four macrosegments defined on the basis of commonalities from a technology point of view: high volume, safety- and liability-critical, high-accuracy, and, new-entry in this edition, timing devices and solutions. Each chapter starts with the macrosegment characteristics and receiver capabilities, depicts the industry landscape and typical receiver form factor, it then delves into the key current and future drivers and trends, and finishes with the added value of the EGNSS, Galileo and EGNOS, for the macrosegment at stake.

This year Editor's special "Space Data for Europe" sheds light on the role that Copernicus and Galileo play within the European Space Programme in the data

management and use, now and in the future. It also provides a vision of major transformations underway within our society and our economy and the benefits expected from this digital transformation, paving the way towards the European Data Strategy and Green Deal. *gsa.europa.eu*

Spirent Federal chosen to support NASA for GNSS testing

Spirent Federal Systems has been selected by the U.S. National Aeronautics and Space Administration (NASA) for testing GNSS for lunar exploration.

The U.S. Space-Based Positioning, Navigation and Timing (PNT) Policy tasks the NASA Administrator to develop and provide requirements for the use of GPS and its augmentations to support civil space systems. NASA is exploring the viability and enhancement of GPS and GNSS signals in the Space Service Volume (SSV) and beyond to support operational U.S. missions and civil space systems. Spirent GNSS solutions and expertise will support testing of the GNSS receivers intended to be deployed in the upcoming lunar exploration. *www.spirentfederal.com*

Coalition asks lawmakers to intervene in GPS-related FCC ruling

Farm Bureau and dozens of other organizations representing a broad range of industries is calling on lawmakers to help protect the satellite communications and GPS services that tens of millions of Americans rely on.

This spring, the Federal Communications Commission granted a petition filed by Ligado to provide 5G services. Ligado's planned use of its spectrum is so near bands used by GPS, it could diminish the reception capability of GPS devices. This is a major problem for farmers and ranchers, who rely on precision agriculture technology and GPS so their farms and ranches can be more efficient, economical and environmentally responsible.

It would also put at risk GPS services used by the military and other national defense agencies, aviation safety agencies, mapping applications and many others.

The groups are asking the lawmakers to work with the FCC to set aside the flawed Ligado order in favor of a process that is responsive to the concerns of the incredibly broad cross-section of L-band operators and users.

The 60-plus organizations that signed the letter represent the aviation, aerospace, agriculture, GPS, ground transportation, mapping, marine, metrological, public safety, satellite communications and surveying industries and professions. *www.fb.org*

Public Release of GPS IIR and IIR-M antenna patterns

Partnering with the U.S. Coast Guard Navigation Center (NAVCEN), U.S. Space Force and Lockheed Martin Space have released the GPS IIR/IIR-M satellite antenna patterns for world-wide public use. Additionally, the Institute of Navigation has offered a related ION Journal article free to the public to accompany the antenna patterns.

The GPS Block II Replenishment (IIR) space vehicle (SV) began improving upon its baseline design in 2003 with the launch of the first Block IIR SV retrofitted with a redesigned 'improved' antenna panel. This is the Earth-facing panel providing the GPS L-band broadcast signal. The improved antenna panel includes redesigned L-band elements mounted on the SV Earth-facing structure in the same manner as the original 'legacy' antenna panel.

The use of GPS signals for spacecraft navigation has increased in general over the last few decades and navigation employing GPS observations for spacecraft in low-Earth orbit is now considered routine. However, the situation is quite different for spacecraft that fly in the Space Service Volume above the GPS constellation, including MEO, GEO, HEO, and missions to the Moon and beyond. For these spacecraft, reception of GPS transmit antenna side lobe signals is essential to improve availability and performance of on-board navigation and timing. In this context, the knowledge of the full antenna pattern (main lobe and side lobes) from the transmitting antennas of each of the GPS satellites is essential.

Russia launches Glonass navigation satellite

"The Soyuz-2.1b middle class carrier rocket launched on October 25, at 22:08 Moscow time from Plesetsk Cosmodrome in the Arkhangelsk Region has successfully placed the Russian Glonass-K navigation spacecraft into the calculated orbit in the scheduled time," the Def ministry noted.

The ministry's information department pointed out that the launch and the operation were carried out as planned. It was also emphasized that the satellite was placed under control of the Russian Aerospace Forces' ground aids.

The group of Glonass satellites comprises 24 spacecraft in circular orbits. At present, the group has 27 spacecraft with 24 of them operational, one is undergoing flight trials, another one is in the reserve, and yet another one is in maintenance. Two of the spacecraft are of the Glonass-K series (with the launched satellite to become third), while the rest are of the Glonass-M series. In the future, all spacecraft are planned to be changed for Glonass-K ones. *https://tass.com/science/1216197*

Service to monitor and alert the UK to GNSS disruption

CGI has been awarded a contract by The European Space Agency (ESA) to develop a GNSS Event Notification Service (GENS) capable of monitoring the UK GNSS spectrum to enable effective alerting and reporting of Position Navigation and Time (PNT) disruption.

GENS will integrate CGI's PNT Incident Event Monitoring (PNTIEM) System with existing UK developed sensors from Ordnance Survey's (OS) OS NET network of GNSS Receivers and GMV

NSL's DETECTOR, GISMO and Strike 3 interface technologies. Bringing together existing systems will build on proven technologies, reducing the cost of development of a large scale monitoring network whilst providing the ability to introduce new services for detecting GNSS events and disruption. Supported by the OS and GMV NSL, CGI will lead the delivery of GENS using agile software delivery experience, supported by system design and DevSecOps development and integration skills. An open interface will be offered for future providers of GNSS measurements, or spectrum event data.

Alongside the GENS system technical delivery, The National Physical Laboratory (NPL) will develop a GNSS Guidance Document in partnership with UK government departments, agencies, CNI operators, professional institutes, academic institutes and commercial organisations to enable informed requirements development, procurement, deployment and support of HMG GNSS reliant services.

The full GENS system will enable users across both commercial and public sector services to subscribe to be informed of both GNSS quality and interference events for regions of interest. *cgi.com*

Germany orders U.S. jam-resistant GPS receivers

Germany has ordered jam-resistant GPS receivers from the United States military, becoming the first buyer of the advanced GPS user equipment under the Foreign Military Sales program.

Foreign Military Sales is the U.S. government's program for transferring defense articles, services, and training to international partners. The Space and Missile Systems Center said Germany on Sept. 30 ordered an undisclosed quantity of Military Code (M-Code) capable military GPS user equipment. M-Code is an upgrade to GPS signals that provides enhanced secure positioning, navigation and timing, anti-jam and anti-spoofing. *https://spacenews.com*

Smallest methane emission ever detected from space

Space Flight Laboratory (SFL), a developer of 53 distinct microspace missions, has announced the successful measurement of atmospheric methane by the GHGSat-C1 greenhouse gas monitoring microsatellite that utilizes a NEMO platform developed by SFL. The methane emission from a source on the Earth's surface is the smallest ever detected by satellite.

Less than a week after the September launch of GHGSat-C1 ('Iris'), GHGSat Inc. recorded the microsatellite's first successful measurement of a methane emission from a known oil and gas facility in Turkmenistan. A week later, the satellite operator tasked Iris to measure a much smaller, controlled methane release from a test site in Alberta, Canada. The satellite-based measurement was successful and confirmed with an airborne sensor. *www.utias-sfl.net*

Statewide California LiDAR mapping project

VeriDaaS Corp. is planning a high-density LiDAR elevation data collection at a minimum of 30 points per meter (ppm) over the entire State of California in the Spring 2021 as part of the VeriDaaS National Mapping Initiative (VeriMAP™). Higher density data above 30 ppm is also an option if stakeholder commitments are secured before the planned start of the project.

VeriDaaS will be using the Geiger-mode LiDAR sensor systems and multiple fixed-wing aircraft for the project. The sensors are optimized for highly efficient collection of high-density data from higher altitudes while maintaining precision and accuracy over wide geographic areas. *https://veridaas.com*

GAF AG and BKG intensify their cooperation

GAF AG, one of the largest European providers of geographic information services with a focus on earth observation, has won an international tendering process issued by the German Federal Agency for Cartography and Geodesy (BKG) for the provision of remote sensing data. The framework agreement concluded on that basis includes consulting services and the granting of exclusive access to the BKG and its users to high-resolution and very high-resolution optical satellite images and radar images.

The cooperation with GAF is designed to ensure the fastest possible acquisition and delivery of remote sensing data, in normal and emergency modes, for especially time-critical activations.

China launches latest trio of Yaogan-30 RS satellites

China launched a seventh group of Yaogan-30 reconnaissance satellites Oct. 26, marking the country's 31st launch of 2020. The China Aerospace Science and Technology Corp. (CASC), China's state-owned main space contractor, confirmed launch success. The trio of satellites are expected to orbit in a roughly 600 kilometer altitude orbit inclined by 35 degrees. They join six earlier groups of Yaogan-30 designated satellites in similar orbits. The first Yaogan-30 trio was launched in September 2017. *https://spacenews.com*

Inertial Labs releases RESEPI

The Remote Sensing Payload Instrument or RESEPI is an affordable solution for extremely accurate remote sensing applications. It was designed with the purpose of private labeling, so Inertial Labs' partners have the ability to put their branding on both the hardware and software components of the complete remote sensing solution.

RESEPI is composed of Dual Antenna GPS-Aided Inertial Navigation System (INS) with a dual use Novatel RTK/PPK GNSS receiver, and is integrated with a Linux-based processing platform. With an embedded cellular modem, RESEPI supports in-flight RTCM corrections for immediate RTK point cloud generation. In addition, RESEPI can be integrated with a variety of the industry leading LiDAR providers. *inertiallabs.com*

Use Esri's Collector for ArcGIS and Survey123 concurrently

Eos Positioning Systems, Inc has released capability in its Eos Tools Pro apps (iOS, Android, Windows) that allows Collector for ArcGIS and Survey123 to run concurrently, allowing the user to dynamically switch between the two apps in the field. "Without this capability, users could not run two data-collection apps, such as Collector and Survey123, or ArcGIS Field Maps and ArcGIS QuickCapture, at the same time," Eos Chief Technology Officer Jean-Yves Lauture said. "With this release, parties can run multiple apps on a single device that simultaneously consume high-accuracy positioning data from the Arrow GNSS receiver."

This new capability allows fieldworkers to run two apps at the same time while accessing the same ArcGIS Online database. Specifically, a user can now record a high-accuracy GNSS location in Collector and then immediately switch to an open Survey 123 form to complete their workflow. The data, including precise positioning will be populated to the same ArcGIS Online database.

Bentley Systems expands alliance with Microsoft

Bentley Systems and Microsoft Corp. have announced an expansion of a strategic alliance focused on advancing infrastructure for smart city urban planning and smart construction. The alliance will combine Microsoft's Azure IoT Digital Twins and Azure Maps with Bentley Systems' iTwins platform, enabling engineers, architects, constructors and city planners to work within a comprehensive city-scale digital twin, empowering better decision-making, optimizing operational efficiency, reducing costs and improving collaboration. *www.bentley.com*

UP42 partnership with Intermap

UP42 has announced that the NEXTMap Elevation Data Suite from Intermap Technologies is now offered on the UP42 developer platform for Earth observation data and analytics. The NEXTMap 3D elevation products are available as Digital Surface Models (DSM) and Digital Terrain Models (DTM) at one-, five-, and 10-meter resolution.

The addition of NEXTMap datasets to the UP42 marketplace enables users to build even more powerful geospatial solutions in the areas of infrastructure management, construction planning, geologic mapping, land cover classification, forestry, resource conservation, and contour generation. *www.up42.com*

GeoCalc online updated

Blue Marble Geographics® has announced the release of GeoCalc Online, a geodetic parameter repository, with a new built-in Point-to-Point Calculator.

Formerly known as the GeoCalc Geodetic Registry, it is the cloud version of the GeoCalc library. All coordinate systems, transformations, and other definitions used by Blue Marble's software products (Geographic Calculator, the GeoCalc SDK, and Global Mapper) are found in GeoCalc Online. *bluemarblegeo.com*

Esri releases Community Health Assessment Solution

The Community Health Assessment Solution was created by Esri to help health organizations collect community information, at the household-level, required for disaster response or health action plans. The solution delivers a set of capabilities that include: planning community health survey areas, collecting survey responses from households, and monitoring key indicators as the assessment occurs.

The solution follows the Community Assessment for Public Health Emergency Response (CASPER) framework. The World Health Organization developed this framework which has been adopted by the U.S. Centers for Disease Control and Prevention. A CASPER survey calls for a two-stage cluster sampling methodology which is made easier with the Community Health Assessment Solution.

Integrated public transport platform for African megacities

Route Masters, based at the European Space Agency BIC UK in Harwell in Oxfordshire, has signed up to the national SPRINT business support programme to develop an innovative transport management solution for African cities. Funding from SPRINT will enable Route Masters to collaborate with the University of Leicester on building a full suite of technology tools and algorithmic data models.

Route Masters is developing an algorithm based on single-band GNSS positioning within cities. The solution will deliver transport flow models superimposed on satellite-based city maps. The technology utilises applied mathematics to build digital route maps that will accurately deliver journey times and modes for city planning tools and mobile navigation applications for consumers.

This data fusion project will combine dual-band GNSS with single-band GNSS and satellite derived city maps. The solution will be leveraged to deliver planning and control intelligence services and consumer services and, after University of Leicester validation, it will be tested and deployed as an active prototype in Lagos, Nigeria. *www.sprint.ac.uk*

Advanced RTLS tag module for real-time positioning

Inpixon has announced the launch of its newest smart tag module, the swarm bee LE V3, supporting a range of indoor and outdoor location applications including real-time location systems (RTLS).

The swarm bee LE V3 is a miniaturized radio transceiver module that can easily be embedded into small tags that transmit a signal allowing them to be located in real-time. These tags can be built into wearable IoT devices -- everything from wristbands and visitor badges to belt clips and mining helmets -- or they can be integrated into tags that are affixed to assets such as heavy mining equipment, forklifts, pallets, hospital ventilators or theft-prone items. *inpixon.com*

Nokia selected for EU aviation comm, navigation and surveillance research project

Nokia, alongside Honeywell International as consortium lead, has been selected as part of Project FACT (Future All Aviation CNS Technology), an innovative research and development program initiated under the SESAR 2020 program, managed by the Single European Sky ATM Research (SESAR) Joint Undertaking.

Nokia will provide 4G and 5G mission-critical infrastructure, consulting and services to Project FACT, which will research future deployment of a new, consistent technology platform for communication, navigation and surveillance (CNS) services across air traffic management (ATM).

The FACT Project will deliver updates to existing CNS technologies, where it is anticipated that applications such as controller-pilot datalink communications – the method by which air traffic controllers communicate with pilots – can also be deployed over new and emerging high-bandwidth mobile broadband technologies. The project will also research potential integration of today's conventional ATM systems with emerging U-Space services such as drones and other unmanned aerial vehicles.

Nokia will be responsible for leading a feasibility study and test specification for the evolution of legacy CNS systems to a new integrated approach. Nokia laboratory trials are projected to take place in the summer of 2021, with field testing by June 2022. *www.nokia.com*

MS&AD to use Tractable's AI across Japan

MS&AD, one of the world's largest property and casualty insurers, is to use AI to accelerate how it processes auto claims, speeding up recovery for its policyholders. The AI solutions, created by technology company Tractable, use computer vision to analyse photos of car damage - making sense of it as a human would, in near-real time.

MS&AD will deploy the AI across both of its subsidiaries, Mitsui Sumitomo Insurance (MSI) and Aioi Nissay Dowa Insurance (ADI), where it will be used across hundreds of thousands of auto claims a year, accelerating how quickly each is processed by as much as two weeks per claim. *tractable.ai*

One-stop-shop solution by HERE and Actility

HERE Technologies and Actility are partnering to provide a new, cutting-edge IoT tracking service for mapping and location data management based on LoRaWAN® networks.

Finding an asset in a warehouse and optimizing stock is difficult enough; tracking it across the world are challenges that HERE Tracking and ThingPark – the Actility IoT network management platform can address, offering an end-to-end, customizable solution to track assets and optimize the supply chain of any industrial facility. The focus of this solution is on critical assets for customers' operations such as Returnable Shipping Assets (RSAs) or Returnable Industrial Packaging (RIPs) including racks, pallets, crates, tubs, bins, containers, forklifts, industrial tools and heavy mobile machinery. *www.actility.com*

NavVis introduces processing in the cloud

NavVis has introduced the Cloud Processing Add-on for NavVis IndoorViewer, a cloud-based tool that enables users to quickly and easily convert laser scans into survey-grade, photo-realistic point clouds from data captured by NavVis M6 and the new wearable device, NavVis VLX. The fully integrated indoor mapping solution is relied upon by laser scanning service providers, professional surveying firms, and Architecture/Engineering/Construction (AEC) companies. *www.navvis.com*

Virtual Surveyor introduces Curb & Gutter Mapping

Virtual Surveyor has introduced Curb & Gutter mapping functionality in Version 7.6 of its popular drone surveying software. The new capability enables surveyors to create a lightweight CAD model of curbs and gutters along the edges of streets and parking lots from standard orthophotos and elevation models captured by UAVs or drones.

The challenge of mapping curbs in 3D from drone data is that the sharp curb edges are not captured well with drone photogrammetry. Virtual Surveyor now allows the surveyor to input curb height measurements taken in the field as offsets starting from the back of the curb. *www.virtual-surveyor.com*

Kongsberg Geospatial and Unifly partnership

Kongsberg Geospatial has announced partnership with Unifly to enable real-time e-Identification and tracking of drones using Unifly BLIP (Broadcast Location & Identity Platform).

The system fuses data from a wide range of real-time sensors, such as the Unifly BLIP technology, to provide drone pilots with a precise real-time picture of their operational airspace when piloting one or more unmanned vehicles beyond visual line-of-sight (BVLOS). *kongsberggeospatial.com*

Sony launches drone project

Sony Corporation has launched a new project for drones in the field of AI robotics. The recent proliferation of drones has contributed greatly to the delivery of previously unseen images, as well as to workflow efficiency and energy savings in the industrial sector. Sony has assigned the "Airpeak" brand to reflect its aspiration to contribute to the further evolvement and the creation of the unprecedented value through its imaging and sensing technology as well as 3R technologies (Reality, Real-time and

Remote) in the drone area.

Airpeak will support the creativity of video creators to the fullest extent possible, aiming to contribute to the further development of the entertainment industry as well as to improved efficiency and savings in various industries. It will also promote this project to enable drone-use with the highest level of safety and reliability in the environments where this has been difficult in the past. *www.sony.net*

FAA moving forward to enable safe integration of drones

The FAA published airworthiness criteria for the proposed certification of 10 different Unmanned Aircraft Systems (UAS) or drones as special class aircraft. This is a crucial step to enabling more complex drone operations beyond what is allowed under the small unmanned aircraft rule (Part 107), including package delivery.

The airworthiness criteria provide a level of safety equivalent to that provided by existing airworthiness standards applicable to other categories of aircraft, and establish a defined path to type certification for specific drones. Each applicant seeking a type certificate must follow FAA's requirements and safety objectives. The applicants' drones range from five to 89 pounds and include several types of vehicle designs, including both fixed wing and rotorcraft, and are all electric powered. Each notice outlines the applicant's proposed UAS for certification and the airworthiness criteria proposed by the FAA.

This is a step in the certification process and does not imply these applicants have earned type certificates. Final determination of whether a specific drone meets FAA safety requirements will occur after the applicant demonstrates they have complied with these requirements. *www.faa.gov*

Microlab enables GPS network synchronization at Distrito T-Mobile

Wireless Telecom Group has announced that theMicrolabDigital GPS Repeaterwas selected and integrated by Anziva Technologies for the new Distrito T-Mobile entertainment venue in Puerto Rico to enable precision network synchronization for its cellular communication network. The GPS Repeater provides future-proof network synchronization for both 4G deployments and the tighter timing demands of 5G. *www.anziva.com*

Leica Geosystems innovates automated total station portfolio

Leica Geosystems has enhanced the entire automated total stations portfolio in 2020. Starting with the newLeica Nova MS60 MultiStationandTS60 total station, now thenew Leica TS16andTS13 total stationsand the newTM60 monitoring total stationare introduced. Leica Geosystems' automated total stations range is designed to help surveyors achieve the highest measurement accuracy and reliability.

The TS16 enables surveyors to work under any environmental condition dynamically, reliably, safely and seamlessly connected. It now comes with AutoHeight, helping users save time during setup with a button press. Also, the optional DynamicLock, allows surveyors to focus on work and safety without having to stand and wait for the instrument to lock onto the target. *hexagon.com*

New compact active multiband GNSS antennas by Taoglas

Taoglas®, the global leader of advanced antenna designs,has unveiled its new active, multiband GNSS antennas – the MagmaX2 AA.200andColosseum X XAHP.50–engineered for use in applications that require critical high-accuracy positioning and timing applications, including autonomous driving and precision agriculture applications. *www.taoglas.com*

Vertical positioning SDK on the FirstNet API Catalog

NextNav has announced the availability of its software development kit (SDK) for thePinnacle vertical positioning serviceon the FirstNet API Catalog – a curated catalog of public safety relevant Application Programming Interfaces (APIs) and SDKs.It provides applications with highly accurate altitude data for real-time 3D location in multistory buildings, enhancing first responder safety, making decision making more efficient, and improving situational awareness.*https://nextnav.com*

Improving accuracy of single-frequency GNSS receivers

Swift Navigation has announced its precise positioning platform can improve the performance of existing single-frequency GNSS positioning, found on most production vehicles today, from the standard average of 3 meters to lane-level accuracy without changing existing hardware and antenna.

These findings are demonstrated during the regular test drives the Swift team conducts to confirm the efficacy of its solutions and software updates. A performance improvement from 2 meters to 0.7 meters for 95% of this mixed-environment drive was achieved on a production vehicle with a low-cost automotive receiver and antenna. This improvement in performance unlocks lane-level precision previously not possible on existing single-frequency hardware. *swiftnav.com*

M-Code enabled mobile timing & sync solutions by Orolia

Orolia through its Orolia Defense & Security business, has announced the availability of M-Code Military GPS receivers in its Resilient PNT products and solutions, including M-Code enabled mobile mission timing and synchronization platforms.

M-Code capabilities further enhance Orolia's Versa mobile PNT platform for

rugged, small SWaP-C requirements and Orolia's flagship SecureSync® resilient time and frequency reference solution - the first Defense Information Systems Agency (DISA) approved time server.

M-Code is a military signal used in the L1 and L2 GPS bands and is required by Congressional mandate for Department of Defense (DoD) military operations. It is designed to enhance positioning, navigation, and timing capabilities and improved resistance to existing and emerging GPS threats, such as jamming and spoofing. M-Code offers several operational benefits, including a higher-power signal that offers improved resistance to jamming and interference; advanced security features to prevent unauthorized access or exploitation; and improved message formats and signal modulation techniques for faster and more accurate performance.*www.OroliaDS.com*

Sapcorda expands safety-critical GNSS augmentation services

Sapcorda Services GmbH has announced that testing of its first GNSS augmentation services for L-band signal is underway in North America and Europe, laying the foundation for its December 1, 2020 launch of the strongest, most reliable GNSS augmentation signal for safety-critical navigation in autonomous vehicles and machinery.

Available in areas without GSM coverage or mobile internet signal, the new Sapcorda L-band beam solutions from two geostationary satellites provide PPP-RTK data-feed redundancy in real-time by swapping to a second data feed when internet connectivity is not available. This automated swapping significantly improves reliability for life-critical applications such as autonomous cars.

The Sapcorda L-band signal will be transmitted in the open SPARTN format, that has been specifically developed for IP-based and geostationary satellite distributions. It will be invaluable for safety-critical applications in automotive (such as V2X and autonomous driving, AD/ADAS) and maritime, as well as a wide variety of uses across sectors such as industrial, robotics and drones. *www.sapcorda.com*

C-Innovation selects Sonardyne technology

Integrated marine services company C-Innovation (C-I) has chosen a suite of Sonardyne's underwater positioning and navigation systems to support its operations offshore Brazil.

Remotely operated vehicles (ROVs) on board six ROV support vessels (RSVs) in the country will be equipped with Sonardyne inertial, gyrocompass and Doppler technologies, as well as hybrid acoustic-inertial systems. *www.sonardyne.com*

Collins Aerospace to provide Army with anti-jam technology

Collins Aerospace Systems has been selected to provide Mounted Assured Positioning, Navigation and Timing System (MAPS Gen II) for manned and unmanned ground vehicles to combat Positioning, Navigation and Timing (PNT) threats.

MAPS II provides a high-assurance, accurate navigation solution across GPS threat environments with industry-leading NavFusion of multiple sensors and is interoperable with the Collins AerospacePRC-162 manpack radioto ensure mission success in the Joint All Domain Command and Control (JADC2) battlespace. *collins.com*

Gexcel presents HERON® MS Twin

Gexcel presents the new HERON® MS Twin: a double Lidar sensor portable mobile mapping system, equipped with a 5k RGB panoramic camera. Thanks to its advanced hardware+software technology, the users can benefit from a very high-level performance in terms of geometric robustness of 3D models.

HERON® MS Twin is the perfect system for surveyors who works indoors, outdoors, in underground mines, multi-level buildings, tunnels, cultural heritage sites, forensic procedures, forests, urban areas, harsh and complex areas. It can make the user able to obtain several outputs from collected data: volume computation, excavation progress monitoring, digital archive, construction progress monitoring, floor plans generation for asset management, logistic/traffic management, dilapidation monitoring, scan to BIM, contours and profiles, 3D virtual experience, real-time change detection, as-built generation, security and safety, and much more. *https://gexcel.it*

5G LBS with AGPS and 5G NR FR2 mmW performance testing by Rohde & Schwarz

As wireless network operators roll out 5GNR in the millimeter wave spectrum, it is critical to ensure continued reliability of E911 calls and accurate determination of location in mobile devices.

Rohde & Schwarz has verified Assisted-GPS (AGPS) performance in a commercial mobile device, while simultaneously transferring data using 5G millimeter wave (mmW). This capability is now available with the Rohde & Schwarz TS-LBS Location Based Services test system.

5GNR utilizes frequencies in the FR1 frequency range (<7.125GHz) and in the FR2 mmW frequency range (>24GHz). FR2 creates unique challenges for mobile devices in terms of power consumption and heat. With FR2 becoming more common in North American mobile devices, performance of critical services such as E911 emergency calls cannot be allowed to degrade when utilizing this mmW spectrum. *rohde-schwarz.com*

First high-resolution, homogeneous DSM for Germany

Hexagon's Geosystems division has been awarded a contract by the German Federal Agency for Cartography and Geodesy (BKG) to provide a homogeneous, comprehensive digital surface model

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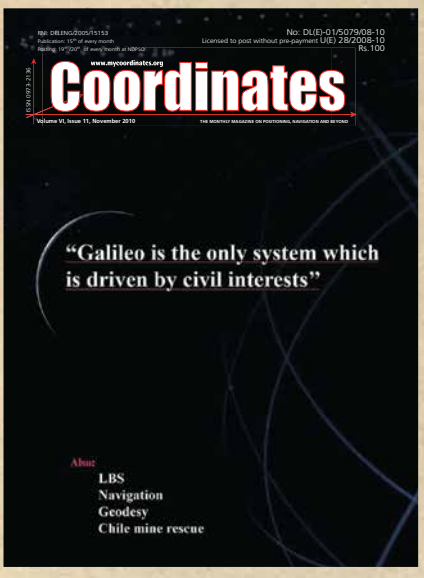

mycoordinates.org/vol-6-issue-11-November-2010

"Galileo is the only system which is driven by civil interests"

says Paul Verhoef Programme Manager, EU satellite navigation programme, European Commission, Brussels, Belgium while emphasising on the difference between Galileo and other GNSS systems.

What are the some of the problems Galileo has faced with respect to the frequencies and signals vis-à-vis other systems?

There have been two issues related to the frequencies and signals with all the systems. One is whether there is interference between the systems and a pure ITU (International Telecommunications Union) frequency interference analysis can determine that. We have not had a problem with that.

The second issue is more complicated and is related to the security requirements which go with the signals. The national security agencies would like to have the means to stop the signals if they are potentially used for terrorist or related activities without causing problems to their own governmental services. In case of the US this would be their military service. We have got a detailed agreement with the US whereby we jointly protect the PRS signals and the encoded military signals on GPS. On this aspect we have a problem with China.

The implementation of a simulation platform for INS/ GNSS integrated systems

Chih-Yu Hu, Meng-Lung Tsai and Kai-Wei Chiang
Department of Geomatics, National Cheng Kung University, Taiwan

This study exploits a complete INS/ GNSS simulation platform. Its architecture includes trajectory generator which can generate all kind of trajectory by user defined. Measurement generator created IMU and GNSS measurements according to the user designed path data and senor error model. Estimator has two different data process strategy, feedforward which suit for high grade IMU and feedback for tactical grade or MEMS IMU.

SAT-SURF: An innovative & flexible HW+SW platform to assist research

The integration of navigation and communication functionalities is one of the key elements exploited in new location-based systems and services

Gianluca Falco
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Researcher, Istituto Superio Mario Boella (ISMB), Italy

(DSM) for Germany. The data is provided via the HxGN Content Program, a licensed, high-quality geospatial data service from Hexagon. The program was launched in 2014 and is currently available in Europe and North America.

The BKG has data sets with general height information of the Earth's surface across its entire federal territory. However, these can vary from state to state because they are generated from different source data. An up-to-date, homogeneous and high-resolution DSM is required by organizations operating across state borders, such as the Federal Agency for Technical Relief (THW), the German Air Traffic Control, the German Armed Forces Geoinformation Centre and the Federal Office of Civil Protection and Disaster Assistance. The data must meet high quality requirements for positional and vertical accuracy, resolution, currency and flexible licensing options for the federal government, the states, European and international organizations. In addition, the HxGN Content Program offers powerful streaming services. *hexagon.com*

Septentrio unveilsAsteRx-m3

Septentrio has announced an expansion of itsGPS/GNSS*OEM portfoliowithAsteRx-m3 productfamily. Theyfeaturethelowest power consumption on the market, allowinglonger operation times.Their new easy-to-integrate design ensuresshortset-up timesand faster time-to-market.The new product familyincludes 3 types of GNSSOEM boards. *www.septentrio.com*

Trimble and Boston Dynamics announce strategic alliance

Trimble and Boston Dynamics have announced a strategic alliance to integrate a variety of construction data collection technologies with Boston Dynamics' Spot®robot platform. The jointly-developed solution will combine the Spot robot's autonomous mobility with Trimble's data collection sensors and field control software to enable automation of repetitive tasks such as site scans, surveying and progress monitoring, while taking advantage of the robot's unique capabilities to navigate dynamic and potentially unsafe environments. The relationship gives Trimble exclusivity to sell and support the Spot robot with integrated scanning, total station and GNSS technologies for the construction market. *www.bostondynamics.com*

SBG Systems to release the virtual base station feature in Qinertia

SBG Systems releases the Virtual Base Station feature in its in-house post-processing software called Qinertia. Geospatial professionals benefit from an optimal centimetric position accuracy in all their projects, even for corridor mapping and in poorly covered RTK areas.

Maximize corridor Survey Accuracy, without Compromise on Processing Time

Qinertia PPK software now includes a brand new Virtual Base Stations (VBS) functionality. The VBS consists in computing a virtual network around your project in which position accuracy is maximized, homogeneous, and robust like a PPK short baseline is. Surveyors can collect data far from base stations or over large areas, making it ideal for corridor mapping.

Qinertia is the Ideal PPK Software for All your Projects

Qinertia has been designed to support all GNSS receivers and third-party IMUs. SBG Systems has worked very hard to offer a VBS, which takes the most out of any GNSS receivers from different brands, models, with different configurations or constellations, and even with different coordinate systems. It automatically adjusts the VBS network to compensate for any base station position inaccuracy and provides full quality control indicators to assess the expected accuracy and reliability.

User Keeps the Control

Qinertia is highly flexible and intelligent. It automatically selects the best positioning technology that applies to your project, whether it is a single base station mode, the Virtual Base Stations mode, or a Precise Point Positioning computation. Control is still in the user's hands: the user can manually choose the mode, take a base station away, add a new one, while Qinertia automatically re-checks and re-computes all parameters simultaneously to validate the accuracy and consistency. *sbg-systems.com*

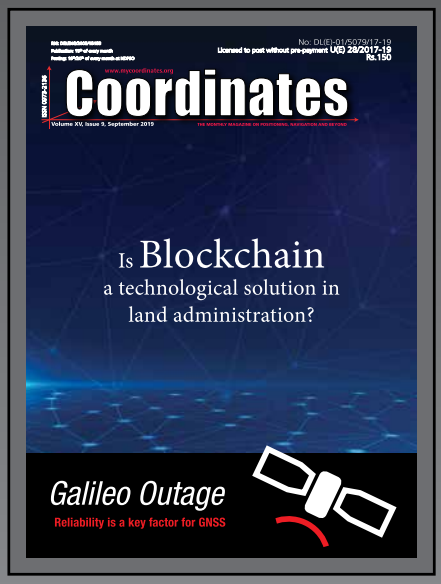
UP42 partnership with Hexagon

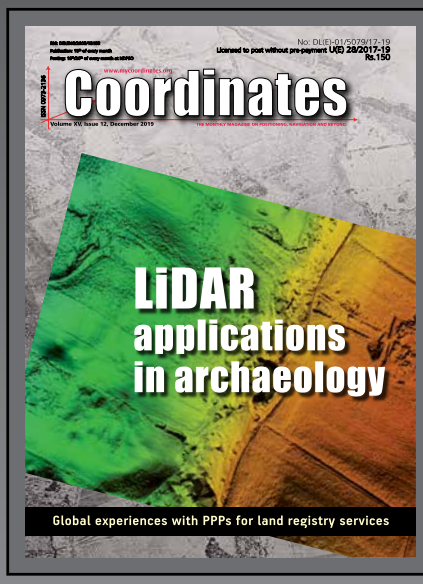
High-resolution aerial imagery from the HxGN Content Program is now available on the UP42 developer platform for Earth observation data and analytics. UP42 customers may now choose from nearly 11 million square kilometers of 30 cm orthorectified imagery for North America and Europe and over 500,000 sq km of 15 cm data for major U.S. cities in the Hexagon aerial image library.

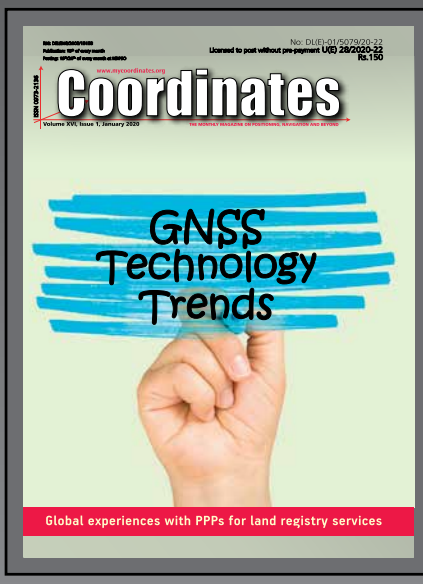
Managed by Hexagon, the HxGN Content Program has created an archive of cloud-free, four-band (Red, Green, Blue, Near IR) multispectral data acquired in the past two years with Leica ADS100 and DMC III airborne sensors. The data sets have been orthorectified to deliver the highest level of positional accuracy and consistency – regardless of geographic area. The library is updated every two to three years. *www.up42.com*

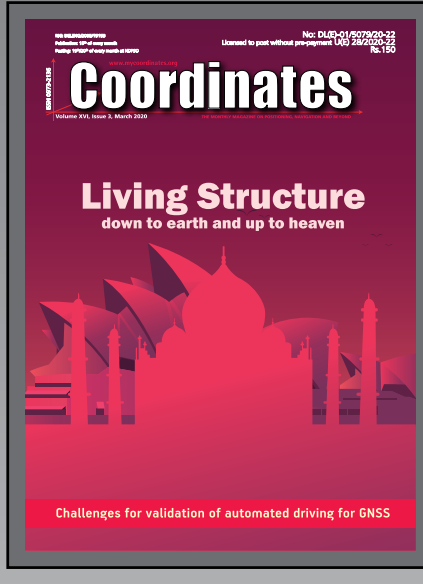
Carlson Software releases Carlson Layout

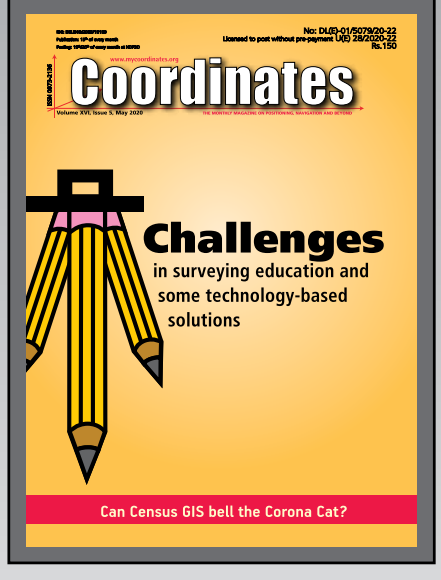
SurvPC, Carlson Software has introduced their Android-based field solution for construction layout. Carlson Layout, a completely new program, represents a streamlined solution that allows fast, efficient layout capabilities for construction professionals using total stations or GPS receivers such as theCarlson CR+series of robotic total stations and theCarlson BRx7 GNSS receiver.It brings the advantage of the full Carlson driver library. *www.carlsonsw.com*

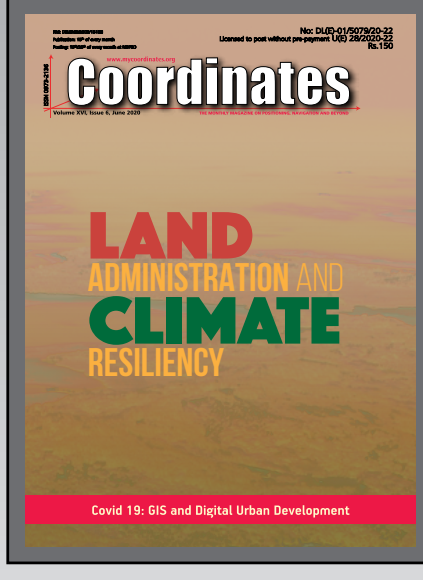


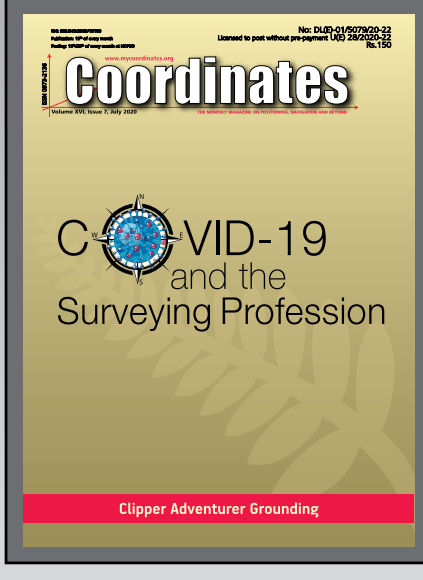












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