Project Name:	Allegro Wireless (WINS - 3/3 projects telcom)	**Start Date:**	2022-02-01
Project Number:	2200	**Completion Date:**	2024-02-08

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Throttling mechanism (KB)	500	64	No
Concurrency (users)	200	1000	No
supported hand held devices (number)	450	500	No
supported printers (number)	250	300	No

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

FACTS:

50] During the relevant years, the Appellant filed claims in respect of SR&ED performed on five separate projects.

1] The Appellant filed appeals in respect of three projects carried out in 2010 and the remaining project carried out in 2011.

2] The CRA accepted portions of 2010 Project 1 and Project 2 as SR&ED.

3] For 2010, the Appellant claimed SR&ED “ITCs” of $279,420 in respect of three projects.

The Minister disallowed $244,208 (87%) of the corresponding ITCs in respect of two projects.

4] For 2011 Taxation Year, the Appellant claimed SR&ED ITCs of $215,567.

The Minister disallowed $162,190 (75%) of the corresponding ITCs.

[101] the Appellant’s core product was its platform (software), which it built and constantly improved to accommodate the different idiosyncrasies of various hand-held devices, servers and printers.

Mr. Rupel (the Principal Investigator) testified that the Appellant was trying to develop products that would address issues that arose when dealing with the interactions of numerous complex systems.

At the time, its clients were using numerous hand-held devices and printers that were in the early stages of development.

It also had to design systems that operated with the various servers of its clients and recognize the different environments that each of its clients operated in.

Field of Science/Technology:

Telecommunications (2.02.07)

Project Details:

Intended Results:	Develop new processes, 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:	Test protocols, test data, analysis of test results, conclusions; Records of resources allocated to the project, time sheets; Design, system architecture and source code; Project planning documents; Design of experiments; Records of trial runs

Scientific or Technological Advancement:

Uncertainty #1: Bug vs. Quirk vs. SR&ED

[28] The Appellant's core product was its platform (software), which it built to accommodate the different idiosyncrasies of the various hand-held devices used by its clients. The platform had to take into account the different operating systems and the frequent updates to the software controlling the low-level features of the devices. The Appellant's goal was to have one system that all the different applications used in the operation of the devices could be written to.

31] He noted that the Appellant did not have access to the source codes for the various underlying software that operated the hand-held devices. He referred to this software as a black box, something the Appellant could not see the "insides of". He noted that as the Appellant developed its various products, various bugs and quirks occurred.

BUGS:

32] Bugs arose when the underlying tools and software performed as expected and the Appellant made a mistake when writing its software, which it needed to fix.

QUIRKS:

33] Quirks arose when, after looking at the problem, the Appellant could not determine why the event was occurring. It did not make sense to the Appellant. In Mr. Rupel's words, there was something mysterious going on and it required a deeper investigation.

34] Mr. Rupel noted that a quirk may or may not end up on the Appellant's SR&ED claim.

The Appellant made the decision later, after it finished its investigation and hopefully found a solution to the quirk.

It would review the work it had done and determine whether it had conducted a significant amount of experimentation or whether the issue had been relatively straightforward and resolved in a direct manner.

In the latter instance, the work was not included in the Appellant's SR&ED claim.

The most significant underlying key variables are:

Bug vs Quirk, If Quirk - whether SR&ED?

Technology or Knowledge Base Level:

Activity #1-1: CRA approved doc system (Fiscal Year 2022)

Methods of experimentation:

DOCUMENTATION:

46] The Appellant also used bug/quirk tracking software: one called FogBugz and a second called Jira X. This allowed the Appellant to keep track of all bugs/quirks that were reported, when the bug/quirk was fixed and when a quality assurance team reviewed the fix.

47] With respect to determining when the work preformed with respect to quirks constituted SR&ED,

the Appellant, with the help of its Canada Revenue Agency ("CRA") SR&ED technical advisor, Mr. Paul Wong, had set up a system in the bugs/quirks tracking software (particularly Jira X).

This system allowed the Appellant to keep track of the problems it identified as quirks, the things that were not working the way the Appellant expected them to work. When the Appellant's developers were attempting to find a solution to a quirk, they would place information in the bug tracking software with respect to the work they were performing in an attempt to fix the identified quirk.

Results:

Conclusion:

208] On the basis of the evidence just discussed, I have concluded that when the Appellant conducted the projects at issue, it formulated hypotheses specifically aimed at reducing the identified technological uncertainty, followed appropriate procedures on testing, including the formulation, testing, and modification of hypotheses, and maintained a detailed record of

the hypotheses tested and results achieved as the work progressed.

209] For these reasons, the work performed by the Appellant on the projects identified by the CRA as

TA1/TO1 of 2010 Project 1 (SAMPLE PROJECT 2201, ACTIVITY #1),

TA1/TO1 of 2010 Project 2 (SAMPLE PROJECT 2202),

TA3/TO3 of 2010 Project 1 (SAMPLE PROJECT 2201, ACTIVITY #2) and

TA1/TO1 of 2011 Project 1 (SAMPLE PROJECT 2203)

constitutes SR&ED for purposes of the Income Tax Act.

The appeals from reassessments under the Income Tax Act with respect to the Appellant's 2010 and 2011 taxation years are allowed, with costs.

THE SPECIFIC DETAILS FOR EACH OF THESE PROJECTS IS PROVIDED IN PROJECTS 2201 THROUGH 2203.

Significant variables addressed: Bug vs Quirk, If Quirk - whether SR&ED?

Documentation:
- Offline Documents: Docs

Uncertainty #2: Backgrounds of Witnesses

During the six days of hearings, the Appellant (Allegro) called three fact witnesses, Mr. Wesley Rupel, Mr. Khalid Eidoo, and Mr. Russell Roberts, and one expert witness, Doctor Gerald Penn.

PRINCIPAL INVESTIGATOR (PI)

8] Mr. Rupel described the Appellant's business and the various research projects. During the relevant period, Mr. Rupel and his business partner controlled the Appellant.

9] Mr. Rupel holds an undergraduate degree in physics and mathematics. In 1981, he started a combined Masters and Ph.D. program in physics at the University of California, Santa Barbara. He completed the Masters portion of the program, however in 1985, while his professor was on sabbatical, he took a break from the program and joined Dynamical Systems Research ("Dynamical"), a software start- up company located in Berkeley, California.

10] A year later Microsoft acquired Dynamical. The acquisition allowed Microsoft access to Dynamical's software, which it used when creating the Windows operating system.

11] Mr. Rupel's work at Microsoft focused on increasing the speed of the Windows operating system, which was a significant issue since the first version of the operating system was extremely slow.

12] Mr. Rupel left Microsoft in 1992 and, in his own words, basically retired. He returned to Microsoft in 1998. He joined the Appellant in 2002 and became President and Chief Technology officer in 2004.

The Respondent (CRA) called one fact witness, Ms. Cathy Sporich, and two expert witnesses, Doctor Shrinavensen Keshav and Doctor Shirook Ali. I found all four fact witnesses to be credible.

EXPERT WITNESSES:

67] The test for admissibility of expert opinion evidence is a two-step test as set out by the Supreme Court of Canada in White Burgess Langille Inman v. Abbott and Haliburton Co., 2015 SCC 23 ("Inman"). Inman confirms and clarifies the common law principles previously described by the Supreme Court of Canada in R. v. Mohan, [1994] 2 SCR 9 ("Mohan").

68] The first step of the test requires the party putting the proposed expert forward to establish that the evidence satisfies the following four threshold requirements (the so-called Mohan factors):
- Relevance;
- Necessity in assisting the trier of fact;
- The absence of any exclusionary rule; and
- A properly qualified expert.

69] The second step requires the trial judge to conduct a cost-benefit analysis to determine if otherwise admissible expert

evidence should be excluded because its probative value is overborne by its prejudicial effect. This requires the trial judge to consider such things as consumption of time, prejudice and the risk of causing confusion.

The judge only relied on the expert evidence of Doctor Penn.

The most significant underlying key variables are:

Relevance, Necessity, Proper qualification, Cost vs. benefit, Exclusionary rules (unresolved)

Technology or Knowledge Base Level:

Activity #2-1: Roles of Expert witnesses (Fiscal Year 2022)

Methods of experimentation:

5] During the six days of hearings, the Appellant called three fact witnesses, Mr. Wesley Rupel, Mr. Khalid Eidoo, and Mr. Russell Roberts, and one expert witness, Doctor Gerald Penn.

The Respondent called one fact witness, Ms. Cathy Sporich, and two expert witnesses, Doctor Shrinavensen Keshav and Doctor Shirook Ali.

JUDGE COMMENTS:

[99] After reading each of the export reports and hearing from the two experts, ... neither of the two experts called by the Respondent (CRA) had a sufficient understanding of the Appellant's business, products or procedures that would allow them to give opinions that would help the Court.

Both Mr. Rupel and Doctor Penn testified that the difficult technological environment that the Appellant was attempting to operate in caused the various technological issues encountered by the Appellant.

Results:

6] I found all four fact witnesses to be credible. For reasons I will discuss, I have only relied on the expert evidence of Doctor Penn.

Conclusion:

JUDGE CONCLUDED:

[120] The Appellant was attempting to develop a new product (its platform) that would work seamlessly with a multitude of devices using different operating systems and operating on various client operating systems.

Neither Doctor Ali nor Doctor Keshav was aware of this difficult environment. As a result of this weak factual foundation, especially when compared to Doctor Penn's factual foundation for his opinion, I have given no weight to the expert reports of Doctor Ali and Doctor Keshav.

The only expert report that I have placed any reliance on is the expert report of Doctor Penn.

Significant variables addressed: Cost vs. benefit, Necessity, Proper qualification, Relevance

2200 - Allegro Wireless (WINS - 3/3 projects telcom)		
BENCHMARKS	**ACTIVITIES BY YEAR**	
	2022	
	'1-1	'2-1
(none)	CRA approved doc system	Roles of Expert witnesses
OBJECTIVES	**RESULTS**	
Throttling mechanism: 64 KB Concurrency : 1000 users supported hand held devices: 500 number supported printers: 300 number		
UNCERTAINTIES & KEY VARIABLES	**CONCLUSIONS**	
1 - Bug vs. Quirk vs. SR&ED		
Bug vs Quirk	Y	
If Quirk - whether SR&ED?	Y	
2 - Backgrounds of Witnesses		
Cost vs. benefit		Y
Exclusionary rules		
Necessity		Y
Proper qualification		Y
Relevance		Y
	METHODS	
Analysis Trials Prototypes Lines of code		
	COSTS	
Hours Materials $ Subcontractor $		

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.

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

Activity #1-2: year 2 + ineligible activity (Fiscal Year 2023)

This Activity is addressed in Fiscal Year 2023.

2201 - Allegro - Protocol Compliant Methods to Extend Bluetooth Functionality	
BENCHMARKS	**ACTIVITIES BY YEAR**
Internet searches: 10 Articles	
Patent searches: 5 patents	
Competitive products or processes: 2 products	2022
Similar prior in-house technologies: 3 products / processes	'1-1
Queries to experts: 2 responses	year 1
OBJECTIVES	**RESULTS**
Maximum buffer use: 64 K	62
Fidelity (relevant info retained): 90 %	83
UNCERTAINTIES & KEY VARIABLES	**CONCLUSIONS**
1 - Technological uncertainty	
“lossy-type scenario” (less data)	Y
buffer overrun - speed vs. clearing	Y
proprietary systems - blackbox issues	Y
throttling - time vs. rate vs. % compression	Y
transparent compression methods	Y
	METHODS
Analysis	14
Trials	6400
Prototypes	
Lines of code	
	COSTS
Hours	650
Materials $	
Subcontractor $	

Project Name:	Allegro - Optimize TCP Services over Cellular Networks	**Start Date:**	2022-02-01
Project Number:	2202	**Completion Date:**	2022-11-30

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Scalability (%)	(not set)	(not set)	No
Throughput (MB)	(not set)	(not set)	No
Reduce TCP timeouts (number)	(not set)	(not set)	No
Reduced data vs TCP (%)	60	55	Yes
supported devices (number)	500	500	Yes
Minimum timeout (minutes)	5	1	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.

TA1/TO1 of 2010 Project 2

142] As discussed previously, the CRA split the 2010 Project 2 into three components. Mr. Rupel explained to the Court a number of general terms/concepts that applied to the entire 2010 Project 2.

143] The technological objective of 2010 Project 2 was to:

. . . develop methods and techniques to improve the scalability and throughput of TCP (Transmission Control Protocol) services transmitted over IP (Internet Protocol) on cellular networks. In particular, the objective was to develop methods to enable more efficient streaming of digital audio, connection-handling mechanisms to translate UDP to TCP and reduce the overhead related to TCP timeouts.3

144] Mr. Rupel explained to the Court the meaning of UDP and TCP. He also explained what is meant by a load balancer, session control and caching.

145] He noted that TCP is a protocol for internet communication. TCP is built on top of the internet protocol and provides a reliable way for the vast majority of things on the internet to communicate.

146] UDP is another protocol that is also built on top of the internet protocol, similar to TCP. UDP is a very lightweight protocol when compared to TCP, but TCP does a number of things that are not done by UDP.

147] Mr. Rupel explained that when a large amount of data is being sent over the internet, it gets broken down into pieces (packets) and each packet is sent separately through the internet protocol.

148] He noted that the advantages of TCP include the fact that it guarantees that the packet of information sent over the internet actually arrives at its destination. If the packet does not show up at the destination, TCP sends a notice to the sender of the information identifying which packet did not arrive. It also has a feature that ensures that packets of data, once received, are placed in the correct order.

149] UDP does not have these features but since it does not have as much “overhead” it can be faster than TCP. The Appellant created a UDP protocol that allowed its clients to reduce their data usage on the wireless cellular networks, which significantly reduced the clients’ costs. Mr. Rupel emphasized that at the time the cost of bandwidth on cellular networks was very expensive.

150] When the Appellant created the UDP protocol, it worked very well, however at some point problems developed. It determined that the problems were being caused by the interaction between its UDP protocol and new firewalls that were being installed by its clients.

151] Another problem related to load balancers. Clients that had a large amount of traffic on their networks and multiple servers used these load balancers. The purpose of the load balancers was to balance the usage of each of the servers.

152] The Appellant encountered problems with the interaction of load balancers and session control. Session control refers to managing sessions between a server and a specific user (referred to as a client). Instead of the client having to send all of the same information repeatedly to the server, the server stores some of the information until the session is completed. This is referred to as caching. A problem arose when load balancers caused portions of the information transferred to be stored on different servers.

153] Because of these issues, the Appellant was required to abandon its UDP protocol. It then worked to develop a TCP

protocol that would work better than its UDP protocol and still reduce the client's data usage.

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:	Test protocols, test data, analysis of test results, conclusions; Design, system architecture and source code; Design of experiments; Records of trial runs

Scientific or Technological Advancement:

Uncertainty #1: Byte array pool

154] Mr. Rupel discussed the portion of 2010 Project 2 identified by the CRA as TA1/TO1.

155] The Appellant's CRA filing described the technological advancement that the Appellant was trying to achieve with respect to the TA1/TO1 portion of the 2010 Project 2 as follows,

"the implementation of a non-disposable byte array pool

into which digital audio was compressed for transmission

completely eliminating audio breakup caused by buffer under runs

(the under runs were in turn caused by insufficient packet throughput)."

156] When switching from a UDP protocol to a TCP protocol the Appellant encountered a problem with audio files.

They were not being sent fast enough and only a portion of the audio file could be played when first accessed by the recipient of the audio files.

The most significant underlying key variables are:

causes low package througput (unresolved), unsafe attributes checking vs speed, parameters relevant to digital audio transmission, eliminating buffer under runs

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Internet searches	20 Articles	Client searches did not yield any existing library of required info.

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

Methods of experimentation:

Method	Experimentation Performed
Analysis / simulation:	3 alternatives
Trials:	14000 runs / samples

156] When switching from a UDP protocol to a TCP protocol the Appellant encountered a problem with audio files. They were

not being sent fast enough and only a portion of the audio file could be played when first accessed by the recipient of the audio files.

157] The Appellant began experimenting with different ways to compress the audio files. At first, the methods it tried were not successful.

158] It then began experimenting with what is known as unsafe attributes. Mr. Rupel explained that the software language that the Appellant was using had a managed environment. Basically, it ensured that the various source code being used operated properly. However, the code used to do this slowed things down.

159] The Appellant tried writing so-called unsafe attributes by adding code that was not going to be managed. Mr. Rupel described the effect of unsafe attributes as follows:
. . . You don't have a safety net underneath you anymore, you're walking across the tightrope hoping that you don't have any bugs at that point because if you do it's not going to catch them, it's not going to prevent you from hurting yourself.5

160] He noted, however, that it resulted in less overhead, which meant that the Appellant could hopefully push data through quickly enough to solve the problem.

Results:

- Reduced data vs TCP: 52 % (160% of goal)
- supported devices: 500 number (100% of goal)
- Minimum timeout : 2 minutes (75% of goal)

161] The use of unsafe attributes did not work. The ultimate solution involved going back into the so-called managed world and using a hybrid solution where the Appellant was "doing things that [were] a little bit unsafe but not particularly unsafe."

162] Mr. Rupel provided a detailed technical description of the solution. It involved reusing certain of the objects that had been transferred. This saved enough overhead that the Appellant was able to solve the problem with the audio files. The solution worked for whatever audio was sent and on the approximately 500 different devices it encountered.

Conclusion:

165] In his expert report, he (Dr. Penn) stated the following:

. . . Programming with audio is a very niche expertise that most software engineers lack. This observation, combined with the increasing demand for smartphones over the last seven years, has led to a commodification of audio processing hardware and audio processing APIs within the mobile device industry that has greatly consolidated during the interval.

In 2010, however, there was still a considerable variance among handheld mobile devices in the range of supported audio formats, audio codecs, available audio transfer rates and supported functionality for audio in vendor-supplied APIs.

In the present component, these audio-specific parameters were underlying technological uncertainties in an ecology of foreign devices that Allegro's platform developers would have had to adapt their product to. ...characterizing the distribution of parameters relevant to digital audio transmission in 2010,

Significant variables addressed: eliminating buffer under runs, parameters relevant to digital audio transmission, unsafe attributes checking vs speed

Documentation:

- Offline Documents: docs

Uncertainty #2: Synchronous event wrapper

TA3/TO3 of 2010 Project 2
166] The Appellant's CRA filing described the technological advancement that it was trying to achieve with respect to the TA3/TO3 portion of 2010 Project 2 as follows: "The development of an [sic] synchronous event wrapper capable of timing out a process quickly, eliminating an average wait of 5-8 minutes for a TCP timeout from a mobile device".10

167] Mr. Rupel explained what a synchronous event was by distinguishing between a synchronous event and an asynchronous event.

A synchronous event occurs when, in the course of communication, the system sends a request for information and then waits until it receives the answer.

An asynchronous occurs when the systems sends a request for information and then does other things while another part of

the system waits for the answer.

168] Mr. Rupel noted that with a synchronous event the whole system is waiting for the response and with an asynchronous event it is not waiting for the response. The synchronous method is used when the system cannot move forward in the logic of the program until the system receives an answer.

169] The problem the Appellant faced was that Microsoft had built a five-to-eight- minute timeout into its software that controlled the low-level features of the hand- held devices. The Appellant had no control over this timeout. Problems occurred in the TCP communication when a request was going out for information and no information was coming back. The Microsoft software would then take at least five to eight minutes to reset. This was a problem for the Appellant, which was trying to make devices that worked in real time, i.e., were always connected to the network.

170] Mr. Rupel described the problem as a software problem that occurred because Microsoft developed the software using protocols from a wired network and the devices were now being used on a wireless network.

He noted that the designers of the software never envisaged a situation where the device would be connected but could not send data, but this is a common occurrence for a device on a wireless network. An example of this type of situation is when a device is taken into a parking garage with poor reception.

171] While it was a design feature of the Microsoft software, the Appellant had to fix the problem without access to the code used by Microsoft, while operating in a very complex system.

The most significant underlying key variables are:

sync vs async events, redesign legacy hardwire code for wireless, firewall and deep packet inspection, packet loopback process, parallel session process

Technology or Knowledge Base Level:

Activity #2-1: Supporting Activity (Fiscal Year 2022)

Methods of experimentation:

172] Mr. Rupel described three methods that the Appellant tested in an attempt to solve the problem.

173] The first method involved using a firewall and deep packet inspection to terminate long-running connections that were waiting for a response. The Appellant was trying to deal with the situation where the software would tell it that it was connected, but there was actually a problem and the device was not communicating.

174] He explained that deep packet inspection meant that the Appellant was “peeking” into places that it would not normally be expected to go, namely the network buffers where the information was coming in through the TCP network.

175] Since the firewalls monitored the system traffic and knew exactly what was passing through the network, the firewall could be used to find information on what was going through the network.

176] Testing using the deep packet inspection and firewalls did not lead to a solution to its problem.

177] The second method it tried involved experimenting with a loopback process which involved sending a packet out through the networking layers with instructions that the place it should go is back to the point where it originated.

178] It hoped to avoid the five-to-eight-minute timeout problem by killing the network session, which, theoretically, would cause everything to immediately reset.

The problem it encountered was that it was only able to kill one side of the session (such as the device side) but was not able to kill the session on the other side (the server side). This left the system in what Mr. Rupel referred to as an inconsistent state, which caused a problem.

Results:

179] The problem was resolved by developing a two-pronged mechanism to eliminate the issue. Mr. Rupel described the process as follows:

. . . by creating another process we created a parallel situation where we could start a new session for -- the original session, which is where everything is still happening, all the important stuff is still going on there, but we create this other process that then creates a new session with the server, and then we have to basically keep track of what's happening over there but we can use that channel then to do our communication until that five-to-eight-minute timeout finally times out.

And so we have sort of a temporary communication channel that we set up during the period of time that the five-to-eight-minute window is blocking us.

Conclusion:

Doctor Penn's Opinion - SUPPORTING ACTIVITY VS. SEPARATE PROJECT

181] Doctor Penn does not believe that TA3/TO3 of 2010 Project 2 by itself constituted experimental development or research. However, he believes that TA3/TO3 supported the other parts of 2010 Project 2, which he believes constituted experimental development or research.

In effect the part of 2010 Project 2 that the CRA identified as TO3/TA3 supported the other portions of 2010 Project 2 in such a way that it contributed to the overall aims of an experimental development project.

He questioned whether it made sense for the CRA (or anyone) to split the Appellant's 2010 Project 2 into three components.

182] He stated the following in his expert report:
. . . This project's [2010 Project 2] description proposes one overarching technological advancement: a TCP-based application protocol that surpasses UDP in throughput and scalability. Whether or not this could be achieved was a technological uncertainty.

To achieve that advancement, there are certain design features of TCP that are inconsistent with its use in this application protocol. One of those, TO3, is the long timeout delays that are typically built into TCP stacks.

It is a defect of the subproject terminology, "TA3/TO3", that it implies such a limited scope of work as to preclude the identification of a TA or TU for just this one component. This component shares in the technological advancements and uncertainties of the project to which it contributes. . .

. . . I am unable to reasonably ascertain that a systematic investigation was conducted as part of this component's work on the basis of the documents and interviews available to me. I am, on the other hand, reasonably certain that Project 2 as a whole did consist of research and experimental development alongside some inevitable routine development that took place in support of the project's overall research programme. I also find it reasonably probable that the work described in TA3/TO3 and the associated technical content by itself was sufficiently novel to serve as the basis for a standardized extension to the TCP protocol for low-latency communication on unreliable networks. What is unclear to me is whether the realization of TA3/TO3's research potential in fact took place.

Significant variables addressed: firewall and deep packet inspection, packet loopback process, parallel session process, redesign legacy hardwire code for wireless, sync vs async events

2202 - Allegro - Optimize TCP Services over Cellular Networks		
BENCHMARKS	**ACTIVITIES BY YEAR**	
	2022	
	'1-1	'2-1
Internet searches: 20 Articles	Activity 1	Supporting Activity
OBJECTIVES	**RESULTS**	
Scalability: %		
Throughput: MB		
Reduce TCP timeouts: number		
Reduced data vs TCP: 55 %	52	
supported devices: 500 number	500	
Minimum timeout : 1 minutes	2	
UNCERTAINTIES & KEY VARIABLES	**CONCLUSIONS**	
1 - Byte array pool		
causes low package througput		
eliminating buffer under runs	Y	
parameters relevant to digital audio transmission	Y	
unsafe attributes checking vs speed	Y	
2 - Synchronous event wrapper		
firewall and deep packet inspection		Y
packet loopback process		Y
parallel session process		Y
redesign legacy hardwire code for wireless		Y
sync vs async events		Y
	METHODS	
Analysis	3	
Trials	14000	
Prototypes		
Lines of code		
	COSTS	
Hours	500	550
Materials $		
Subcontractor $		

Project Name:	Allegro - Multi-point Integration Platform for Mobile Applications	**Start Date:**	2022-04-12
Project Number:	2203	**Completion Date:**	2022-12-30

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
distributed transaction timeout (1= yes/ 0 = no)	0	1	Yes
intelligent packet routing (yes = 1 / no = 0)	0	1	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.

58] Only the portion of 2011 Project 1 identified by the CRA as TA1/TO1 is before the Court. The CRA accepted that the portion it identified as TA2/TO2 qualified as SR&ED. The Appellant conceded during the hearing that the portion of 2011 Project 1 identified as TA3/TO3 did not constitute SR&ED.

TA1/TO1 of 2011 Project 1

183] The Appellant described the technological advancements it was trying to achieve for all of Project 3 as follows:

184] The technological objective of this project was to develop an integration platform for mobile devices that enables dynamic multiple endpoints.

Specifically, the objective was to develop methods to enable mobile data packets to be intelligently routed to different applications without the need for setting up specific end points or messaging agents for each integration point.

185] With respect to TA1/TO1 of Project 3, the Appellant hoped to achieve a technological advancement by developing a connection timeout mechanism for distributed transactions initiated by a mobile device.

Field of Science/Technology:

Communication engineering and systems (2.02.06)

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:	Test protocols, test data, analysis of test results, conclusions; Records of resources allocated to the project, time sheets; Design, system architecture and source code; Records of trial runs

Scientific or Technological Advancement:

Uncertainty #1: necessary wait times

185] The technological obstacle the Appellant faced was related to mobile transaction timeouts. The Appellant noted that the main purpose of its system was to provide data to client devices such as mobile devices. This required data to be sent across high-latency cellular networks. Because of the latency of cellular networks, it is not easy to determine whether a connection has timed out.

186] Mr. Rupel noted that people confuse bandwidth with latency. Latency is another aspect of speed or timing. He noted that information may pass through a system at a high speed (high bandwidth) and still be delayed in arriving at its destination (high latency).

187] He explained that cellular networks are high latency when compared with wire networks.

In a cellular network,

"there's a lot more handshaking that has to go on with decoding what's in the radio waves and the layers of technology that has to filter through in order to just get where you're going with it that initial delay is worse on a wireless network, especially on a cellular network."

188] The timeout was the same as in 2010 Project 2, but the timeout in 2011 Project 1 caused a different problem.

Mr. Rupel explained that the Appellant's system bundled up business logic messages and sent it through the system. As discussed previously, the messages are broken up into pieces and sent through in little packets, which are reconstructed on the other side.

The process has what is referred to as a queuing mechanism. The Appellant's software handles what is in the queue to feed the information through the underlying black box and then reconstruct it on the other side. The timeouts were causing problems in the fidelity of the Appellant's queuing process.

189] For example, the timeout may cause the system to reset. Once it resets it feeds all the information sitting in the queue into the system at such a fast rate that it overwhelms the device.

The most significant underlying key variables are:

filtering methods vs. latency vs. ..., timeout length vs. queuing mechanisms

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Internet searches	10 Articles	Client could not find any libraries of necessary wait times for the proposed application.

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

Methods of experimentation:

Method	Experimentation Performed
Trials:	1400 runs / samples

190] As a result, the Appellant had to conduct tests on application timeouts to determine the optimal timing.

Mr. Rupel noted that there are a lot of trade-offs in the timing in that if you make it too short, you have one set of problems, if you make it too long, you have another set of problems.

It was trying to find the "sweet spot", complicated by the fact that it was working with black boxes and had no way to know if the individual problems that occurred on one extreme or the other were going to become unacceptable from a business standpoint.

Results:

- distributed transaction timeout: 1 1= yes/ 0 = no (100% of goal)
- intelligent packet routing: 1 yes = 1 / no = 0 (100% of goal)

Conclusion:

191] He (Dr. Penn) provided the following opinion in his written report:

. . . the development of a mechanism that waits a specified period of time before resetting a network connection is standard practice, and the experimentation required to set the wait time often involves only a trivial amount of experimentation. . . . however,

knowing how long to wait when developing a product within an ecology of foreign devices and on multiple cellular networks is not routine.

Allegro were building just such a knowledge base

[knowledge of necessary wait times]

that would have been of value to members of the broader community of mobile software developers, including those who had never intended to purchase Allegro's products. This was the result of applied research.

Significant variables addressed: filtering methods vs. latency vs. ..., timeout length vs. queuing mechanisms

Documentation:

- Offline Documents: docs

2203 - Allegro - Multi-point Integration Platform for Mobile Applications	
BENCHMARKS	**ACTIVITIES BY YEAR**
	2022
	'1-1
Internet searches: 10 Articles	Activity 1
OBJECTIVES	**RESULTS**
distributed transaction timeout: 1 1= yes/ 0 = no	1
intelligent packet routing: 1 yes = 1 / no = 0	1
UNCERTAINTIES & KEY VARIABLES	**CONCLUSIONS**
1 - necessary wait times	
filtering methods vs. latency vs. ...	Y
timeout length vs. queuing mechanisms	Y
	METHODS
Analysis	
Trials	1400
Prototypes	
Lines of code	
	COSTS
Hours	820
Materials $	
Subcontractor $	