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'SMART-COP'-Mobile Governance Framework for Policing

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Abstract: The growth of mobile and cloud computing technologies have impacted every facet of human activity and the powerful duo has revolutionised the way governments across the globe interacts with its citizens. Many governments across the globe have started harnessing the potential of Mobile Technologies (MT) to provide a bouquet of advanced mobile services to its customers viz., citizens, inter-government departments, employees, businesses and tourists. The adoption of MT's have not only benefited the citizens but also has enabled governments to reinvent themselves by replacing obsolete and less efficient processes with improved efficient systems and practices. Improved mobility and internet access on the move provided by devices like smartphones and tablets coupled with unlimited compute power and storage offered by cloud computing has given rise to a new generation mobile work force. In this study, the authors highlight how a cloud based interoperable framework based on web serviceswas developed using web services and how the same was leveraged to deploy a multifaceted mobile application "SmartCop" for empowering the mobile enforcement squads of law enforcement agencies like police, excise, customs and motor vehicle departments.

Key words: Mobile governance, mobile applications, law enforcement, web services, API, cloud computing, service delivery platform

INTRODUCTION

Crime prevention and policing have been a fundamental and integral part of society right since the advent of Human civilization. With crime and criminal activities being capricious and largely unforeseeable, an excellent Policing mechanism is the only solution to maintain a just social order. In this context it has become imperative for enforcement agencies across the globe to upgrade their levels of functionality, leveraging all resources available because criminals evolve on an hour to hour basis and will exploit any weakness found ruthlessly and without remorse. Policing has come a long way since the days of the beat constable armed with a cane and whistle. The Policing has evolved to the current stage by adoption of newer technologies in a phased manner. Efficiency improvement in the first phase has been fuelled by the adoption of telephony, two-way radio (wireless sets) and patrol vehicles (Manning, 1989, 1992). The adoption of Information and Communication Technologies (ICT) marked by development of data centre for housing web based Information systems on databases relating to crime and criminals like finger print, convicts, habitual criminals and their modus operandi, etc. with improved ability to store and process large volumes of data, investigate and gather intelligence coupled with the establishment of network connectivity between police stations and police headquarters could not only make radical efficiency improvement in the internal efficiency but also resulted in enhanced citizen-police interactions (Ashby and Longley, 2005; Manning, 1989, 1992). These efficiency improvements could be reaped only by sedentary cadres of the police but it failed to equally enthral the patrol officers due to lack of internet availability in the field as a result forcing them to do study research after patrolling resulting in loss of considerable time devoted for patrolling for field force wireless sets and officers in the control room were the weak link which connected them to the information systems. With ever-increasing adoption of mobile phones and rapid advancement in the field of Mobile Technologies (MT) and the ability to enhance productivity and security (Ehrlich, 1981) has prompted the governments to ride the mobile technological wave and MT was harnessed to bridge the gap between the sedentary and patrol enforcement officials-bridging the wired and wireless worlds (Gordon, 1996; Landy, 1989). As part of the mobile-governance strategy government has developed a Mobile Service Delivery Cloud (MSDC), a shared ICT infrastructure which can be leveraged by respective departments to deploy and run ICT solutions. The unified mobile solution "Smart Cop" developed for police in particular and other enforcement agencies like excise, motor vehicle department etc., was deployed in MSDC.

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The enforcement officials armed with mobile devices loaded with "Smart Cop" having versatile functionalities and enhanced information availability in multiple formats (photo, biometric, voice, text and video) from multiple departments has resulted enhanced the security savings and better law and order situation (Colvin and Goh, 2005). This is due to the fact that Smart Cop enabled the officers in the field to remain connected with their counterparts 'on-the-go' and could facilitate seamless exchange of real-time intelligence, gain secure access to databases, to receive analytical outputs and any other required information in anywhere anytime manner.

MATERIALS AND METHODS

Implementation of the system

Cloud computing: Cloud Computing (CC) is the delivery of computing services over the Internet using software and hardware provisioned by third parties. CC is very economical as it provides a responsive and scalable shared pool of resourcescompute power, networksand data storage which can be self-serviced on-demand. It is engrained on the principles of SOA and web services. Various service models offered by CC are Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). In SaaS, an application, along with any required software, operating system, hardware and network are provided. In PaaS, an operating system hardware and network are provided and the customer installs or develops its own software and applications. The IaaS model provides just the hardware and network one can install or developone'sown operating systems, software and applications. This makes CC ideal for deploying mobile applications (APPS) which helps in rapid provisioning and releasing APPS with minimal intervention of service providers or management effort.

Mobile service delivery cloud: The Mobile Service Delivery Platform (MSDP) is a convergence of three channels of mobile communication viz., voice, signalling and data and a wide range of applications (APPS). The voice channel provides Interactive Voice Response (IVR) and Out Bound Dialler (OBD), signalling channel provides Short Messaging Service (SMS), Multimedia Messaging Service (MMS) and Unstructured Supplementary Service Data (USSD) and Cell Broadcast (CB) capabilities and data channel provides WAP/GPRS, 3G and 4G services supporting the government app Store to download validated mobile applications developed for specific purposes from government app store. In order to be elastically scalable the MSDP is implemented in a cloud system-Mobile Service Delivery Cloud (MSDC) the architecture is depicted in Fig. 1. It provides a unified view of the platform to the citizens and the government departments. In short MSDC serves as an Infrastructure as a Service (IaaS) platform for the departments and citizens to consume. Open Application Programming Interfaces (API)-a set of standardized services based on a common protocol (rules for how the service works) and formats (schema for using the service) developed as part of the current initiative is made available to the departments for consuming the same from within the applications that are already deployed.

Voice channel: The voice remains an important function for telecommunications be it mobile or land lines and has the unique distinction that it works on all telephony networks and all phones and can be consumed by people with lower literacy voice is a familiar and trusted communication channel Out Bound Diallers (OBD) helps in initiating simultaneous calls and can be scaled and Interactive Voice Response (IVR) systems allows a computer to interact with humans through the use of voice and dual tone multi frequency tones input via keypad after which they can service their own inquiries by following the voice XML (VXML) based applications can process millions of telephone calls daily to provide audio-guides, driving directions, information about artefacts in a museum, etc.

Signalling channel: The service offerings in this segment include the most popular mobile application viz., short messaging service, Multimedia Messaging Service (MMS) and Unstructured Supplementary Service Data (USSD) and cell broadcast. Short Message Service (SMS) represents a communication protocol which permits the exchange of short text messages up to 160 characters between mobile devices. SMS is a globally accepted service and can be categorized into following types Push SMS (Mobile Terminated) and Pull SMS (Mobile Originated).

Multimedia Message Service (MMS) is an extension of messaging services similar to SMS for data transfer which enables sending rich content such as images, video or audio files back and forth between Governments and citizens. Unstructured Supplementary Service Data (USSD) services are more interactive as compared to SMS but nothing is stored on the phone. This can be very useful for submitting requests for a service through an interactive menu and for tracking their status and also has great potential for mobile banking, accessing news services, submission services, feedback, voting and

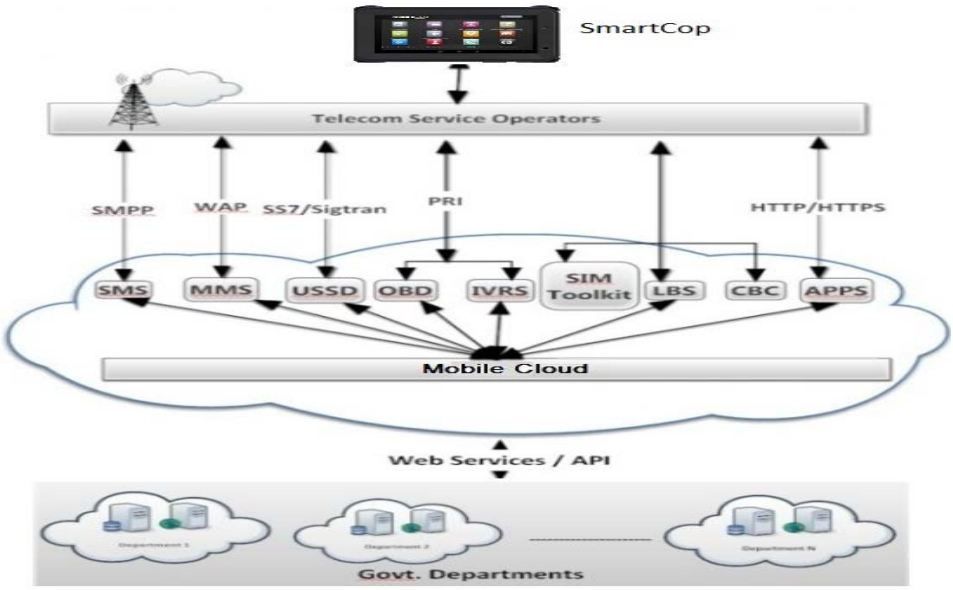

Fig. 1: Architecture of mobile service delivery cloud

directories. With interactive navigation, USSD is fast and allows for mass usage. However, messages cannot be saved or forwarded, the codes may be difficult to remember and usage is not always reliable due to session-based timeouts. Cell Broadcast (CB) is the functionality of mobile networks to "push" text or binary message to multiple mobile phones without the lag times associated with sending messages via SMS which are queued and one to one unlike from one to many in CB.

Data channel: Technologies including WAP, GPRS, APPS etc., enable data transmission using mobile networks. With the smart phone shipment overtaking ordinary handsets, a large number of applications designed for smart phone platforms (Android, Blackberry-OS, iOS, Windows Phone etc.,) utilises data services to transact. In addition to the above mobile technologies, open application programming interface based functionality improvements like mapping, location based services, payment gateway integration and other such open standards based technologies can be plugged into the MSDC.

Application Programming Interfaces (API): Application Programming Interfaces (API) are a set of standardized services based on a common protocol (rules for how the service works) and formats (schema for using the service) that are familiar to developers. APIs are at their most basic, a combination of protocol (the means of interacting with data and services) and format (the model by which the data and services are arranged in order to allow such interaction). API protocols are typically either SOAP (Simple Object Access Protocol) or REST (Representational State Transfer). REST is preferred by many because it's based on the familiar http Web protocol. API formats are usually either XML (Extensible Markup Language) or JSON (JavaScript Object Notation). New APIs are routinely described as RESTful JSON because they follow the REST architectural style and use JSON as its data representation format.API is emerging as a standard for externalizing applications and services for easy consumption through mobile devices. APIs are both transforming the way we work it helps in adapting new technologies with ease and also helps us in connecting data and functionality from disparate application systems. APIs can take many forms-the most functional enable a third party to query a data set at a granular level. Because of the simplicity and less complicated structure provided by Representational State Transfer (REST), REST-APIs are now being increasingly used by governmentsto make data and information available to mobile and web applications and to ensure interoperability amongst disparate legacy systems. Governments by publishing the APIs which allows developers within and from outside government to build apps widgets, websites and other value added services based on government information and services allowing the citizens to get what they need from many places, rather than from a single website. The increased use of API for various functions stems from the simplicity of using it and great flexibility in

using it for almost any transactional use and can be consumed easily by mobile apps as well as mobile interfaces. API has made a great impact on the web services arena and has revolutionized the mobile application space, by simplifying the app development processso the researchers used APIs to develop Smart Cop.

Architecture of MSDC: A layered approach has been followed in developing MSDC. It has been developed with the goal of providing inclusive access, keeping in mind the diversity of access devices used by citizens ranging from basic phones, feature phones and Smart phones. MSDC provides the departments with an easy to use interface that requires less technological skills for integration and ensure interoperability and data sharing capabilities between technologies. Free and open source software have been leveraged to the maximum extent possible and also open standards. Cloud offers the government department's on-demand ICT Infrastructure provided as a Service (IaaS) to host departmental application with ease and provision user services while for the user it provides virtualized infrastructure and a unified access platform to consume mobile services heterogeneous mobile devices whenever and wherever. MSDP has been designed using open standards to ensure integration capabilities are compatible and seamlessly integrated with any existing legacy or third party system when on demand scaling up is initiated without disturbing the existing services and thus capable of accommodating future expansions with ease, enabling to derive optimal output from the infrastructure investment.

The uppermost layer is the interface engine which utilizes XML based device and content profiles to render the contents, either in (HTML, WML, HDML etc.,) formats, properly in consonance with the access device capabilities. The Second layer acts like a proxy which is basically a short-code or long code number where all the signalling channel services converge e.g., the short code 537252- (corresponds to spelling of Kerala in non-qwerty mobile keypad) for Kerala specific m-services, 166-for national m-gov services (World Bank in 2012). This layer intercepts the requests from various wireless devices subscribed to services from different MNOs. A WS will then push the data received in different formats at the short-code number of a particular MNO to this layer the intelligent application middleware parses the forwarded data and extracts the metadata keywords and routes the requests received in different formats specific to the channel (SMS/USSD/IVRS) used to specific gateway (SMS Gateway/USSD Gateway/Voice Gateway). These gateways, after processing the data, forwards the same to the MSDC which applies the various routing logic and routes the data to the appropriate government department directly or through standards based messaging middleware. The reply from the department is sent back to the citizen through the same path and the pull request from the citizen is fulfilled by way of receiving information in appropriate formats. This layer also accommodates the caching module which acts as a repository for temporarily storing the contents optimized for a particular device, based on the XML profile. This helps in dynamically serving the contents as and when the same contents are sought later.

The metadata storage facility, in the previous layer where in the XML based device profiles and content profiles are stored is consulted before rendering the content in a proper format in accordance with the device capabilities. This layer is responsible for rendering the contents derived by invoking a single WS or through service orchestration-combining two or more WS from the next layer-the Messaging middle ware. The MSDC developed which is embodied on the principles of service oriented architecture will make the heterogeneous ICT infrastructure already deployed as part of independent departmental information systems interoperable and thus allowing seamless intra-departmental flow of information possible and aids in presenting the user with contents rendered based on single (WS) or through service orchestration-combining two or more WS.

Algorithm: The application flow is as follows and the algorithm is depicted below since the device and application combined is being used by the enforcement agencies, many sensitive information and databases can be accessed using Smart Cop, so whitelisting of devices is of paramount importance. For authentication the first level is the device security PIN or pattern, the application level security is implemented using username, password and IMEI number by consuming the Oauth2 API. Once authenticated, the presence manager module and associated service is activated which announces the location of the device by asynchronously pushing the latitude and longitude values (geo-tags) as an HTTP request to the web server at pre-determined intervals (30seconds) for plotting the position in a map using Google Maps and based on the role privileges, appropriate menus/applications are enabled, for field officials modules for field level registration, navigation, messaging and push to talk, etc. will be visible while for higher officials in addition to the above MIS and Analytics will be displayed. If the authentication fails the initial splash screen will be displayed and the officer will be asked to resubmit the credentials (Algorithm 1).

Algorithm 1:

S0. Start
S1. Authorized request Generation
S2. User credential Checking
{ Receiving user name and password from client
If authorization is true
User _ credential = 1
Token generation
Storing Token to client and server
Else
User _ credential = 0
}
S3. If User _ credential = 1
user privilege provisioning
Location identification (Presence Manager)
Enabling User Interface (role privileges)
(Incident-Reporting , E-challaning process, Live-Streaming, E-beat, Rapid Response, Push to talk , Notification, Navigation

Else
Go to S2
S4. Stop

RESULTS AND DISCUSSION

"Smart Cop" solution: 'Smart Cop' is a handheld-device running android operating systemloaded with a unified mobile app deployed at the MSDCwhich has the power to perform multiple functionalities that a policeman on the field is expected to carry out on daily basis without the limitations pointed out by Ajibulu. The screen shots of the application are depicted in Fig. 2. The Smart Cop device would help the policeman issue traffic-challans quickly and efficiently. The device would have real-time high-speed connectivity to the databases of the police department and the motor vehicles department. The added advantage is the feature that allows credit/debit card swipes to collect the fines in the field. The Smart Cop device will provide the force with much needed 'eyes on the ground', giving the control-room personnel real time knowledge of field activity. This is made possible by the live-streaming facility provided by the device. Mobile enforcement squadswill now be able to report incidents, file FIRs and capture images and audio-clips from the field with the help of the 'Incident-reporting' facility of the device. The device will function as the perfect beat-patrol/task assistant when special beat/tasks are assigned to the policeman. A policeman on the field can view the beat-route assigned to him on a map with the geo-fenced beat check-points clearly marked out. With the help of Global-Positioning-System, one can watch his motion on the road in real-time. Also he would be able to 'check-in' at a beat check-point only after reaching the proximity of the check-point. The device will support portable, plug-in modules for Alco-meters and finger-print scanners eliminating the need to carry separate devices. This device can even be mounted in vehicles to serve as a GPS module providing a view of the entire geographic area. By doing so, the system effectively rids the use of separate GPS units. Also, it is proposed to integrate push to talk and assistance request functionalities in the future effectively to eliminate wireless sets. The control-room will have greater ability to evaluate what's happening on the field with the help of all the Smart Cop devices out there. On the real-time internet-based map the control-room will be able to see all the devices on the field and therefore can initiate coordinated action. The control-room will have access to a wealth of data generated from the field, like videos, images, incident-reports, challans, special task/beat history etc., A detailed analytics of the data thus captured will generate intelligence like crime and accident hotspots like never before. Such insight will be helpful in optimizing the forces to carry out enforcement more effectively.The versatile functionalities offered include incident reporting, e-challan, live streaming, beat patrol assistance, rapid response, push-to-talk, messages, navigation, Evidence recorder and contacts.

This incident-reporting functionality will revolutionize the way incidents are reported the collected evidence is maintained, shared and acted upon. This application allows officers on the field to record images, videos and sound evidence/clippings on the field and add relevant description and geo-tagging of the media recorded. The data gathered from the field can then be shared via wireless data to a central information repository. This information can then be accessed via the web application, by the control-room and senior cadre of the force for further analysis. The data captured by one officer can be shared to other personnel enabling collaborative working and better networked sharing of information

The challaning (fine collected for violations in the field) process used by the officials relies on a traditional approach wherein an overwhelming portion of the process involves cumbersome manual effort. Currently personnel need to collect fines, reconcile fines collected with the challans issued and then ultimately transfer collections to the bank. The process is prone to inefficiencies, human error corruption and procedural delays. Moreover the department incurs Manpower costs, wherever effort is involved. The e-challan application integrates the challan system onto the Smart Cop system. This eliminates the need for an officer to carry the challan booklets moreover, with on screen keyboards, high display resolution and enhanced processing speed this application is far superior

Fig. 2: Screen shots of the app, incident reporting and analytics and beat

in comparison to other e-challan systems. It allows for the retrieval of the images and videos capture by surveillance cameras with automatic offence detection, driving licence details, selection of multiple offenses, options to settle dues for previous offenses and also provides daily reports on the amounts and cases collected by the respective device. Most importantly it collates data onto a single database allowing for easy reconciliation and analytics derivation. The procedural inertias associated with the traditional challaning systems are dispensed with while at the same time reducing corruption and improved collection of fines and even e-payment by way of an add-on magnetic strip reader.

The beat functionality will change the paradigm of how patrolling is currently being done by the force. In the current scenario, officers under a particular station patrol is assigned a set of pre-defined routes under its jurisdiction the officer in charge signs a 'patta book' kept at points along the route to verify his presence for duty. With Smart Cop, each of the pre-defined routes would be uploaded on to the device. Once a route is selected, the monitoring room officials would receive a real time update indicating the route selected and the officer responsible. Officers en route are notified on arrival at check-points all along the patrol. As he checks in at the specific location (geo-fenced) an immediate update is triggered and the presence of the officer at the checkpoint would be registered on the central server. Simultaneously the patrolling activity can be monitored via the back end web interface on a real time basis via GPS tracking or through locating the phones in google maps using SMS technology. Hence, an efficient system for management of patrolling can be implemented by the force. In cases of emergency, monitoring officials can identify officers closest to scenes of disturbances and assign emergency patrol routes or custom patrol routes. Such updates would be received on the device with the map indicating the entire route to be taken and the checkpoints along the new route. This would further aid the force in optimum resource management.

The rapid response functionality helps in improving the way force responds to emergency situations. For example IBM has developed a system which gathers data from accelerometers or vibration sensors and analyses the information generated by seismic events. Information is then delivered to decision makers for action including the emergency response representatives such as police, fire fighters, etc. Depending on situations developing on the ground, officials can mark locations where personnel are needed, select the personnel to respond and add description of the duties prescribed to them from the web application. Once all these are done and updated all selected officials would receive updates on their devices detailing the location to head to along with description of tasks expected of them. Moreover once at the location, officers will have to check in to signal their arrival at the location.

Live-streaming allows officers on the field to capture incidents on the field as they happen and stream it live for officials to view over the web application. Currently in situations of violent strikes, riots or other similar incidents the force depends on visual media or field visits to assess the situation accurately. But, the fact remains that media

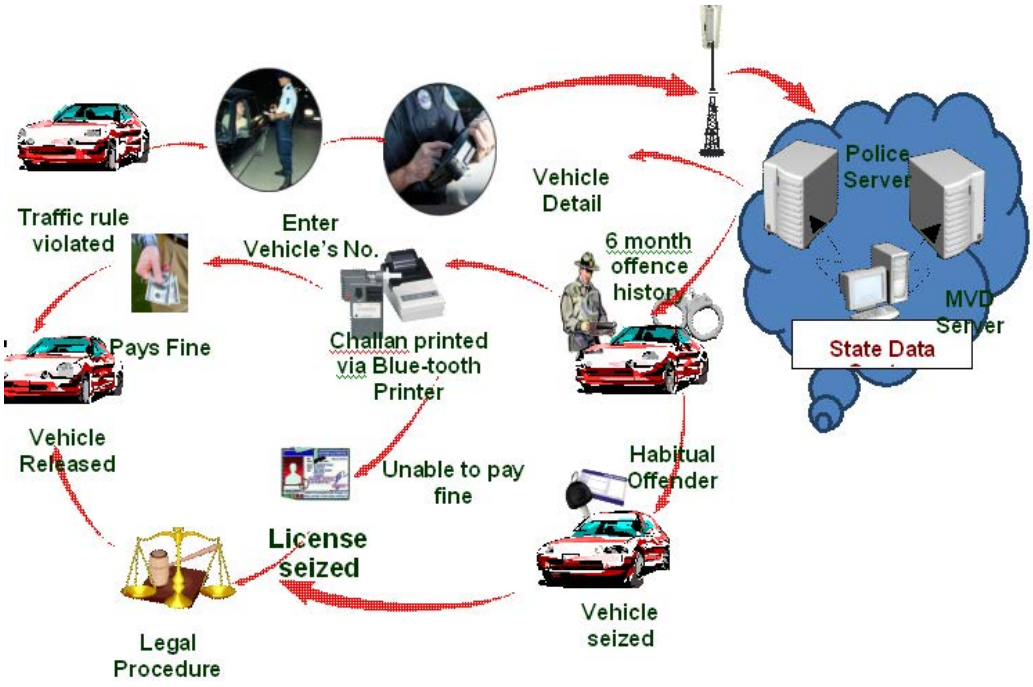

Fig. 3: Process flow associated with E-challaning

access to sensitive or remote areas would be limited and visiting such areas on an immediate or regular rate would be infeasible. To a lesser degree communication via radio devices are also done but a major drawback here is that such communications can at time fail to convey the gravity of the situation to superior cadre. This might result in issuance of less effective orders. With live streaming officials can monitor developing situations live assess the law and order risk they pose and take effective redressal measures to nip such incidents in the bud. Therefore Live Streaming would empower officials to take appropriate action while at the same time saving time and travel costs traditionally associated with situation monitoring and also eliminate media dependency for visual images.

Push to talk functionality replaces the walkie-talkies used by the field officials today. Functionality remains the same as the walkie-talkie but employing this system will allow the department to create closed groups within the app which can replace the current wireless devices used by the force. Like the conventional hand held devices, officers can manually select the bands through which communication are to be sent out as well.

The notification feature facilitates multimedia communication between officers on the field and monitoring officials in the control room. Text messages, voice clips, pictures and video clips, lookout notices etc. can be aired to multiple officials in tandem. In comparison to the voice communication in use today this would add multiple dimensions to the communications capability and enables control room officials manage the personnel and situations effectively. The navigation functionality provides map based routes and easy navigation and to find the shortest path for the benefit of field officers by leveraging superior GPS and location mapping technologies.

Workflow-interaction: The application "Smart Cop" installed in the mobile devices of police patrol officers enables to verify the authenticity of the vehicle's identity, tax paid, validity of driver license, historical offences/ traffic rule violation committed by the driver etc. The workflow is depicted in Fig. 3. The police officer in charge of the patrol vehicle can fine the driver on the field and show evidence of his violation (videos and pictures). The application combines WS offered by the Motor Vehicle Department (MVD) who are the custodians of vehicle and licence data and combining with WS from police CCTV based violations database of the police department, before the fine is collected another WS will check the MVD as well as Police databases as to there is any un-paid offences and the pending fines will also be added to the current fine which is presented to the patrol officer's device. Once the fine is paid another WS will update the offence database in both police as well as MVD databases. As you can see from the example the

same infrastructure is being leveraged for pushing and pulling information using API calls. Ina similar fashion Weather alerts, natural disaster alerts, Traffic disruptions, etc. can be aired.

API based XML interactions: The author traces the interactions associated with the E-Challan application. The field officer armed with the Smart Cop stops an offending vehicle, chooses the E-Challan item it waits for officer to enter the vehicle number. Once the registration number is entered, the number is used as a parameter and the API is called (Algortihm 2and 3) the request message posted is as follows

Algortihm 2:

```
<?xml version = ”1.0” encoding = ”utf-8”?>
<soap:Envelopexmlns:soap=”http://www.w3.org/2003/05/soap-envelope”>
<soap:Body>
<RegQry>
<registration>REGNO</registration>
<servicename>RegQry</servicename>
</RegQry>
</soap:Body>
</soap:Envelope>
```

The response message received as part of API invocation would be

Algortihm: 3

```
<soap:Envelope xmlns:soap=
“http://www.w3.org/2003/05/soapenvelope”><soap:Body><RegQry>
<Vehicle>
<Registration>REGNO</Registration>
<Make>MAKE</Make>
<Model>MODEL</Model>
<Description>CD 2.0</Description>
<BodyType>SEDAN</BodyType>
<FirstRegistrationDate>20-012012</FirstRegistrationDate>
<FuelType>PETROL</FuelType>
<EngineCapacity>1998</EngineCapacity>
<Transmission>Manual</Transmission>
<Power>136BHP</Power>
</Vehicle>
<Owner>
<OwnerName>OWNERNAME</OwnerName>
<OwnerAdd1>ADDRESS1</OwnerAdd1>
<OwnerAdd2>ADDRESS2</OwnerAdd2>
<OwnerAdd3>ADDRESS3</OwnerAdd3>
<OwnerDist>DISTRICT</OwnerDist>
<OwnerPin>PIN</OwnerPin>
<OwnerFrom>20-01-2015</OwnerFrom>
<PrevOwnerRecordNo>1250, 2956</PrevOwnerRecordNo>
</Owner>
<PrevFine>
<FineDate>25-05-2015</FineDate>
<FineSpot>TOLL JUNCTION</FineSpot>
<FineAmt>200.00</FineAmt>
<FinePaid>YES</FinePaid>
<FinePaidDate>25-05-2015</FinePaidDate>
</PrevFine>
</RegQry>
</soap:Body></soap:Envelope>
```

Table 1: Cost Savings due to man-hour saved

Man hour cost	Hours saved	No of smartcop devices	Savings in INR/Day
100	3	1.00	300
100	3	1000	3,00,000

Man hours saved/year = 3×365×1000, 10,95,000; savings in INR per year = 100×3×365×100010,95,00,000/-

Cost-benefit analysis: The introduction of Smart Cop will result in direct revenue benefits for the exchequer as well as indirect gains to the police-force. The details have been elucidated below:

Savings in cost of acquisition of multiple devices: The force currently employs numerous devices such as alco meters, E-challan devices, radio sets, GPS trackers etc,. Smart Cop would bundle all these devices into a single device. This would eliminate the need for the force to procure multiple devices at high costs and also the time consuming and arduous procurement process to acquire these devices. In addition to cost of acquisition, costs incurred in AMC, training servicing and up gradation of multiple devices which would amount to significant recurring charges and the same can be eliminated. The potential is immense and a conservative projection of the savings that can be made over a period of 5 year by not having to procure multiple devices is around Rs. 60-70 crores. This would result in a yearly fiscal saving of Rs.12-15 crores.

Savings in man-hour costs: Officers today need to travel from the field to the station to receive, handle and process critical information such as incident appraisals, reconciliation of fines collected via challans, complaint registration and other miscellaneous activities. These activities necessitate the need for officers to commute to stations/offices and often for redundant purposes. This contributes to unproductive man-hour costs and also leads to officers forced to spend less time on the field. Smart Cop would help save about three man hours per device per day of the police force.

So, as suming, a minimum man hour cost of Rs. 100 and number of SmartCop devices deployed are 1000. The savings details are tabulated as follows (Table 1). The total man hours saved would be 3×365×1000, i.e., 10,95,000 h. In terms of cost saved, this would amount to 100×3×365×1000 i.e., Rs. 10,95,00,000/-a modest savings of three man hours conservatively pegged at Rs. 100 per h for 1000 devices directly translates into savings of <10 crore rupees annually to the state exchequer.

Savings in vehicle running costs and maintenance: These activities discussed in the above section necessitate the need for personnel to commute in police

vehicles regularly and often for redundant purposes. These build up significant and recurring fuel and vehicle maintenance costs which are quite a heavy burden on the exchequer currently. Assuming, Rs. 100 worth of fuel is saved daily per SmartCop device. Number of vehicles equipped with SmartCop is 1000 savings in fuel expenditure would amount to 100×365×1000, i.e., Rs. 3,65,00,000 furthermore, extrapolating these figures on the assumption that the force deploys this technology in 5000 vehicles it would amount to 100×365×5000, i.e., Rs, 18,25,00,000. It must be remembered that savings of >Rs. 100 a day is a given, when post adoption multiple trips can be avoided. This coupled with the fact that fuel is getting dearer by the day with no depreciatory trend expected; the savings per day would definitely exceed Rs. 100 per device. Additionally running charges maintenance costs too would be added on to fuel savings made. Also by reducing the frequency of use of vehicles the department would also be able to keep a check on its carbon footprint in the environment.

CONCLUSION

To summarize in the police context, this includes the availability of real-time information on licenses and registrations, summons and warrants of arrest in contrast to the earlier system when information had to be obtained using a cumbersome procedure based on radio dispatch, resulting in unacceptably high latency in decision making. As a result, patrol officers are now able to perform many of the tasks for which they were once dependent upon wireless operators and desk clerks. Dependence on a major communication medium that is wireless operators, has also been virtually eliminated for communication among officers. The logical extension of these advantages is the financial gain accrued to the exchequer due to removal of redundancies increased efficiency and higher productivity per man hourby just taking into consideration the overheads mentioned above and the extremely conservative savings Figures the force stands to save almost Rs. 30 crores year on year basis when 1000 devices are pressed into service. It can be stated with a definite degree of confidence that the force can in terms of actuals make a savings in the range of Rs. 50-100 cores yearly. This is quite a significant amount and would provide the state exchequer with some much needed breathing space.

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