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Brief History

Drakewell Computers was established in 1982, specializing in software development for the road traffic monitoring profession. Drakewell Limited was founded in 2011 as a private limited company, existing alongside Drakewell Computers (sole trader). The company is independent of any equipment manufacturer and the software products will work with all major equipment suppliers, reading raw data files or communicating with remote equipment using manufacturer's specific communications protocols. Drakewell works closely with all major equipment manufacturers to ensure that all data recorder facilities are fully integrated into Drakewell software.

Software

Drakewell software is designed to be *device neutral* meaning that it is possible for one manufacturer's device to be replaced at an outstation with another manufacturer's device without any configuration changes being made to the overall network and for the data capture to continue without interruption.

C2-Cloud

Drakewell's flagship C2-Cloud product is used by a majority of local government authorities in the UK and in a significant number of overseas territories. C2-Cloud is a scalable database designed to capture, validate, store, analyse and disseminate road traffic data via any web-enabled computer. Data types handled include binned and per vehicle record traffic data covering vehicle class, axle, speed, time, direction, weight, gap and headway. Other data types handled include environmental, ALPR and Bluetooth all captured using raw file import or GPRS and IP communications protocols.

The C2-Cloud program suite is fully web-based, accessed via any modern browser. There are desktop programs in the Drakewell suite for POTS and field-based installation/maintenance with laptops/notebooks rather than tablet/smartphone use (supported by Apps).

C2-Cloud is a hosted SQL database solution developed over the past 20 years by Drakewell specifically for the traffic monitoring sector. C2-Cloud is a fully integrated database which can import, analyse, verify and store all types of traffic data including binned data, per-vehicle record data, weigh-in-motion data, turning movement data and journey time data. As well as being able

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to verify and store traffic data, C2 will store supporting documentation such as site photographs, design diagrams, site layouts, associated Word and Excel documents all on a per site or per site group basis.

The C2-Cloud suite is fully web compatible. If sites are not 'live', retrieved data is uploaded via FTP from a web page and verified automatically using well developed and proven checking algorithms. There are over 115 different web reports to support all types of analysis. Reports cover volume, axle, speed, class, headway, gap, weight, journey time and emissions. All web reports can be downloaded as Excel spreadsheets (or CSV files) for further analysis as required. C2-Cloud supports a map front end using Google maps but other map systems can be accommodated such as Open Streetmap or web-mapping tile services.

C2-Cloud also includes a GPRS Instation for receiving data via GPRS from most popular GPRS enabled data recorders. Data is passed directly (if counters 'push data', or alternatively pulled in via polling) to the C2 database where it is checked and processed. The GPRS Instation supports diagnostic facilities and displays them on the map-based user interface such as loop status, battery voltage, alerts and configuration updating. C2-Cloud is very scalable; some customers have up to 1000 live counters, and many have thousands of temporary surveys in our database.

Drakewell works closely with hardware vendors on joint projects from conception through to completion. Sites will be created in the C2-Cloud database in advance and communications credentials supplied to the engineers. An engineer is able to view live data streaming successfully into the C2-Cloud database before moving to the next site. This can be on a smartphone/tablet/laptop at the roadside, or by making a call to the Drakewell Helpdesk. Hardware vendors can also have a C2-Cloud login on some contracts, enabling them to view and check if all equipment is functioning.

C2-Cloud is accessed via a secure web login. Password complexity and frequency of password change can be set to meet customer requirement.

Drakewell unlimited remote maintenance and support with their products, running a Helpdesk and having named Project Managers as customer contact points. Drakewell provides full customer training at the start of a license period and further training as additional project phases are completed and software updates/releases made available. Software upgrades would be applied with customer consent. Drakewell has long-term relationships with many customers and prides itself on excellent customer support and account management.

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Drakewell hosts customer data in a state of the art data centres. Customer data would never be lost and large queries can be run quickly due to very high specification servers. Data ownership remains with the customer at all times.

Drakewell's software and Instation is manufacturer independent. Data from different manufacturers can be brought together, all traffic data types. Drakewell has experts at integrating with new/different equipment, data and communication protocols, giving a future-proof platform.

Drakewell's Instation can generate email and SMS messages in response to a counter not working correctly. A customer can specify how long a device issue is tolerated before email/SMS generation. Site status can also be viewed via Drakewell's Site Status App on Android/Apple smartphones or tablets.

Drakewell has ISO 9001 (FS 591865) and 27001 (IS 605464) certification.

Drakewell is a progressive, innovative company who wish to work with our customers to develop new techniques and procedures to improve the quality of data collection and dissemination. We have a proven track record built up over many years working on innovative projects.

Software Architecture

C2-Cloud is web-based application with the proposed system operating a single server containing the database, data processing elements of the software and the web application itself. Although a single server approach is proposed, the software elements (Database, Data Processing, and Web Application) can be placed on separate servers if required. The C2-Cloud server requires Microsoft Windows Server with IIS services fully installed. Oracle and Microsoft SQL are both supported but the preferred database is Microsoft SQL Server and all of the current hosted and non-hosted installs of C2-Cloud utilize Microsoft SQL. An FTP server is required to be running on the C2-Cloud server to allow for the manual upload of raw files for automatic processing; no other third party software is required.

The programming languages used for development of C2-Cloud are C++, TCL, VBScript, ASP.Net and JavaScript (please note that JavaScript is not Java). No programming languages are necessary for configuration or customization.

The C2-Cloud system is designed with growth in mind and has no limit on sites, users and the amount of data stored. Current installations of C2-Cloud can have databases in excess of 1.5TB without any loss of performance.

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C2-Cloud is constantly being developed and refined along with the regular addition of new features, reports and modules, typically a quarterly update to the latest version would be proposed as part of the overall contract. It is not foreseen that the software will become obsolete during the course of the contract; maintenance will be available for many years.

The client workstation requires just a browser IE8 or higher to access the C2-Cloud system. Google Chrome and Firefox are also fully supported. The only other requirement for the client workstation would be to load an FTP client if the user needs to upload raw files for processing.

Customer staff levels needed to support the software is hard to define precisely because they depend on desired management structure, how data is entered into the system and the desired robustness of data.

Software Releases

C2-Cloud is a hosted, web-based service consisting of hundreds of web pages and a number of background processing components. Web pages are constantly being revised to improve functionality and usability or to fix problems (which can be caused by corrupt data or new configurations of data).

Background processing components are more static and updated less frequently, usually to add functionality requested by users, for example processing a new traffic data file format. These components are mature and rarely require bug fixes.

The content of future releases is determined either by customer request or a perceived general need for improvement of functionality or usability. New content can be requested at User Group meetings, which are held periodically or directly through the Help Desk. New content is presented at User Group meetings; it is also communicated to customers through regular contact with sales staff. Enhancements are usually available to all customers.

Recent enhancements include user interface redesign to fully support mobile devices; database redesign to support even better (and faster) display of data from multiple regions and sources... plus new functionality required on various on-going customer projects.

Because C2-Cloud is a hosted service, there is no client installation involved other than setting up data collection hardware, which we will supervise. Similarly there are no patches to worry about, and there are no old releases to support – the latest release is always on the web site. Configuration settings carry forward and do not need resetting. Client installations may be

required for 'Roadside' software (laptop/notebook based), or for customers using Drakewell software to run their own dialling schedule for POTS sites.

Ad Hoc Reporting

C2-Cloud provides a very large range of online reports most of which perform analytical processing. Reports are highly configurable, from date ranges to traffic direction and lane to vehicle class, speed range etc. to display units to report-specific parameters. If the exact processing and format you want is not available from our hundred or so reports, we are very experienced in quickly implementing a new report for a specific requirement for a specific customer, usually also generalizing it so it can also be used by other customers. Almost all reports can be downloaded into Excel or PDF for further analysis if desired.

Many of our customers have large amounts of historical data (some going back to the 1980s); all reports can display historical data where applicable.

System Security

The C2-Cloud system is a purely web based application delivered to the end user via a browser using either HTTP or HTTPS (preferred). The C2-Cloud server would incorporate standard anti-virus protection and firewall access.

The C2-Cloud web application has been written to include defence against *SQL injection code* and *cross-site scripting (XSS)*. Users are identified via a login and password and authority to the system is granted based on settings within a complex user group security table that includes details of which reports can be accessed along with the type of data (Class, Weight, Speed, Length etc.), and the level of access to data regarding the ability to edit or setup. An audit log is maintained which can be accessed by system administrators that details all access to the system and attempted access along with details of pages viewed and actions carried out, included in the log are user details and IP Address details.

Details of users are stored within the database along with an encrypted password. The complexity of the password and expiry can all be set by system administrators or designated users. A test system can be run alongside the production system so that system updates can be tested by the customer before final release to the production system.

The C2-Cloud server will be positioned behind a firewall within a datacentre; the firewall is configured to provide protection against *denial of service* attacks.

C2-Cloud allows for user accounts and groups to have expiry dates set so that accounts will automatically become disabled after a pre-defined time period. Data integrity is maintained by means of data checking and verification during the loading of data. There is a reliance on the structure of Microsoft SQL and the built in database integrity and maintenance functions to ensure the database structure does not become corrupt. Disk mirroring and database transaction log shipping is recommended to minimize any potential issue caused by hardware faults.

IT Standards

Web pages conform to HTTP/HTTPS standards, and data interchange conforms to XML or JSON standards. Data export is in CSV format for Excel.

Interface Standards

Drakewell C2-Cloud Traffic Data provides an Export Service that writes data to CSV format files. This service is configured through the Windows Control Panel and can be scheduled to run as required. The data written in CSV format (optionally zipped) and is configurable via the control panel applet. CSV files can be read by Microsoft Excel or a text editor. The Export Service exports four types of data: summarized traffic data; per-vehicle data; fault data; and environmental data. The formats and file names are fully configurable and no programming is necessary.

Most of the C2-Cloud reports support an export option for downloading in Excel (CSV) format.

Drakewell C2-Cloud Traffic Data implements many web service interfaces that allow data to be accessed over HTTP/HTTPS. In particular there is an XML web service that is used to support the export of data in various XML formats. Many other services have been implemented, mainly to support web pages, which export data in JSON format. Generally the web services require the user to provide authentication or to have a current logged in session. Nearly all modern programming languages support accessing web services over HTTP/HTTPS.

Traffic Database Management System

The following diagram illustrates a number of the major architectural components of the proposed Drakewell C2-Cloud Traffic Data system.
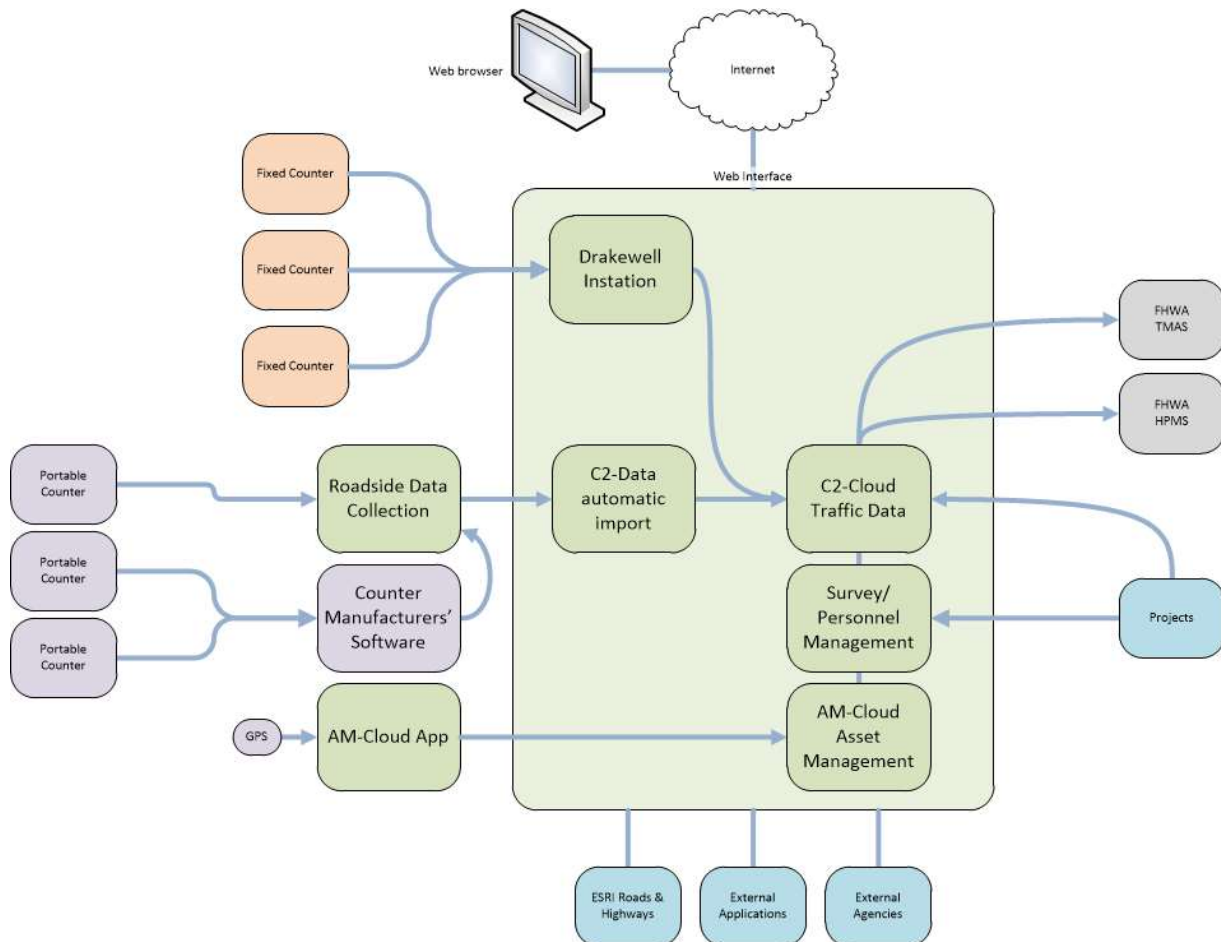
C2-Cloud accepts data in many formats and supports all the leading traffic monitoring equipment manufacturer's formats. Drakewell C2-Cloud prides itself in being an equipment vendor neutral solution.
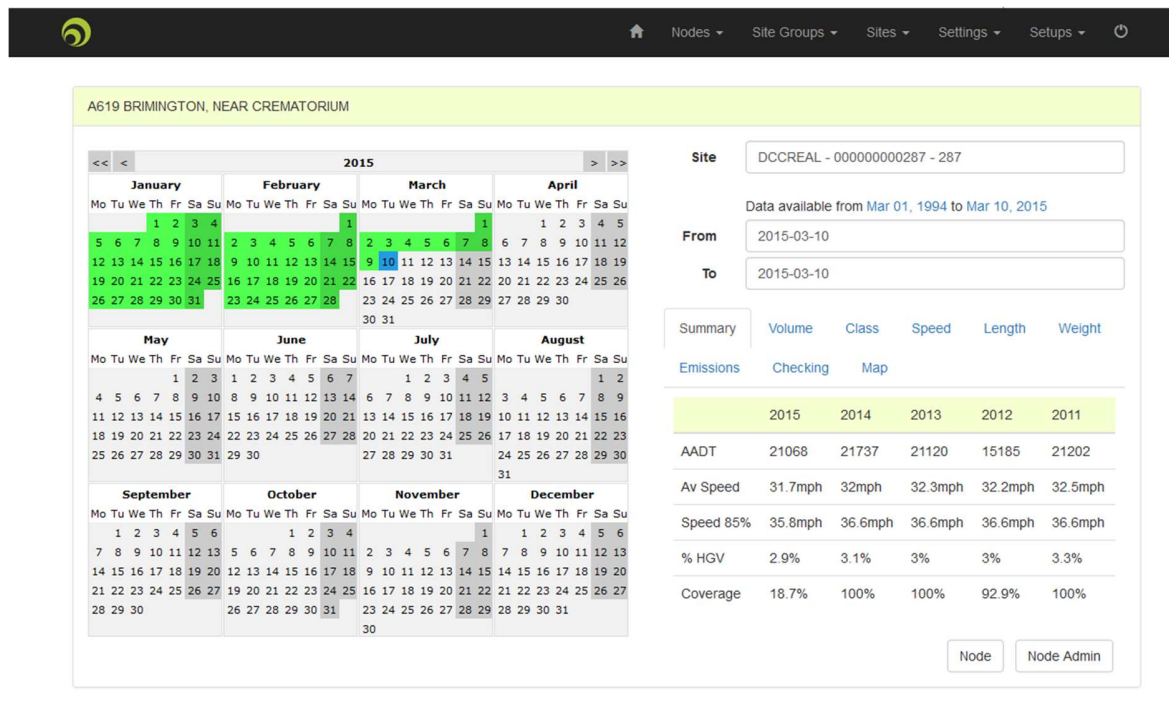
Data is collected automatically from traffic recorders by connection over the internet or over a mobile network, with the schedules being fully configurable. Both dial-in and dial-up are

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supported. Furthermore data files may be uploaded into the system over a secure FTP connection.

Data collected is automatically processed and checked and becomes available for reports or export. All raw data is archived and historic data is kept indefinitely allowing reports to go back to or span many years. The C2-Cloud system is designed with growth in mind and has no limit on sites, users and the amount of data stored. Current installations of C2-Cloud can have databases in excess of 1.5TB without any loss of performance

The automatic data processing and checking functions are capable detecting and alerting to the user faults in the system. These include recorder faults (connection failed, power failed, battery low, cabinet door open, clock time, no detections, etc.) and data faults (data corrupt or missing, invalid values, runs of zeroes, etc.) The optional journey time module also includes alerts for expected and abnormal travel time congestion.

<div align="center">Tabular calendar</div>

C2-Cloud has a modern web-based interface with many of the features accessed via the map-based pages. Both tabular and graphical calendars are provided to give easy access to the data. In addition to the more than 115 different reports (volume, class length, speed, weight, gap, headway, emissions, etc.), batch reporting is also supported. Most tabular reports have user configurable columns.

C2-Cloud supports locales and localization. It has already been translated several languages, including Spanish and Arabic.

Typical report
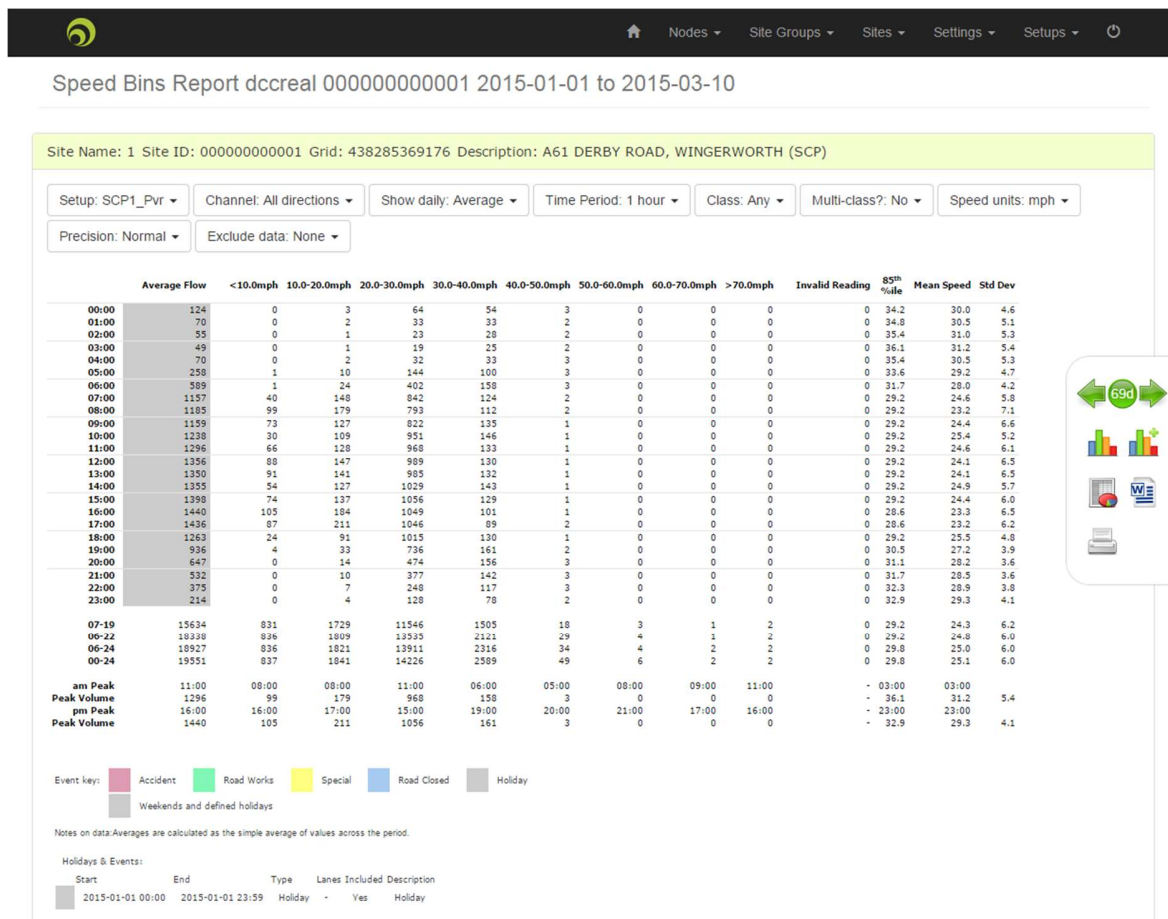
C2-Cloud includes many configuration tools from a fully featured site editor, a route editor, node and group tools, a class scheme editor, to tools that support user configuration. The access to these tools, the reports and the data itself is fully configurable on a user or user group basis.

In addition to most reports directly supporting Excel export, there is an Export Service to that can export summarized traffic data, per-vehicle data, fault data, and environmental data.

C2-Cloud is supported by comprehensive user guides and manuals that are available in both printed and PDF format, and by other downloadable material. Both on-site and off-site training is provided with C2-Cloud which is often supplemented by webinars. Drakewell hosts User Groups as a forum for gaining customer feedback and for presenting new features or technical insights.

C2-Cloud currently includes additional specialist modules (not illustrated). These other modules are designed for handling short-term or manual surveys (Survey Manager), for survey personnel and costs (Personnel Manager), specialized Weigh-in-Motion charts, asset management, journey time/origin-destination analysis, and traffic safety. C2-Cloud is constantly in development and new modules are added according to customer requirements or perceived trends in the market.

With C2-Cloud, Drakewell has been working with counties, departments of transportation and local authorities handling their traffic data needs for more than 20 years. Drakewell has a great deal of expertise in all aspects of this domain, software engineering, and of running a 24x7 web service. Drakewell currently holds both ISO9001 (Quality Management) and ISO27001 (Information Security Management) accreditation.

Backup and Recovery

As the C2-Cloud system is provided as a service via a browser all the backup and recovery functions will be handled by the server.

The proposed solution is Symantec Backup Exec including the Microsoft SQL Agent. A dedicated backup server will be setup with a large disk capacity which will perform and hold the backup. This backup server location should outside of the building housing the server should the network bandwidth allow this. As an extra backup and disaster recovery solution it is proposed to use SQL transaction log shipping to an additional offsite location. The database receiving the logs will act as complete copy of the database and could be used as the main production database if required.

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The backup will be configured to perform incremental backups during the week and a complete backup at the weekend. The backup routine will be configured to have very little impact on the general running of the system as the SQL agent will perform the backup in the background without the need for the database to be offline and without locking any files.

A test restore should be carried out every 6 months to confirm the backup regime status and to allow personnel to become familiar with the routine.

Archiving

Drakewell have a very thorough approach to data archiving. With C2-Cloud all data is always online and all records retained on the proposed servers for the duration of the contract. This will apply for imported legacy data and current data loading. Drakewell offer a very robust database which can hold millions of records. Data ownership remains with the customer at all times.

User Training Approach

Drakewell C2-Cloud Traffic Data is a mature product currently accessed by hundreds of users from very many different organizations, and as a consequence Drakewell has developed a range of training materials. These materials include user manuals and guides (available in both printed and PDF format), downloadable videos, webinars and training sessions (both on-site and off-site).

For the majority of installations, the user manuals and videos will provide a basic introduction to the application and will answer most questions. However Drakewell usually likes to accompany this with one or more targeted training courses. In the latter case, the course topics will usually be agreed beforehand to ensure the greatest value from the course.

Training courses can be provided via webinars – this is often very convenient to customers as it often the least disruptive to the client's organization.

Technical Knowledge Transfer

Drakewell C2-Cloud Traffic Data supports a number of user roles: guest, ordinary user, group administrator and system administrator. The standard training fully covers the first three roles and no additional training is recommended. The system administrator role, normally carried out by Drakewell staff would be part of the proposed solution support and maintenance.

During normal operation full technical support is available via phone to the front line and the back office technical experts. Since Drakewell C2-Cloud Traffic Data is a hosted system, little administrative or technical support is required once the system has been brought into operation.

Drakewell hosts user group meetings in which not only new features are presented but they also provide a forum for the exchange of technical information.

Testing

C2-Cloud is a mature, commercial, standard product used by dozens of customers and hundreds of users. Various components making up the product are updated often, and a testing regime ensures that the product is adequately tested each time.

Factory Acceptance Testing will be performed by Drakewell in compliance with procedures from its ISO9001-certificated quality management system and any project procedures and plans.

C2-Cloud is a hosted data service, so the main "deliverable" is in the form of providing access to the service; the only other deliverable is the legacy data import. The web service consists of hundreds of largely independent web pages, each of which can be tested in isolation. The other components requiring separate testing are: results of legacy data import; file upload and processing; and communication with outstations (if required).

Any issues found during testing will be raised on the Drakewell Help Desk (with priority Low, Normal, High, Urgent or Critical, as agreed with the Customer). This is the standard defect recording system used by Drakewell and will continue to be used after delivery.

Acceptance Testing on previous projects has always been quite smooth, with just a few issues raised that get recorded on the Drakewell Help Desk and which do not hold up roll-out to the customer's users. The issues are resolved a few days or weeks after delivery, depending on the priority. It should be borne in mind that any serious issues will affect hundreds of users and will be investigated very quickly; also that the nature of C2-Cloud means that a failure in a particular report (which is often due to an unusual combination of factors such as corrupt data) generally only affects that report, leaving 99% of the product working correctly.

Legacy Data Imports

Drakewell has considerable experience transferring data from customers' legacy systems to C2, including from Access databases and proprietary database format from other suppliers. Extensive checking is used to identify errors, unreasonable values, ambiguities and conflicting

data. A report is written cataloguing the anomalies, giving explanations, suggested resolutions and inviting the client to advise on how to resolve the issues. A trial data transfer is made available to the user to help them see the issues in the data. The data is transferred using a bespoke program so that the transfer can be repeated again and again as modifications are made (to the input data or the program) and issues are resolved.

In one recent transfer of data to C2, an Excel spreadsheet, eight Access databases and over 4,000 data files were imported (5103 surveys at 3078 locations over 18 years including classified traffic counts, classified junction counts and pedestrian and vehicle counts; also a personnel database was imported into the C2 Personnel Manager module); two reports were written, identifying over 3,000 data anomalies of 20 types.

In another recent transfer, a single 500MB Access database was imported into C2 (16 years' data from 873 locations); a report was written identifying about 12,000 data anomalies of 15 types. One of these anomalies was that the name of the data collection location differed between two tables in the database, usually by a small amount (e.g. Road instead of Rd.), but sometimes by a large amount (e.g. West Road instead of Entrance to Supermarket). An intelligent algorithm was written to calculate a measure of the difference between the two names so that we could highlight to the customer the worst cases of incorrect matches as these were the most likely cases of the data being linked to the wrong location.

A transfer performed in 2013 involved import of survey data from two Access databases (traffic surveys and speed surveys) involving 16268 surveys at 8837 locations.

Another legacy import involved an Excel spreadsheet and an Access database containing 733 manually-counted surveys of 4 types (passing count, turning count and multi-section pedestrian count and PV2 counts) at 486 locations into Survey Manager. Drakewell extended the C2 database schema and wrote new reports to handle the PV2 data, which we had not previously been asked to support.

Interfaces

Drakewell will work with a customer to implement the required interfaces. The client's input will be to provide details of the interfaces and explain them where necessary; to provide sample data; and to assist with testing. Drakewell will implement modules necessary to provide the interfaces; no client programming will be needed.

Risk and Issue Management

Drakewell operate a Help Desk system where customer issues can be officially logged and assigned a priority. Help Desk reference numbers are passed to customers when items have been raised. Drakewell staff would have access to create and update Help Desk items. CUSTOMER access to the helpdesk system itself (in addition to being able to raise items by telephone/email) could be arranged if required. CUSTOMER Help Desk items will be presented and discussed during status meetings.

It should also be noted Help Desk items can be escalated in priority following status meetings or specific high priority discussions. Drakewell's software engineers will be taking items from the Help Desk system in order of priority.

Quality Assurance Approach

Drakewell operates a quality management system and is certificated to ISO9001 and ISO27001. Implementation of all deliverables complies with quality procedures, project plans and designs, and project procedures. Customer requirements will be taken into account in planning, design and testing. Thorough, planned testing is done on all deliverables before delivery.

Support and Maintenance

The C2-Cloud system is a hosted system supplied through a browser and as such support and maintenance will be mainly handled at the datacentre. The C2-Cloud system presents data to the client by means of a browser so there is no need for any system software to be installed other than an FTP client for users who will be uploading data for processing.

Any maintenance to hardware that requires downtime will be carried out during the evening after the Customer has been notified to minimize any inconvenience. Operating system patches will be applied monthly during an evening after the Customer has been notified as these will occasionally require a reboot of the server. If an emergency patch is required due in particular to a security update the customer will be notified and the update will then be applied as soon as is possible. The proposed SQL database will have system based maintenance plans in place to keep log files to a manageable size along with a fully structured backup regime.

Software patches and updates to the application will be carried out on a quarterly basis except in the case of a bug fix that will applied as soon as is possible. The updating of the C2-Cloud

system will be first applied to a test system so that agreement can be sought from the Customer to update the full production version.

The C2-Cloud system is being developed continually and this development is in part structured through customer requests and suggestions. The Customer would receive the benefit of updates requested or developed alongside other customers as part of the proposed system.

Any C2-Cloud issues or suggested developments will be logged into a help desk system and given a unique reference number along with a priority level.

Open Standards

C2-Cloud is proprietary software and not open source. ESCROW agreements can be arranged where a third party company hold a full copy of Drakewell's source code.

Interfaces to C2 data accessible to users constitutes an Open Data format using CSV, XML or JSON with content and syntax defined by Drakewell.

Interfaces between roadside traffic data equipment and C2 are mainly proprietary and defined by the equipment manufacturer. Drakewell is independent of equipment manufacturers and C2 supports most hardware commercially available.

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