Project Name:	Allegro - Protocol Compliant Methods to Extend Bluetooth Functionality	**Start Date:**	2022-01-01
Project Number:	2201	**Completion Date:**	2022-12-31

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Maximum buffer use (K)	256	64	Yes
Fidelity (relevant info retained) (%)	100	90	Yes

The following example is based on the Tax Court of Canada judgement ALLEGRO WIRELESS CANADA INC., and HER MAJESTY THE QUEEN, March 31, 2021.

126] Project 1 as follows: “the implementation of a throttling mechanism to prevent overruns when sending more than 64KB across a Bluetooth printer connection (overcoming specific Bluetooth printing implementation limitations).”1

127] Mr. Rupel described in some detail the technological obstacles the Appellant had to overcome, the work it performed and the results it obtained with respect to the TA1/TO1 portion of 2010 Project 1.

128] He noted that the printers in questions were small printers that were used by approximately 20% of its clients and that hung on the belt of the client’s employees. The printers printed documents, such as receipts, based upon information that was transferred via Bluetooth from the hand-held device to the small printer. Microsoft wrote the software used to communicate with the small printer (referred to as the “Bluetooth stack”). The Appellant was not able to “look inside” the software to see how it worked or to adjust how it worked.

129] The problem the Appellant faced was that the small printers had a 64 KB buffer which stored the information sent from the hand-held device to the printer until the printer was able to use the information to print the document. The problem was that if too much information was sent, then the buffer was exceeded and some or all of the information was lost. This meant that its client could not get a proper printout of the document.

Field of Science/Technology:

Telecommunications (2.02.07)

Project Details:

Intended Results:	Improve existing processes
Work locations:	Research Facility
Key Employees:	Wesley Rupel (Allegro PI) (Physics - PhD (1985) / President & CTO), Gerald Penn (Allegro Expert Witness) (Computer Science - PhD (1991) / Expert witness)
Evidence types:	Progress reports, minutes of project meetings; Test protocols, test data, analysis of test results, conclusions; Records of resources allocated to the project, time sheets; Design, system architecture and source code; Design of experiments; Records of trial runs

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

130] The fact that the Appellant’s different clients had Bluetooth stacks from different companies and printers and hand-held devices from different manufacturers compounded the problem. The Appellant needed to write software that would work on all of these systems.

131]Mr. Rupel noted that the problems placed the Appellant in a situation that was outside the bounds of normal engineering. He noted that with normal engineering one is working with systems that do not have buffer overruns, systems that work.

The Appellant was required to work with someone else’s system that had bugs and did not work properly, a system that was basically a black box.

The most significant underlying key variables are:

proprietary systems - blackbox issues, throttling - time vs. rate vs. % compression, transparent compression methods, “lossy

-type scenario" (less data), buffer overrun - speed vs. clearing

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Internet searches	10 Articles	
Patent searches	5 patents	cholar&oq=(Maximum+buffer+use)+%26+bluetooth
Competitive products or processes	2 products	Based on prior work of Mr. Rupel as one of the original 10 developers in the Microsoft Windows team.
Similar prior in-house technologies	3 products / processes	The 3 current projects are all built upon Allegro core device management technology
Queries to experts	2 responses	Input from Dr. Russ Roberts (PhD) & Dr. Gerald Penn (PhD)

Activity #1-1: year 1 (Fiscal Year 2022)

Methods of experimentation:

Method	Experimentation Performed
Analysis / simulation:	14 alternatives
Trials:	6400 runs / samples

132] Mr. Rupel stated that the Appellant experimented with three different solutions to the problem, doing a "lossy-type scenario", using a transparent compression method and using a throttling mechanism.

He noted that the Appellant a "lossy-type scenario", using a transparent compression method and using a throttling mechanism. He noted that the Appellant was looking for creative solutions that would allow it to work around the problem while using the standard interfaces.

133] The "lossy-type scenario" involved sending less data in order to avoid exceeding the 64 KB buffer. Mr. Rupel explained that this meant that one does not have complete fidelity in the document being printed, in the sense that the information being passed to the printer is incomplete in some manner, which may be acceptable depending on the application. The document that is printed may not look as good as the original, but it may be acceptable to the user.

134] Compressing the data meant using one of numerous available methods. It appears that one of the methods the Appellant tried was to create a JPEG image. The JPEG image would have all the text that needed to be transferred but in a compressed format.

135] He noted that the Appellant tried to develop a transparent compression method. This meant that that the Appellant was trying to compress and then decompress the data without the intervening software being aware that this was happening.

It had to develop software to "dig" into different places in the Bluetooth stack to try to inject compression in a way that would avoid the 64 KB buffer overrun.

Results:

- Maximum buffer use: 62 K (101% of goal)
- Fidelity (relevant info retained): 83 % (170% of goal)

136] Neither of these methods proved to be successful. However, the Appellant was able to overcome the problem by developing a throttling mechanism. A throttling mechanism is a way to control the speed at which the data is being pushed through the system. Mr. Rupel noted that, through experimenting, the Appellant was able to find an optimum speed that allowed the Bluetooth printer to clear out its buffer fast enough that it would never overrun the buffer.

Conclusion:

138] Doctor Penn concluded that the work performed by the Appellant with respect to TA1/TO1 of 2010 Project 1 was experimental development and applied research.

140] His actual conclusions were as follows:
The application of throttling and compression can only be achieved by setting certain quantitative parameters that are inherent in these techniques, such as lengths of time and targetted transfer rates or percentages of compression.

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While setting or optimizing the settings of these parameters for a fixed pair of devices could be considered routine in different circumstances, this project dealt with interoperability across a range of mobile devices that were not manufactured by Allegro.

I know of no readily assessable knowledge base, now or in 2010, with which Allegro's engineers could have set these parameters merely through due diligence. This was a painstaking, experimental diversion from ordinary software development activities that no reasonable software engineer would call routine.

141] (Judge then stated) Doctor Penn's opinion is an example of the importance of knowing the technological environment that the Appellant faced when conducting experiments in an attempt to improve its products.

Significant variables addressed: "lossy-type scenario" (less data), buffer overrun - speed vs. clearing, proprietary systems - blackbox issues, throttling - time vs. rate vs. % compression, transparent compression methods

Documentation:

- Offline Documents: docs