Project Name:	Acsis - Distributed Software (WIN)	**Start Date:**	2015-01-01
Project Number:	1501	**Completion Date:**	2016-03-31

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
CPU Hardware limitations (MHz)	500	100	No
Data accuracy (% correct)	82	99.9	No
Response time (seconds / query)	350	15	No

After commencing the project, the Appellant encountered a number of challenges in Belize, including poor telecommunication infrastructure. As a result of these challenges, the Appellant was unable to utilize its Electronic Health Record ("EHR") solution to address the project's goals, primarily because of the inability of the limited infrastructure in Belize to support this EHR technology. Consequently, the Appellant was unable to link the various health institutions, including health care centres, rural clinics, labs and pharmacies for the comprehensive exchange of data, as required pursuant to the terms of the project contract.

The approach to even the simplest component of detecting when connectivity existed had to change. The challenge was one of providing equal access to predictable data integrity where connectivity issues ran far deeper than would be encountered in a stable and secure environment such as Canada.

Field of Science/Technology:

Computer sciences (1.02.01)

Project Details:

Intended Results:	Improve existing processes
Work locations:	Commercial Facility
Key Employees:	
Evidence types:	Records of trial runs

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

Initially, the Appellant attempted to duplicate the target environment conditions of Belize in the laboratory, focusing on the correct operation of replication algorithms, without the burden of network problems, in order to isolate potential defects in the algorithms. Transitioning of the replication algorithms to the conditions of the target environment required the algorithms to be more fault-tolerant in an attempt for the system to seize the advantage of connectivity when it was available.

DEPARTURES FROM PRIOR ART:

The company testified that the technological challenges were not reasonably predictable of resolution using standard procedures or routine engineering. The Appellant searched unsuccessfully for an existing "off-the-shelf" replication software system.

The replication solutions that were available in the field at the time did not suit the required objectives of the Appellant for this project. The most commonly-used replication solution was a system of master/slave replication. This solution permitted changes on the master database only while replicating or mirroring those changes to the slave databases. However, the Belize project required replication technology that would support changes to any database with those changes being exchanged asynchronously because of the connectivity issues.

As Mr. Rutter explained:
The master doesn't know that the node has connection. And the node doesn't know if the master has a connection. So, they've got to act independently or asynchronously – asynchronously to move the data.

It formulated a plan to develop a multi-write database where each 'node' (of which Belize had more than fifty) could write to the main file. The replication systems that were available were intended for different purposes and were not appropriate to

achieving the Belize project goals. Those existing replication systems did not account for the nature of the severe underlying network problems.

The most significant underlying key variables are:

node and master behaviour, sequence & subscription strategies (unresolved)

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Internet searches	10 Articles	see Google articles in Prior art list
Patent searches	10 patents	see patent links in Prior Art list

Activity #1-1: Activity 1 (Fiscal Year 2015)

Methods of experimentation:

Method	Experimentation Performed
Analysis / simulation:	854 alternatives
Trials:	1400 runs / samples
Other methods:	140000 lines of prototype code

Due to the unprecedented technological problems, the Appellant “undertook experimental development to attempt to create technology that could mimic the availability of stable communications infrastructure in a hostile network environment where nodes must optimize the utilization of the minimal network resources.”

The claimant provided a SR&ED activity sample that elaborated on the systematic investigative process that occurred with respect to a particular task, of observing and analyzing replication functionality over dial-up, which was part of the larger project.

This was meant to serve as an example of one experiment of many project elements that took place over a three-week period. The document outlined the objectives, procedures, observations conducted and investigative techniques that were pursued and utilized in respect to this one element. These various documents showed how the project evolved in respect to developing hypotheses, conducting various testing of theories, installing and refining algorithms and evaluating the outcome.

They did not “measure these connectivity issues”, except through observation and experience, because they had no control over the private company in Belize that was in charge of connectivity in that country. This measurement related more to the integrity of the data and the accuracy with which it reached its destination despite connectivity challenges.

He referred to the content of these notes, which list “rough algorithms” for network behaviour, the three stages of full synchronization using the mobile connector, the operative requirements of the node manager in order for it to manage sequences and subscriptions, and node and master behaviour.

TYPES OF DOCUMENTATION MAINTAINED

Mr. Kilburn testified that he kept notes, whiteboard photos and computer script notes, which were completed contemporaneously with the planned testing being conducted.

In conducting test cases, some of them were embedded in the software through unit tests, while others were developed through “idea development” from initial brainstorming to prototyping design of the various aspects of the health information system that had to be integrated within an environment of unreliable network connectivity.

Unit tests and staging tests led to algorithms that could be refined and installed to try to simulate and validate theories based on available connectivity.

Mr. Kilburn testified that logs, or notebooks of the software, tracked events and if there were errors or connectivity issues, an analysis of the logs was conducted. The code was modified to address the problems so that eventually, based on the anticipated environment, the code would behave as expected at every facility in Belize.

In addition to constructing algorithms that would synchronize data across a multi-write network and ensure that patient data

COMMERCIAL CO

had complete availability and correctness.

Results:

Conclusion:

Taxpayer Wins - Based on the facts & issues analysed the judge concluded that;

"Although the documentation was not as detailed as I would like to see, particularly with respect to the types of tests performed and the results achieved, I am satisfied with the oral testimony of the Appellant's witnesses. For the most part, their evidence was not challenged on cross-examination and Mr. Rutter, Mr. Kilburn and Mr. Bearisto provided credible explanations respecting the scientific investigation and method they adopted in order to develop the HIS."

The solution to the technological uncertainties that existed with the Belize project resulted in the creation of a multi-write database replication system. This approach was not only innovative but leading-edge in that it produced an integrated health information system that resulted in the successful establishment in Belize of the first nationwide health information system of its kind.

The evidence suggested that the available open source replication solutions were inappropriate as they were meant for very different purposes within the field, designed to work with strong connectivity infrastructure. Since an appropriate replication solution was not available, the Appellant undertook experimental development work to create technology that could mimic a stable communications infrastructure in the hostile environment that existed in Belize.

LONG TERM SIGNIFICANCE (moderate):
DESPITE THE FACT THAT THE TAXPAYER WON THE CASE, THE FACTS PROVIDE LITTLE IN THE WAY OF SPECIFIC HYPOTHESES OR TECHNOLOGICAL ADVANCEMENTS. AS A RESULT IT IS LIKELY OF MODERATE LONG TERM SIGNIFICANCE.

Significant variables addressed: node and master behaviour

Documentation:

- Offline Documents: journals, whiteboards & computer scripts