Response to Regional Council Advice Request 1108-TSDC86

Prepared for Martin Doyle, Tasman District Council

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Executive summary

This report was prepared in response to a regional council advice request from Martin Doyle of Tasman District Council. Advice was sought on:

“To improve the timeliness, accuracy and security of data, a tool is required to replace paper based systems for collecting and transferring field inspections at stations logging environmental data”.

“All Council use different databases, and have different standards relating to how they transfer and access external information. Prior to developing a tool to collect and store field inspection information, expert external advice is required to survey Councils and recommend a standard way of transferring data from mobile type devices. This standardisation will prevent duplication of effort and allow Councils to collectively adopt this new technology quicker”.

A questionnaire about the existing processes, technology and requirements was prepared and sent out to representatives of four councils – Tasman, Marlborough, Auckland and Canterbury. This report has been prepared using the compiled results from the responses to that questionnaire. Recommendations have then been made regarding the software architecture that might be used to implement the tool required.

This tool could contain the following parts:

Server data provider: This is an application or group of applications/processes that:

- Compile the site metadata (e.g. name, location, access information) and reports (e.g. previous inspections, recent data received) that will be required by the remote user when undertaking a site inspection and
- Receive and process the data, (site inspection, site modification information), and files, (images and data logs), returned from the remote user

Most of this application would be council specific unless the underlying databases and file storage used at the councils were to be standardised. However, the basic data formats for data exchange could be standardised to facilitate re use of the software used to process the data in the remote device.

Client server communications: This is an application providing the web service interface for the remote devices to:

- Respond to requests for site searches, site metadata, site resources (reports, forms, images) and serve the information compiled by the server data provider to the remote devices and
- Receive form and attachment submissions to be passed back to the server data provider for processing and storing

If all users agree to a common interface and protocol for the exchange of information between server and device it will be possible to implement common parts of this application just once. Here is where re-use of architecture, design, and implementation and, therefore, cost savings can be made.

Remote Device Local Storage: Prior to leaving the office users will synchronise their local storage by requesting data/files from the server data provider through the client server communications. On reconnect any new data/files will be uploaded to the server in reverse.

Remote Device User Interface: On the mobile devices there maybe two choices for delivering user interfaces, local application or web browser, each with pros and cons. No recommendation is made in this report. However, in either case the operation/workflow can be standardised and made extensible by detailing the labels, input fields, instructions, entry validation and error messages in a data structure that can be interpreted and rendered by the software on the device. This approach would allow councils to customise and extend their forms.

This report also details some standards and protocols that could be considered in the implementation of this tool.

There is further analysis and design work to be done before a solution could be implemented but the recommendations in this report should provide a solid foundation for future work.

1 Introduction

This report was prepared in response to a regional council advice request from Martin Doyle of Tasman District Council. Advice was sought on:

“To improve the timeliness, accuracy and security of data, a tool is required to replace paper based systems for collecting and transferring field inspections at stations logging environmental data”.

A questionnaire about the existing processes, technology and requirements was prepared and sent out to representatives of 4 councils – Tasman District, Marlborough District, Auckland and Environment Canterbury Regional Council. This report has been prepared using the results from that questionnaire.

1.1 Background

From the original request:

“The collection of environmental information from Council recording stations requires site visits to ensure accurate data are being collected. Modern mobile technology allows us to replace paper forms that are manually filled out and transferred later to a computer”.

“Quality checks that are presently carried out retrospectively will be carried out immediately on site to ensure operational standards are met, and problems identified and fixed immediately. Photographs will be automatically stamped with location and time to reduce errors and manual effort to archive properly. Information presently kept at each site (on paper) such as bench mark locations, instruments and safety instructions will be held electronically and will be up to date, and calculation of river flow will be done immediately. Data published on websites may need correcting based on field information, and the sooner this is available, the quicker the published information can be verified, or flagged as in need of correction”.

“All Council use different databases, and have different standards relating to how they transfer and access external information. Prior to developing a tool to collect and store field inspection information, expert external advice is required to survey Councils and recommend a standard way of transferring data from mobile type devices. This standardisation will prevent duplication of effort and allow Councils to collectively adopt this new technology quicker”.

The project is aligned with existing Envirolink projects to ensure environmental data are:

- described in a standard manner and is discoverable across NZ
- collected in a consistent and accurate manner across NZ

2 Existing Processes

Each council has staff undertaking visits to council recording stations for maintenance and quality control checking. As noted in the original request each of the councils involved use different technology and different standards for data transfer and accessing external information. This section provides a brief summary of each council’s current process.

2.1 Tasman District Council

Paper forms are filled out and a carbon copy left on site. The original is returned to the office, checked for any immediate action to be taken, like adjustments to telemetered data, and then filed by site.

The information from these sheets is used during data processing prior to data archiving, which maybe up to one month after the visit. Check data, external staff gauge and rainfall check gauges, are recorded as a data series in the Hilltop database. Data may be adjusted based on the date/time and reference checks provided by the field information and relevant comments recorded.

Digital photos taken at the site are stored in a file system folder per site. File names start with the date for easy sorting. Most of the photos they have currently have are not geolocated.

They do have an existing Access database containing details about sites and existing instrumentation which would probably be absorbed into any new system.

They have a comments logging database. I.e. any changes/occurrences on a site are stored as comments associated with the site. This would probably remain but be linked to any new system.

2.2 Marlborough District Council

Inspections are recorded on paper log sheets, which are scanned and archived in PDF. The details, e.g. staff gauge readings, are entered in Hilltop to assist with data verification and editing. This manual processing occurs within 5 days of the inspection. Other inspection details are added to a paper based station record file.

Some photos are taken and manually added to electronic storage.

Marlborough noted that they are currently upgrading the electronic field sheets used for water quality samples. Data is currently captured in the field using Excel and transferred to Hilltop in the office for checking existing data. They recently purchased Hiiltop Sampler to enable lab results and field measurements to be automatically processed.

2.3 Auckland Council

Inspections are recorded into an MS Access database running on the staff member's laptop. (Includes field inspections, instrument calibrations, instrumentation location, manual groundwater bore dips). This is then synchronised with a central version when the staff member returns to the office. Telemetered data is recorded to a Hydrotel server and is pushed into the Hydstra database. The inspection data is used during data processing prior to archiving.

Auckland already have one option to upgrade their existing system:

"The next release version of our time series manager Hydstra has added functionality to capture field site inspection information. This information is managed through a workbench within Hydstra and will be stored with the time series data under a site hierarchical system. This will require operating Hydstra on a laptop while in the field – either using Citrix remote

connection to Auckland Council Hydstra database or running a local version of Hydstra and later synchronizing when back in the office".

Auckland also provided details of other remote data collection their staff are involved in:

- Water quality data is collected on hand held PDAs in .net datasheets. Data is downloaded from the PDA in csv format for automatic loading to a database. The PDAs are increasingly unreliable dues to harsh field conditions.
- Stream ecological valuations (SEV) and Fresh water macro-invertebrate (FWM) data is collected using the Windows mobile version of MS Excel
- Terrestrial Biodiversity data is collected on Juniper AllegroMX units using DataPlus software and then loaded manually into their ecological database. "These are highly reliable industry-standard units, which are used extensively in the forestry industry.

2.4 Environment Canterbury Regional Council

ECAN use a mobile application for collecting stream health data which is then uploaded to their StreamHealth database in the office. A new application for filling in recorder site visit information is currently being tested. There are plans to include groundwater well inspection sheets and compliance monitoring site visit field sheets.

Digital photos are taken routinely on digital cameras. These are uploaded to a file system with strictly defined directories for applications can locate them for display.

3 Required Operation

Changes are required to the processes and technology utilised so that (taken from the original request):

- Quality checks that are presently carried out retrospectively will be carried out immediately on site to ensure operational standards are met, and problems identified and fixed immediately.
- Photographs will be automatically stamped with location and time to reduce errors and manual effort to archive properly.
- Information presently kept at each site (on paper) such as bench mark locations, instruments and safety instructions will be held electronically and will be up to date, and calculation of river flow will be done immediately.
- Data published on websites may need correcting based on field information, and the sooner this is available, the quicker the published information can be verified, or flagged as in need of correction.

The following requirements are amalgamated from the documents supplied by the Councils. For any common system a full set of requirements would need to be investigated, documented and agreed.

3.1 Functional Requirements

1. When in the office, or within range of a cell phone network, a site inspector must be able to update data about sites in their local system to match that held in the master system.

1.1 Note: A full update for all sites may only be possible when in the office due to volume of data

1.2 Note: This update to be as automatic and seamless as possible

2. An inspector must be able to find and view the details of any site held in their local system

2.1 The site could be identified by GPS location given by an inbuilt system or entered coordinates

2.2 AKL: Allow a search by site name, site number, inspection run, sensor type or station type. Map searches would be less useful.

2.3 ECAN: Maps are good, but every thing can go by name and site number for the environmental sections as they are quite familiar with the sites they monitor.

3. During a site inspection at a site the inspector can record electronically the inspection site, date, time, observations, measurements, comments etc.

3.1 The inspector is able to select an inspection form suitable for the current site's installation.

3.2 Some data is entered by default – date, time, user.

3.3 Where appropriate checks/calculations are made on data entry to assist with data accuracy. Could include:

   i. Environmental monitoring standards

   ii. Calculation of river flow, differentials

   iii. Trends from past inspections

   iv. AKL: e.g. for a water level site comparison of encoder reading, logger reading, external staff gauge reading, internal plumbob reading could apply the correct quality code.

3.4 The inspector can record/cancel a prompt/reminder note for the next visit.

3.5 Prompts are made to the user of, for example, site safety details, reminder to take photos, recorded prompts from previous visits

4. During a site inspection at a site the inspector can take geo and time located photographs

4.1 The photo filename should be set to some standard that will allow easy identification of the picture once stored in the master file system. (Including date).

i. ECAN: we burn on Site IDs and date

4.2 The geo location information should be stored to facilitate map based searches.

4.3 It would be useful to be able to store other information associated with a photo.

4.4 The user could adjust the file size prior to upload

4.5 It would be a useful feature of synchronisation if these could be automatically associated with the correct site

5. When in the office, or within range of a cell phone network, completed data can be synchronised from the local system to the master system. See section 3.3 for the data/files to be synchronised.

3.2 System Requirements

1. The completed system must provide regional councils with a standardised approach to collect and store field inspection information.

2. The site inspection forms must be configurable to allow for the different fields that may be captured by different councils.

3. Data entry checks must be configurable to all for different data requirements, lookup data etc for different councils.

4. There should be a standard database structure to facilitate synchronisation between the master system and user's local systems.

5. The local application needs to work both on and off line.

5.1 TDC: Assumption by IT dept. that the application would be browser based rather than requiring a web service.

5.2 MDC: 30% of our sites are outside mobile sell coverage.

5.3 MDC: device agnostic system, easily deployable to devices.

3.3 Data Requirements

1. When inspecting a site the inspector will require existing data about that site from the master system. This may differ between councils but could include:

1.1 Last 10 inspection forms (preferably all data if space/performance permit)

1.2 Safety details for each site

1.3 Most recent flow rating

1.4 Recent and historical images (including sensors and instrumentation, flow rating control)

1.5 Image of station plan

1.6 Instruments

1.7 Details of benchmarks (locations, images and RLs)

1.8 Locations of photo control points

1.9 Access information such as landowner contacts

1.10 Site safety details

1.11 Asset management information about a site – serial numbers etc.

1.12 Calibration certificates

1.13 Product user manuals

1.14 Procedural manuals

1.15 AKL: Last 6 weeks to 2 months telemetered data for onsite assessment

1.16 AKL: Last 12 months data for manual ground water bore dips

1.17 ECAN: location map

1.18 ECAN: consent details

2. Summary of possible fields included for an inspection and to be uploaded to the master system:

2.1 Station, location

2.2 Date, time

2.3 Instrument readings

2.4 Staff gauge readings

2.5 Rainfall check gauge readings

2.6 Battery check data

2.7 Inspection specific comments

2.8 Site specific comments.

2.9 Photographs

2.10 MDC: Downloaded data files including flow gauging

2.11 AKL: Water Quality site .csv files.

2.12 AKL: Quality code and comments regarding telemetered data assessed

2.13 AKL: Water quality sample bottle bar codes

2.14 AKL: Results of manual groundwater bore dips

2.15 AKL: current GPS location

4 Extended Requirements

From the results of the questionnaires it appears that Auckland council are further advanced in their use of technology than both Tasman and Marlborough District Councils, and they have more requirements of any new system. In particular, it appears that any new system would replace their existing Access database and would have to cover all its existing functionality.

From the questionnaire results it looked as though Tasman and Marlborough were mainly interested at this stage in adding data – field inspections – to a database. But Auckland, from the information supplied may also need to maintain data in a database – i.e. instrumentation location.

From a telecon with Martin Doyle: he confirmed that they too would like to keep track of assets, replacing their existing MS Access database. He also indicated that they keep a database log of changes/operations to a site and this could be updated in similar fashion.

So, although the initial scope of the request was for a mobile application for station field sheets, the following requirements should be considered in any implementation of a solution:

1. The system must hold details of assets at a site including manufacturer, model numbers, and identifying serial numbers.

2. A remote user must be able to update details of the assets at a site and have those changes synchronised with the master system when in the office, or within range of a cell phone network.

2.1 Any deletion of data should be adequately traced via an audit trail

It looks as though ECAN already have an SQL database in place for storing their site and instrument data.

Auckland have also expressed a requirement for more historic and current data comparisons. E.g. The ability to pull back data from sites that have automatic telemetry recorders to allow onsite assessment of the previous 6 weeks to 2 months data record for any problems. This provides an indication of the complexity that may be required in any data checking.

5 Equipment

Each council wants to take advantage of the capabilities of mobile technology.

- Ability to synchronise data, in both directions, when within cell coverage
- Ability to work offline, when no cell coverage, for later synchronisation.
- Good device durability i.e. rugged devices with good power options.

The councils provided the following details about their existing equipment and future plans or requirements.

5.1 Tasman District Council

5.1.1 Current equipment

- Paper forms
- GPS
- Digital camera – they have just bought a GPS enabled camera
- Data from loggers is downloaded to Panasonic tough books which are also used for ADCP (Acoustic Doppler Current Profiler?) gauging.
- Processing of the paper forms is completed in the office
- Laptops are the only “mobile” equipment currently used

5.1.2 Future requirement

Quoting Martin Doyle:

“I have a strong preference for a mobile phone rather than a tablet. An all in one device…”.

5.1.3 Current infrastructure

The council predominately uses Windows servers and SQL server databases. The use of MS Access is definitely deprecated.

5.2 Marlborough District Council

5.2.1 Current equipment

All involved staff have the following:

- Office desktop – Windows 7
- Field laptop – Panasonic Toughbook – Windows 7
- Currently no tablets or smart devices but currently looking at and trialling windows phones
- Network connection is only used in the office but remote access is available via Telecom mobile t-sticks using Citrix.

5.2.2 Future requirement

Quoting Mike Ede:

“These choices if possible should be down to the user as everyone has a preference as to what platform the want to run applications on. We should be limited by currently technology. But the system should look the same no matter what device it is running on. If we where required to make a choice at this stage a tablet computer would be the preferred as a large number of software applications we use are still restricted to that tablet computer platform, but this may change and it is easier to carry one device rather than one for each application you are using in the field”.

5.2.3 Current infrastructure

The server infrastructure is virtual with the majority of servers running Server 08 R2. Databases are SQL 08 R2.

5.3 Auckland Council

5.3.1 Current equipment

- Panasonic CF-19 tough books for telemetry site inspections and sensor interface
- Motorola PDA for monthly WQ and annual FWM sampling
- Juniper Systems Allegro MX units for Terrestrial Biodiversity work
- All network communication/data exchange is done in the office

See section 2.3 for further information about Auckland's use of this equipment.

There is currently no ability for remote access or mobile connection to a remote server. The PDAs have mobile capability, but this has not been explored.

5.3.2 Future requirement

Quoting Phil White:

"Mobile smart phones for ease of use.

Continue with the Allegro Units for Terrestrial Biodiversity monitoring.

Investigate IP68 units for WQ, FWM, Marine ecology".

5.4 Environment Canterbury Regional Council

5.4.1 Current equipment

Laptops, smart phones, cameras.

Staff only connect to the network for transferring data in the office.

5.4.2 Future requirement

Weather proof, not too small and fiddly.

5.4.3 Current infrastructure

The hydrology section uses an MS Access interfaced SQL database system for keeping track of manual gaugings, instruments and sites with various reporting and export options.

6 Implementation

Each council has detailed in house knowledge about their existing systems. Modifications to their existing systems or additions to move data from any new system to their existing systems, can be achieved by their internal staff, with the assistance of contractors where necessary.

Any new system must involve the council IT staff in decisions about the implementation, especially around security, application support, existing/new technologies etc.

7 Comments about application of mobile technology

7.1 Tasman District Council

Quoting Martin Doyle:

"I don't think the time saving will be immense, but it will be noticeable. I estimate 10 minutes per day. However, what it will do is improve accuracy, prevent things being forgotten, and provide access to a lot more information (which, importantly, is up to date) to help a field person do their job properly. Also it will enable the easy collection of a lot more data such as geo referenced photos, which will be taken based on a prompt from the device, rather than be forgotten during a visit".

7.2 Marlborough District Council

Quoting Mike Ede:

"It is hard to quantify the time improvements that would be made using such a system as when time improvements are made you end up doing other things rather than actually spending less time on the task.

Typically currently for everyday in the field a day is spent in the office downloading editing and updating data systems. I can see that this time would be reduced by approximately 25-30% if data captured in the field was transferred automatically to the main system using mobile technology.

Using mobile technology would be good for our organisation. Time efficiency gains both in time to complete the tasks and the effective real-time additions and updates to the database would be good".

7.3 Auckland Council

Quoting Phil White:

- "Mobile tech could allow instant transfer of data collection or site inspections back to the home server. This could allow an automatic processing data script to be developed that could then transfer this data automatically to the database and apply a quality code.
- Monthly WQ samples could be instantly assessed against the home database to allow comparison and potentially notification of Pollution Response automatically. Also, mobile technology will be utilised to identify when WQ samples are taken, and transfer the information directly to the laboratory, as opposed to paper field sheets accompanying the samples. Furthermore, bar-coding information will be integrated with the system, to ensure that the bottle count is complete.
- The ability to pull back data from sites that have automatic telemetry recorders would allow onsite assessment of the previous 6 weeks to 2 months data record

for any problems, then apply a quality code + comments which would then be archived while the user was still on site.

- To be able to collect manual groundwater bore dips and plot against last 12 months of data for verification while in the field. The upload the data remotely back to the office for archiving.
- The ability to edit/update/insert data while disconnected for later upload would be very useful. Some sites are out of range of GPRS/XT communications and if this process was automated to allow updates once back in range it would be great.
- To be able to remotely retrieve benchmark and historical survey information from the office database. This would facilitate levelling surveys while in the field".

7.4 Environment Canterbury Regional Council

Quoting Phil Downes:

"A major improvement for our mobile technology applications would be if the field person can connect up to the office to download a location map, consent details, previous monitoring data for use in the field. Upload of data can usually wait till the field person is back in the office, although in a few cases (monitoring low flow sites and water usage restrictions) would benefit from a speedy update. Unless we totally change the way the compliance field staff works (never in the office nearly always in the field) we don't need much updates from the field to the office.

Currently we have a procedure in the water usage data download where field staff e-mails a picture of a manually filled in field sheets for the office staff to process from the smart phones. It also has a digital data logger file attached. It would be a small step to get this process into a mobile app.

Up to date-ness from weeks to within days, amount of work roughly estimated to save maybe less then 1 day per week. The rule is 3 days field work, 1 day preparation and one day post processing – this could be reduced to save 2* 0.5 day so ultimately 20% for compliance or well check field work. For some field sheets it is not going to saving that much time e.g. entering the results of a 'well run' of a day requires less then 15minutes to re-enter in the database on return to the office. There is a trade off between a manual upload of the data against an automatic upload from a mobile device. The manual system is simple in it's setup and offers a re-check while entering the collected data by the field person rather then a 'blind' upload".

8 Recommendations

8.1 Introduction

The end user requirements list a range of information services that are to be made available on field devices ranging from smartphones, tablets, laptops and specialist rugged devices.

These devices differ in key features such as screen size, storage available, operating system and communications ability. The devices may or may not have camera and GPS functions.

Device Connectivity ranges between:

- Fully connected to the Internet - high bandwidth
- Partially connected to the Internet - low bandwidth, expensive
- Intermittent connection
- Disconnected - all information must be available locally.

It is assumed that even disconnected devices will at some point in time be able to be fully connected in order to synch or update information.

At its most abstract the site management application is consistent across all the platforms:

- A user interface allows selection of a site and display of information about a site.
- Site details can be viewed and a list of documents and forms associated with the site presented.
- Users can view Documents (reports, images etc.) with display being provided by the application or by a viewer tool suited to the document type (e.g. PDF viewer).
- Users can select Forms to enter in new or updated information about aspects of the site.
- Users can associate messages, notifications and comments with each site.
- Site, Document and Form information is supplied from a server source, cached locally if necessary and presented through the user interface.
- Changed information is returned to the server when connectivity allows.

The application therefore consists of:

1. A user interface - 8.2

2. A storage system - 8.3

3. Client Server communications - 8.4

4. Server data provider - 8.5

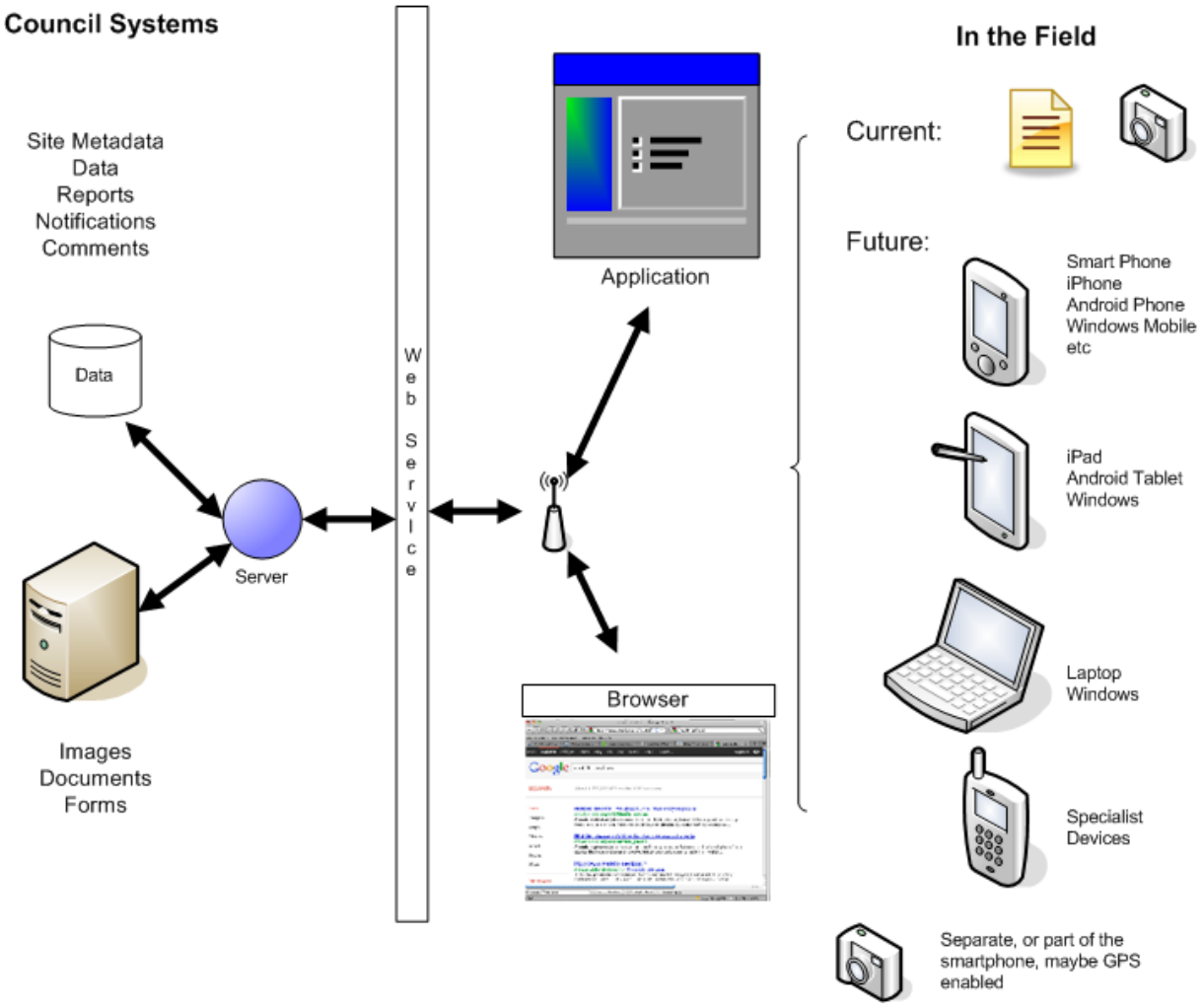

Figure 8-1: Mobile Site Management Information System.

8.2 The User Interface

On mobile devices we have two main choices for delivering user interfaces (and applications generally).

- App - An executable program written in a language supported by the device Operating System, Using native device user interface components and resources. With an App both presentation - the screens, forms etc. - and behaviour are coded using the native language.
- WebApp - A set of web pages, style sheets and scripts delivered from a web server and running in a Web Browser hosted on the device. With a WebApp the presentation is typically coded using HTML with CSS styling while behaviour is coded in JavaScript (and sometimes Java).

These two choices have various pros and cons and the choice taken depends to some extent on the device, operating system, budget and intended use of the system. The model presented here is agnostic as to the choice taken. Instead we suggest an abstract model that either choice should follow to maximise design and implementation re-use. We may see the development of both types of application.

8.2.1 App

Pro - can use native user interface components; can access storage and device functions such as camera, GPS; can use non HTTP internet protocols.

Con - different for each device size and OS; may require specialist knowledge of the device; multiple versions may be required; may have to go though vendor delivery system (e.g. app store).

8.2.2 WebApp

Pro - common well understood language for presentation and behaviour; one solution fits all; server side delivery; no local installation required.

Con - needs web connectivity; has to run inside a browser; depends on browser capabilities; may still have to customise for screen size; less access to system functions; modern browsers support local storage and offline access, but this may not be available on some devices.

8.3 The Storage System

In the pure Web Application model with a permanently connected device and good bandwidth no local storage is required except the standard browser cache. However this system requires the application to work in low bandwidth or offline conditions, so any solution will have to make use of some form of local storage. This could be a local database or file system.

The application would use the client server communications to obtain the site details, documents, forms etc. required to run the user interface and would place them into an organised 'cache' folder or database. When the document is required again the cache is first checked and the local copy used in preference to the server copy.

Prior to leaving the office users should be able to synch or pre-populate the storage by requesting all, or a subset of, the information available depending on storage requirements & availability. On reconnect any new data or form results also need to be uploaded to the server.

HTML5 local storage and offline capabilities allow WebApps to operate in this disconnected environment with synching during times of connectivity. Given that users may switch between expensive mobile radio connections and cheap office Wi-Fi connections some controls would need to be put in place to optimise the use of synching.

8.4 Client Server Communications

Given that there may be alternative implementations of the client app or web application for different devices, it is in the client server communications that the most re-use of architecture, design, and implementation and, therefore, cost savings can be made. If all users agree to a common interface and protocol for the exchange of information with the server it will be possible to implement just once common parts of the server communications and protocol, and common parts of the client communications and presentation.

We propose what might constitute this communications layer below.

8.4.1 Data server

There are two ways in which the system might be constructed.

1. A common broker
2. Individual Client servers.

Common broker

In this model a single system is built that all devices, from any council, communicate with. This accepts requests and dispatches responses and holds a central repository of station identifiers and sources. A second communications layer (Web service) links this common broker to each council's private system. Councils would either push content into the common repository, or respond to requests to pull information out of their own repositories.

Individual client servers

In this model each council runs its own instance of the site service. They each implement a back end to the server that connects it to their own information sources. This back end connection might be an internal web service or a direct database connection.

Given the current variety in the systems and information used by each council it would seem that the individual client server model would be the simplest solution. However if all clients conform to the same protocols the option of a common broker remains open in the future.

8.4.2 The Communication Interface

The next step in the analysis is to define the main features of the communications protocol for the messages and documents involved. This is beyond the scope of this document, but an outline is given here as to what might be found in such an interface.

Following current best practise it would be likely that the protocol would be based on HTTP using RESTful practises such that requests are GET or POST messages to a URL. Response content would likely be XML or JSON encoded structured data, or resource documents such as images, PDFs, MS Office docs etc.

At this current level of requirements analysis we see the following main functions being provided by the interface:

- List/Search Sites
- GetSite
- GetResource
- Get/Submit Form
- Notifications and Comments
- Attach

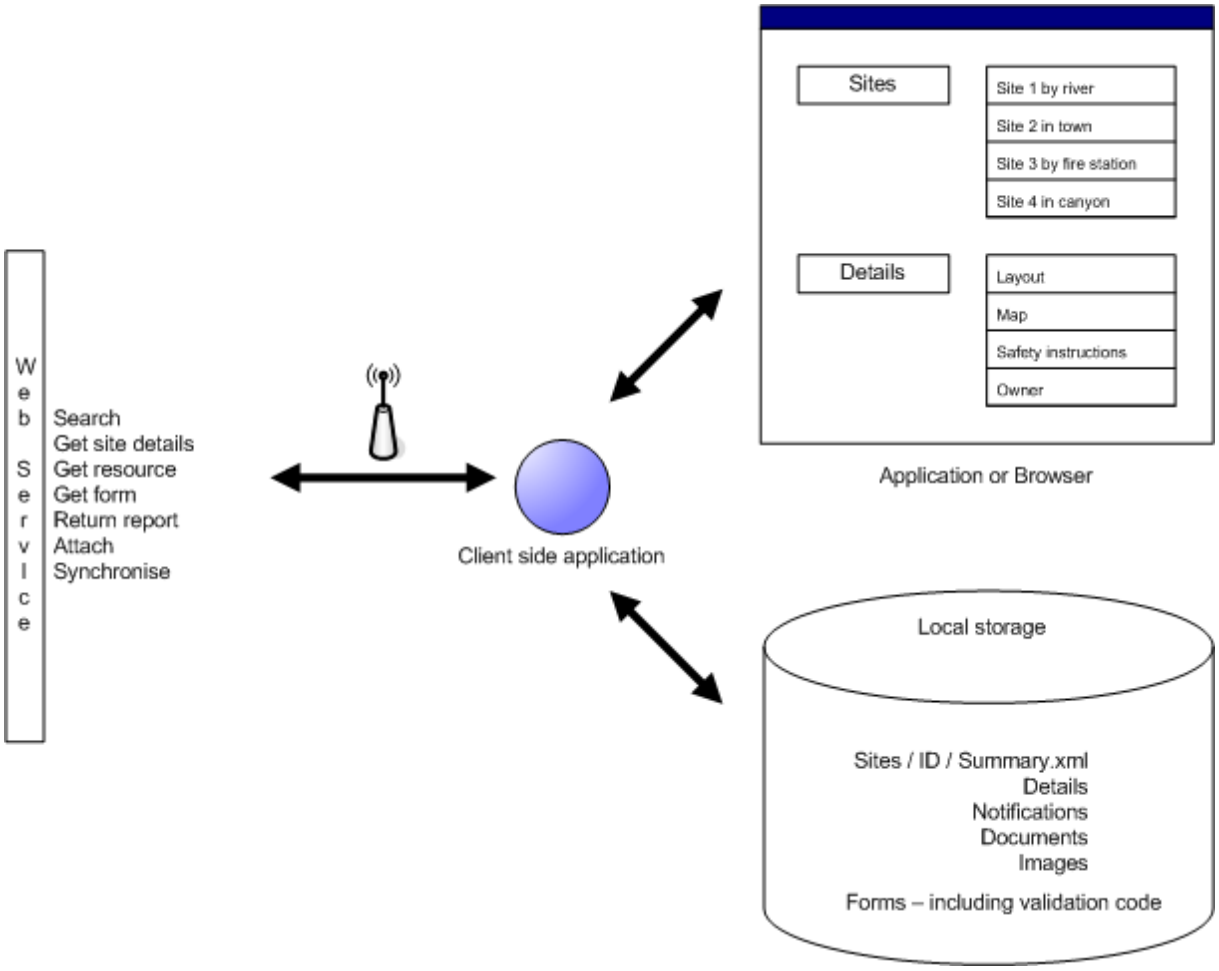

Figure 8-2: Mobile Application.

List/Search Sites

Any user interface needs to be able to select the site of interest. The user may:

- Already know the site name or identifier.
- Want to search for sites matching a name
- Want to search for sites by a geographic name or spatial extent (e.g. box on a map)
- List sites according to some other criteria - e.g. field group, sensor type etc.

The information returned would be a collection of results one for each site with a small amount of key information sufficient to allow the user to make the next selection decision. e.g. Name, location, group, owner, id etc.

Having selected a site all further communications about that site are by identifier.

If a common broker is to be used (see 8.4.1) identifiers will need to be unique across all council systems -for example by combining the council name and local identifier into a URN (Uniform resource name e.g. urn:niwa:stations:1235).

Get Site (by id)

This request should retrieve a document containing the main details for a site. As well as site metadata, the document should include links to other resources associated with the site including reports, images, documents, and forms. In effect this document acts as the manifest or index for all other site information.

It is the responsibility of the source server to identify what resources are associated with a site.

A protocol already exists that meets many of the requirements for the search and get functions. The OGC Web Feature Service allows requests to be made to the WFS server for features matching the search criteria - name, id, location etc. Providing the base level site catalogue as a WFS feed would enable a range of client apps to locate and display sites.

Get Resource

This request obtains a document specific to a site - a report or form.

This request does not really require a specific protocol call as a standard Web URL call will suffice. The URL would be generated by the source server and placed in the site details document. The client app simply needs to list the available choices and get the document with a standard HTTP GET request. Using standard internet MIME types the client should receive either data to display directly e.g. html, or a document that may need to be displayed using 3rd party software, such as the PDF viewer in the device.

Get/Submit Form

We use the term form here for any type of interaction whereby the user is asked for information to submit back to the source system. This encompasses all existing paper forms, as well as filling in status boxes, making comments, uploaded images etc.

A form consists of a set of labels and input fields along with instructions, entry validation and error messages, along with the server side address the form contents should be submitted back to. The result of submitting a form is a block of structure data (attribute value pairs, xml, json etc.) that is returned to the server to be stored or otherwise affect the operation of the system.

In the WebApp environment a form would usually be expressed using HTML with client side validation being performed by JavaScript. In the App environment the form might be expressed in XML forms language or a specialist system such as Microsoft .NET or Adobe XML Forms Architecture (XFA) assuming suitable client side libraries are available.

In either case the workflow is similar. The available forms are listed in the site details document. Selecting one obtains it from the server or the local storage and it is rendered into the User Interface. The user fills in the details and validation routines confirm that the values are correct. Scripts may also calculate derived values and display help and error information.

When the form is completed it is submitted to the server either directly or by saving into the local storage until the next synch event. The server checks the results and updates the underlying system. The change may result in the station details being modified and the information held locally may need to be updated.

Note that this flow is slightly different to traditional web forms whereby the form is submitted to the server and validated there - being returned to the user if it is not complete. The offline validation and storage does open the small possibility of multiple users trying to submit forms changing the same site details and some means to arbitrate this may be required.

Notifications and Comments

Notifications are messages sent from the server to be read by the user of a particular site, or may be global messages to all users.

The client application should, when possible, check to see if there are any extant notifications for the user, or the site and display in the user interface.

Comments are messages sent from the user to the server. These might be notes about a site, messages for another user or group or global messages to be sent out as notifications.

Protocols and clients already exist for this type of messaging (e.g. Extensible Messaging and Presence Protocol – XMPP http://en.wikipedia.org/wiki/Extensible_Messaging_and_Presence_Protocol).

Treating a site as a 'buddy' one can send and receive messages from may be an effective way of providing this functionality.

Attach

The requirements identify the taking of a photograph and uploading it to the server as an important activity. Attach is a special case of the Form function - the user would open the add photo form, fill in the comments they want to make, take or otherwise attach the image, and submit the form to the server in the usual way. Where it is stored is a server side decision.

8.5 Server Data Provider

The model described provides a very general purpose interface for exchanging information between client side mobile field applications and council systems. Such an interface can support communication between heterogeneous devices and sources.

The model leaves undefined the nature and content of the site documents, forms and reports. Although some fairly general purpose client applications could be written much of the work is pushed to the server side where an interface has to be built between the council systems and the data server, see 8.4.1.

8.5.1 Site Metadata and Identification

For the system to work it needs to have a fairly consistent concept of what constitutes a site. Ideally it should be possible to agree a standardised site metadata document containing name, id, location and other minimal properties that would allow the client user interfaces to work with all council sources. Using an XML base schema for this document would allow both the commonality, and leave space for more detailed council specific information that would be interpreted by a council specific client application.

There would be long term value in following international standards such as the OGC Features specification in this respect.

8.5.2 Forms

This interface needs to define each form provided to the end user, its fields and validation, and the manner in which the returned form information is stored or otherwise processed.

Where councils can agree common forms and processes there will clearly be a saving in developing the forms.

8.5.3 Reports

Reports include tables, charts, word documents etc.

For each report, a system is required that generates the report from source data and places it in a known format in a location accessible to the client devices. Reports might be generated dynamically, on demand, or in advance. As long as the system can map a URL request onto the report the system will work.

The system then needs to be able to list the reports available for each site.

8.5.4 Attachments

Attachments will mainly be photographs but might include other files such as updated word documents, files from sensors etc.

When the client submits a new attachment this needs to be handled by moving the file to storage and adding its metadata to the information available for a site.

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