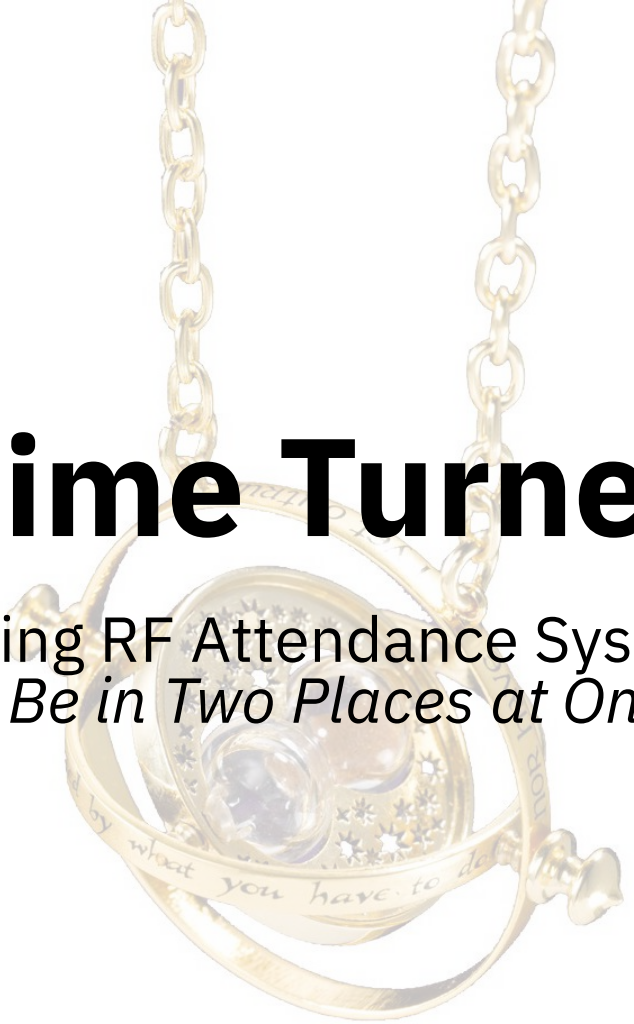


Time Turner

Hacking RF Attendance Systems
(*To Be in Two Places at Once*)

☑ 1) ORIENTATION AND PROFESSIONAL DEVELOPMENT

FA18	ENG 100 CS8	0.0	S
FA19	ECE 316 E2	3.0	A+

☑ 2) CORE MATHEMATICS COURSES

FA18	MATH 220 1	4.0	PS
FA18	MATH 241 CL2	4.0	A-
GS19	MATH 415 M16	3.0	A
GS20	MATH 231 AD2	3.0	A

☑ 3) PHYSICS SEQUENCE

SP20	PHYS 212 A11	4.0	A+
FA20	PHYS 211 A2	4.0	A+

☑ 4) SCIENCE ELECTIVE
(COURSE LIST ON DEPARTMENT WEBSITE)

FA18	FSHN 120 A	3.0	A

✖ 5) COMPUTER SCIENCE REQUIREMENTS

NEEDS: 2 COURSES

SELECT FROM: CS 374, CS 421

1) ORIENTATION AND PROFESSIONAL DEVELOPMENT

FA18	ENG 100 CS8	0.0	S
FA19	ECE 316 E2	3.0	A+

2) CORE MATHEMATICS COURSES

FA18	MATH 220 1	4.0	PS
FA18	MATH 241 CL2	4.0	A-
GS19	MATH 415 M16	3.0	A
GS20	MATH 231 AD2	3.0	A

3) PHYSICS SEQUENCE

SP20	PHYS 212 A11	4.0	A+
FA20	PHYS 211 A2	4.0	A+

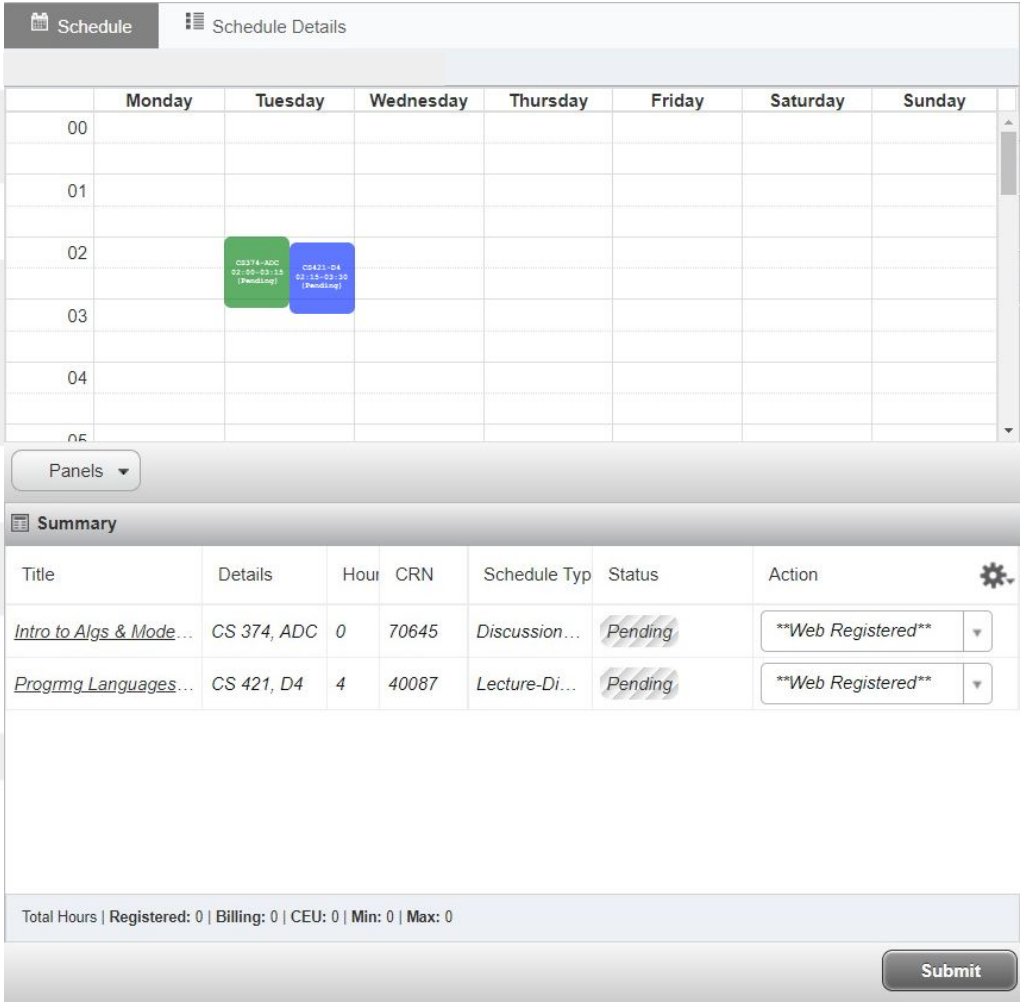
4) SCIENCE ELECTIVE
(COURSE LIST ON DEPARTMENT WEBSITE)

FA18	FSHN 120 A	3.0	A

5) COMPUTER SCIENCE REQUIREMENTS

NEEDS: 2 COURSES

SELECT FROM: CS 374, CS 421



1) ORIENTATION AND PROFESSIONAL DEVELOPMENT

FA18	ENG 100 CS8	0.0	S
FA19	ECE 316 E2	3.0	A+

2) CORE MATHEMATICS COURSES

FA18	MATH 220 1	4.0	PS
FA18	MATH 241 CL2	4.0	A-
GS19	MATH 415 M16	3.0	A
GS20	MATH 231 AD2	3.0	A

3) PHYSICS SEQUENCE

SP20	PHYS 212 A11	4.0	A+
FA20	PHYS 211 A2	4.0	A+

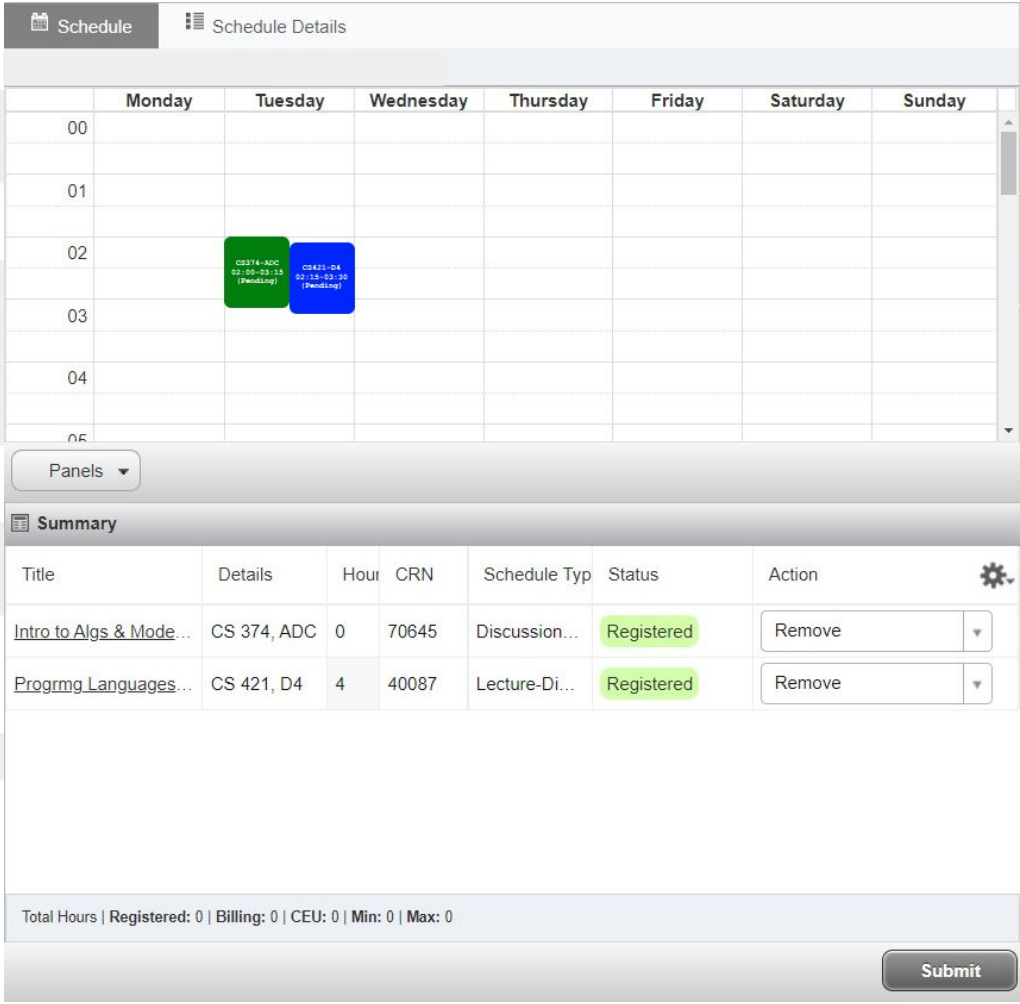
4) SCIENCE ELECTIVE
(COURSE LIST ON DEPARTMENT WEBSITE)

FA18	FSHN 120 A	3.0	A

5) COMPUTER SCIENCE REQUIREMENTS

NEEDS: 2 COURSES

SELECT FROM: CS 374, CS 421



1) ORIENTATION AND PROFESSIONAL DEVELOPMENT

FA18	ENG 100 CS8	0.0	S
FA19	ECE 316 E2	3.0	A+

2) CORE MATHEMATICS COURSES

FA18	MATH 220 1	4.0	PS
FA18	MATH 241 CL2	4.0	A-
GS19	MATH 415 M16	3.0	A
GS20	MATH 231 AD2	3.0	A

3) PHYSICS SEQUENCE

SP20	PHYS 212 A11	4.0	A+
FA20	PHYS 211 A2	4.0	A+

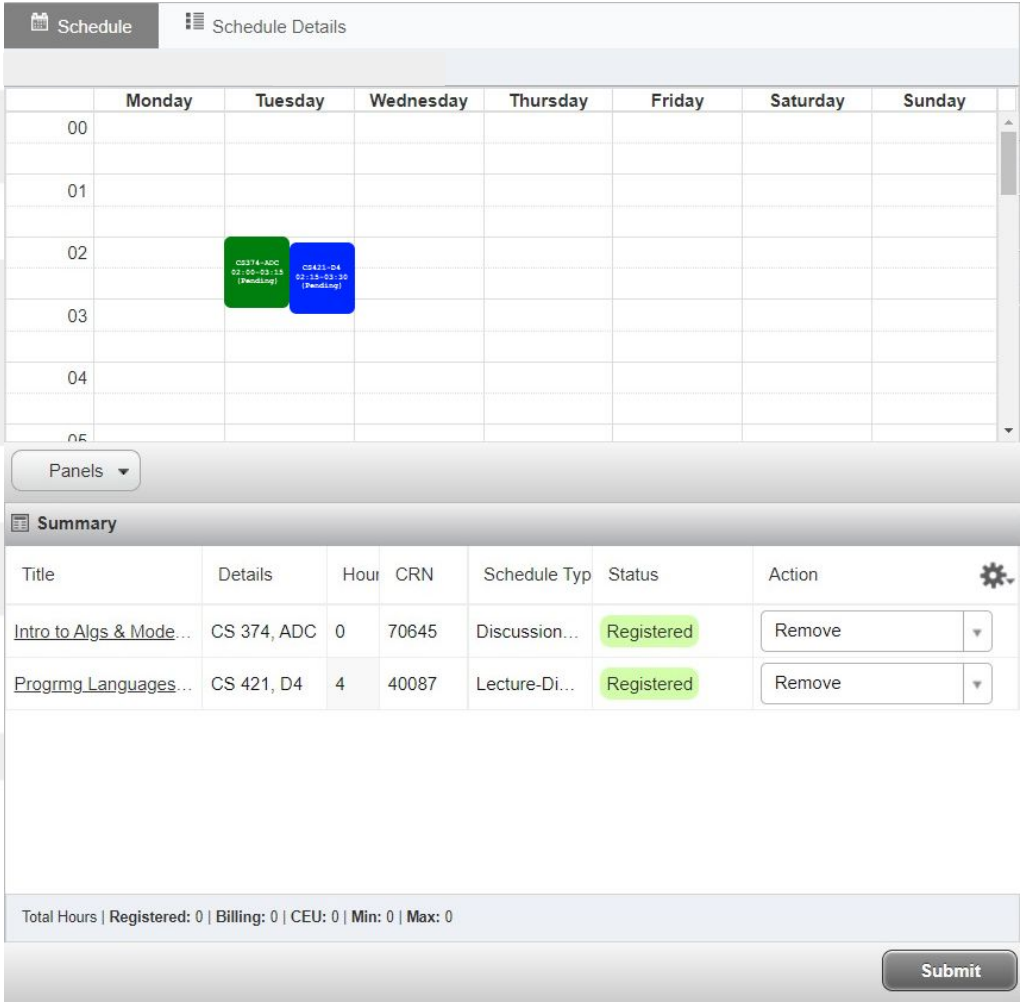
4) SCIENCE ELECTIVE
(COURSE LIST ON DEPARTMENT WEBSITE)

FA18	FSHN 120 A	3.0	A

5) COMPUTER SCIENCE REQUIREMENTS

NEEDS: 2 COURSES

SELECT FROM: CS 374, CS 421



Grading

Warmups - 5%

Midterm Project - 40%

Final Project - 30%

Attendance - 15%

Quizzes - 10%

Grading

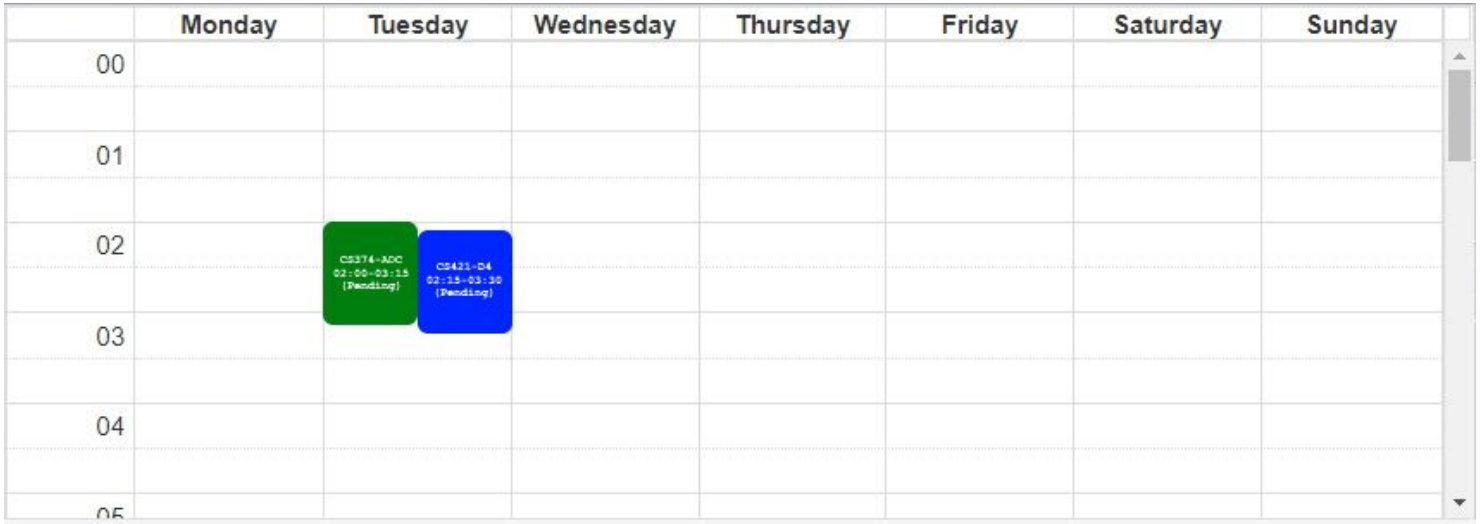
10% Class attendance

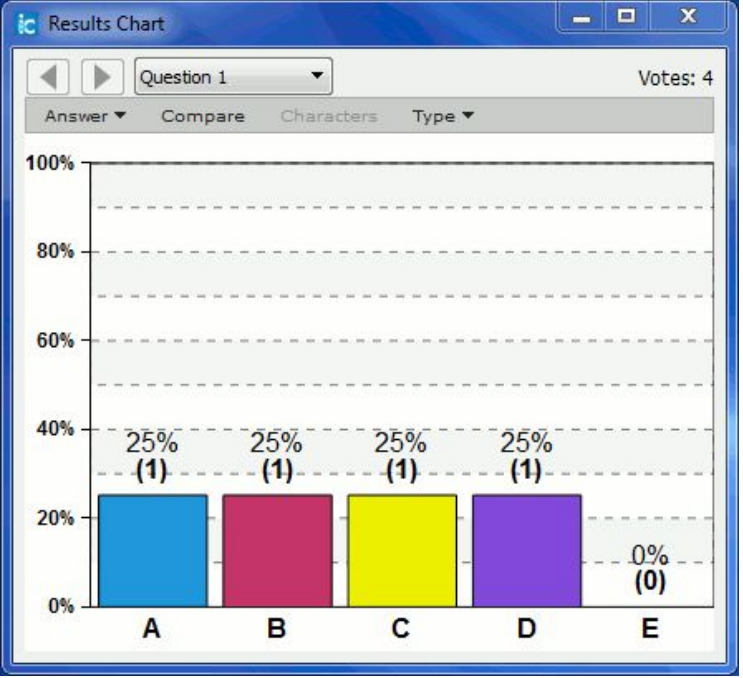
40% Homework

50% Project (35% presentation + 15% final report)

*	Other	Grade does not count toward the student's GPA or earned hours.
ABS	Absent	More than six total unexcused absences or absent from the final exam without an acceptable excuse counts as a failure not acceptable for degree credit).
AU*	Audit	Indicates attendance as a visitor only

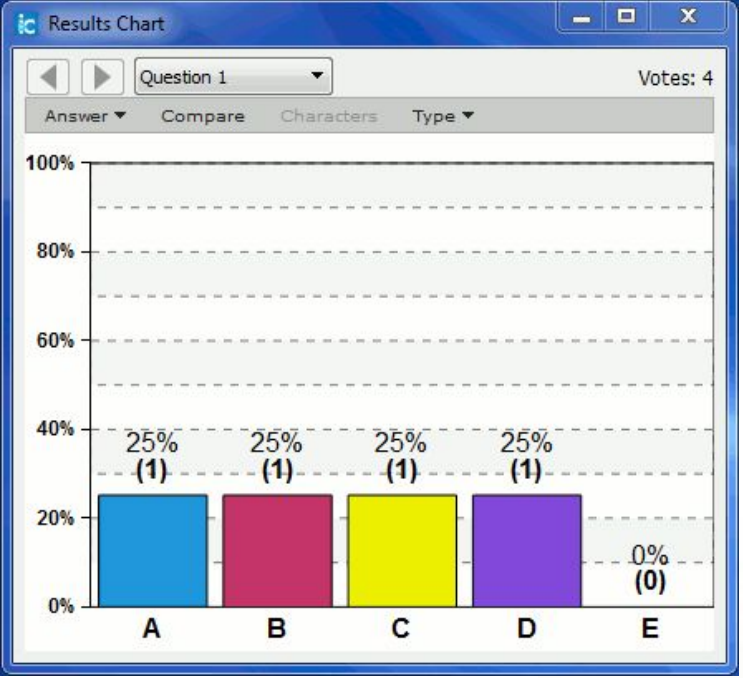
*	Other	Grade does not count toward the student's GPA or earned hours.
ABS	Absent	More than six total unexcused absences or absent from the final exam without an acceptable excuse counts as a failure not acceptable for degree credit).
AU*	Audit	Indicates attendance as a visitor only




Results Chart
Question 1
Votes: 4
Answer
Compare
Characters
Type
100%
80%
60%
40%
20%
0%
25%
(1)
25%
(1)
25%
(1)
25%
(1)
0%
(0)
A
B
C
D
E

DEMO 1


0:36 PCT
44 25 19 13 16
0
iclicker


Results Chart
Question 1
Votes: 4
Answer
Compare
Characters
Type
100%
80%
60%
40%
20%
0%
25%
(1)
25%
(1)
25%
(1)
25%
(1)
0%
(0)
A
B
C
D
E


0:36 PCT
44 25 19 13 16
0
iclicker

2020

January

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

February

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29

March

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

April

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

May

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

June

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

July

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

August

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

2020

January

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

February

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29

March

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

April

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

May

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

June

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

July

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

August

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

2020

January

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

February

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29

March

S	M	T	W	T	F	S
1	2	3	?	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

April

S	M	T	W	T	F	S
			?	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

May

S	M	T	W	T	F	S
			?		1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

June

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

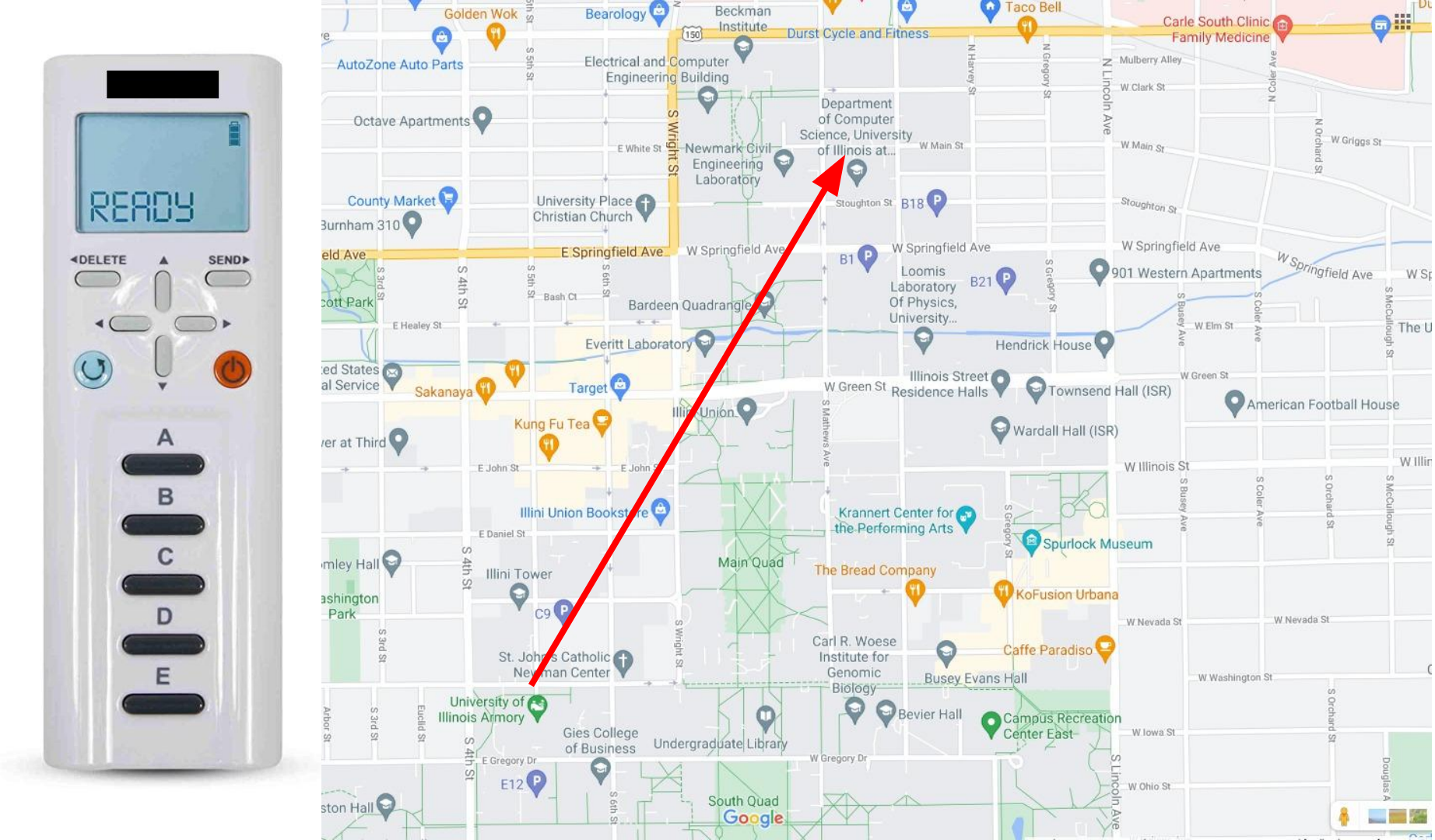
July

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

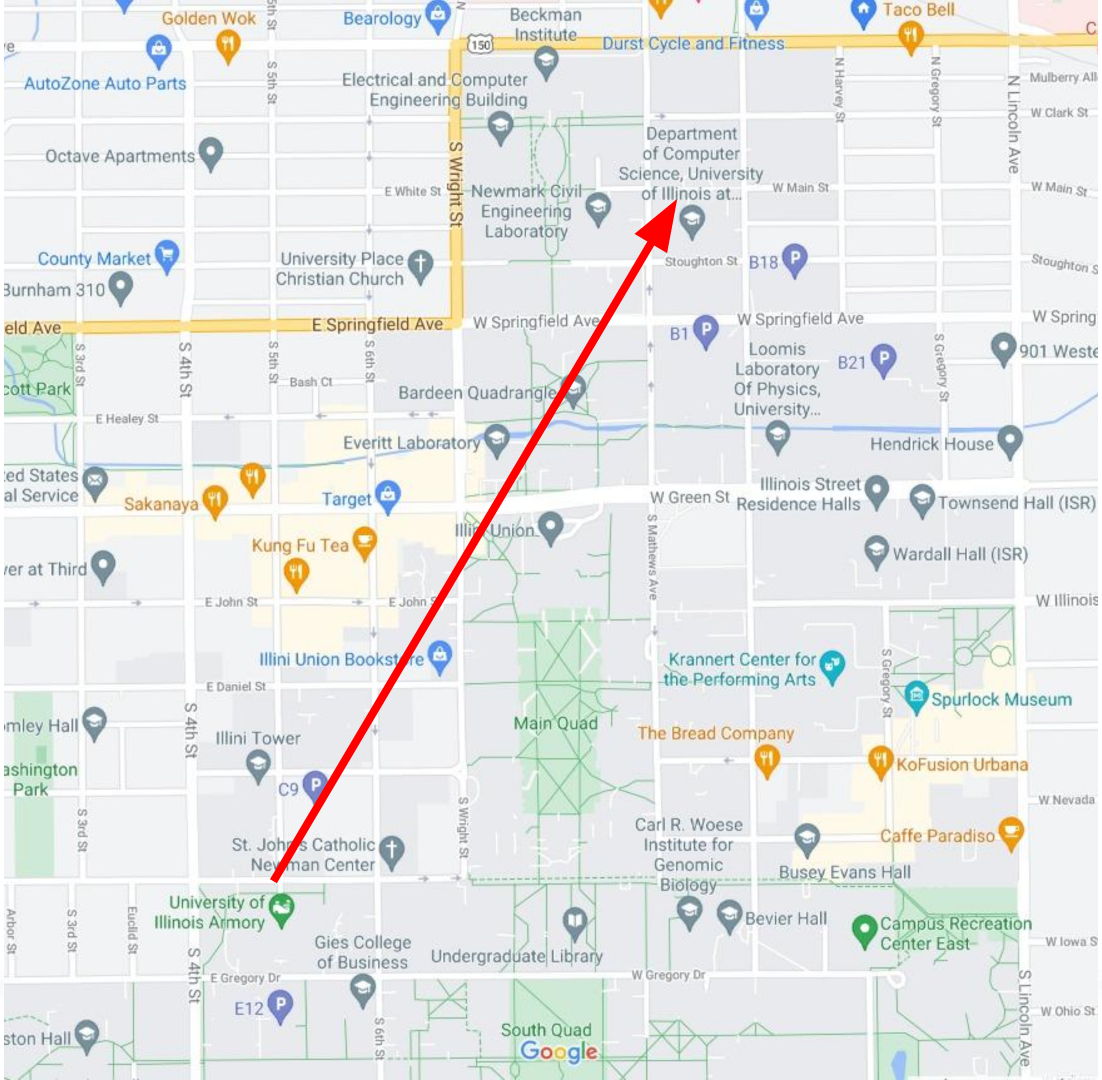
August

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					


READY
DELETE
SEND
A
B
C
D
E

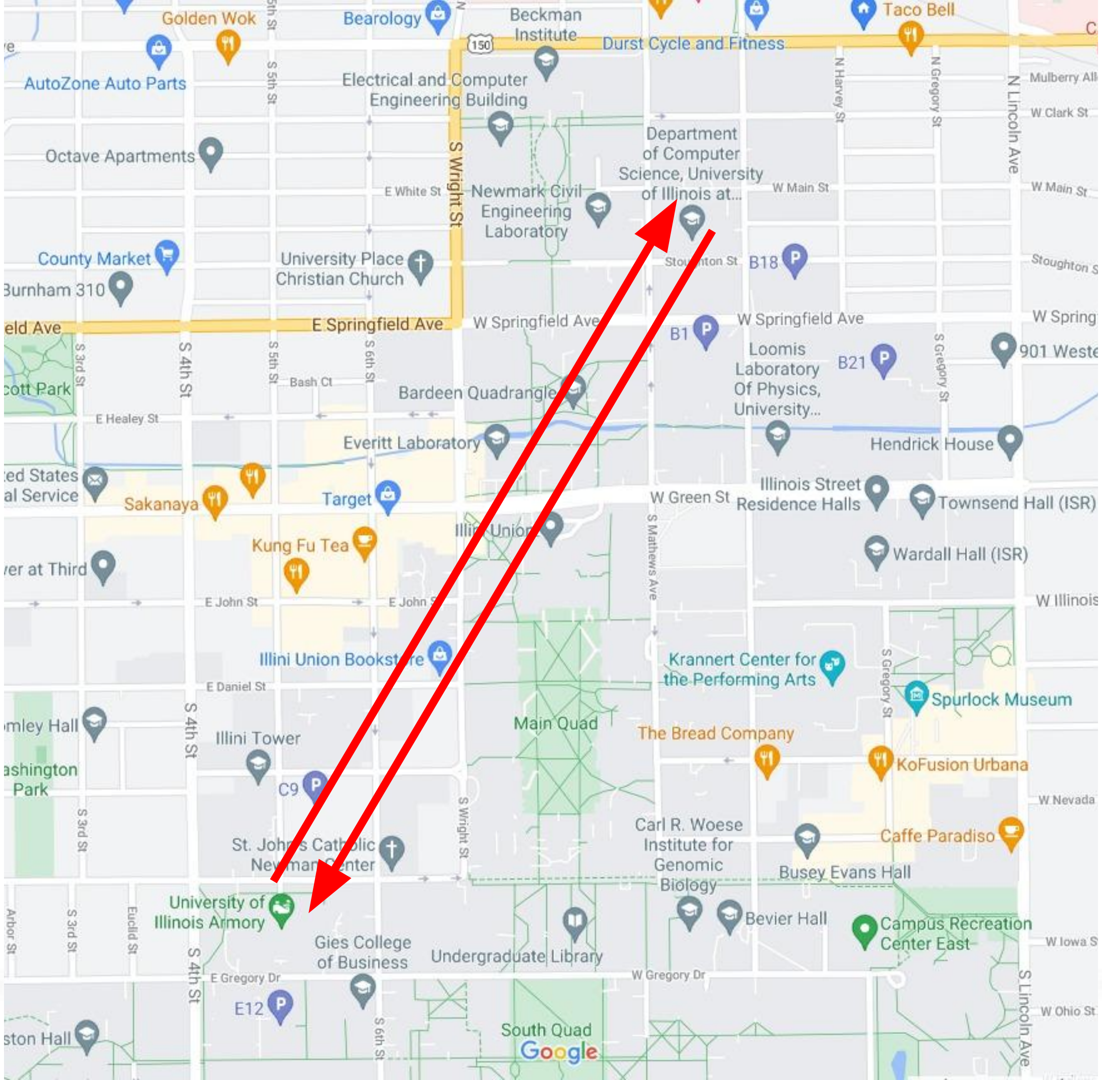

READY
DELETE
SEND
A
B
C
D
E
Golden Wok
Bearology
Beckman Institute
Taco Bell
Carle South Clinic Family Medicine
Durst Cycle and Fitness
AutoZone Auto Parts
Electrical and Computer Engineering Building
Mulberry Alley
W Clark St
Octave Apartments
Department of Computer Science, University of Illinois at...
S Wright St
E White St
Newmark Civil Engineering Laboratory
W Main St
N Lincoln Ave
W Griggs St
County Market
University Place Christian Church
Stoughton St
B18
Burnham 310
E Springfield Ave
W Springfield Ave
B1
Loomis Laboratory Of Physics, University...
B21
901 Western Apartments
Bash Ct
Bardeen Quadrangle
E Healey St
W Elm St
Everitt Laboratory
Hendrick House
Sakanaya
Target
W Green St
Illinois Street Residence Halls
Townsend Hall (ISR)
American Football House
Kung Fu Tea
Illini Union
Wardall Hall (ISR)
E John St
W Illinois St
Illini Union Bookstore
Krannert Center for the Performing Arts
Spurlock Museum
E Daniel St
Main Quad
The Bread Company
Illini Tower
KoFusion Urbana
C9
W Nevada St
Carl R. Woese Institute for Genomic Biology
Caffe Paradiso
St. John's Catholic Newman Center
Busey Evans Hall
W Washington St
University of Illinois Armory
Bevier Hall
Campus Recreation Center East
Gies College of Business
Undergraduate Library
W Iowa St
E Gregory Dr
W Gregory Dr
E12
W Ohio St
South Quad
Google


READY
DELETE
SEND
A
B
C
D
E


Golden Wok
Bearology
Beckman Institute
Taco Bell
Durst Cycle and Fitness
AutoZone Auto Parts
Electrical and Computer Engineering Building
Mulberry Al
W Clark St
Octave Apartments
Department of Computer Science, University of Illinois at...
E White St
S Wright St
Newmark Civil Engineering Laboratory
W Main St
W Main St
N Lincoln Ave
County Market
Burnham 310
University Place Christian Church
Stoughton St
B18
Stoughton S
E Springfield Ave
W Springfield Ave
W Springfield Ave
W Spring
B1
Loomis Laboratory Of Physics, University...
B21
901 Weste
Bash Ct
E Healey St
Bardeen Quadrangle
Everitt Laboratory
Hendrick House
Sakanaya
Target
W Green St
Illinois Street Residence Halls
Townsend Hall (ISR)
Kung Fu Tea
Wardall Hall (ISR)
E John St
W Illinois
Illini Union Bookstore
E Daniel St
Krannert Center for the Performing Arts
Spurlock Museum
Illini Tower
Main Quad
The Bread Company
KoFusion Urbana
C9
W Nevada
St. Johns Catholic Newman Center
Carl R. Woese Institute for Genomic Biology
Caffe Paradiso
Busey Evans Hall
University of Illinois Armory
Bevier Hall
Gies College of Business
Undergraduate Library
Campus Recreation Center East
W Iowa S
E Gregory Dr
W Gregory Dr
E12
South Quad
W Ohio St
S Lincoln Ave
Google

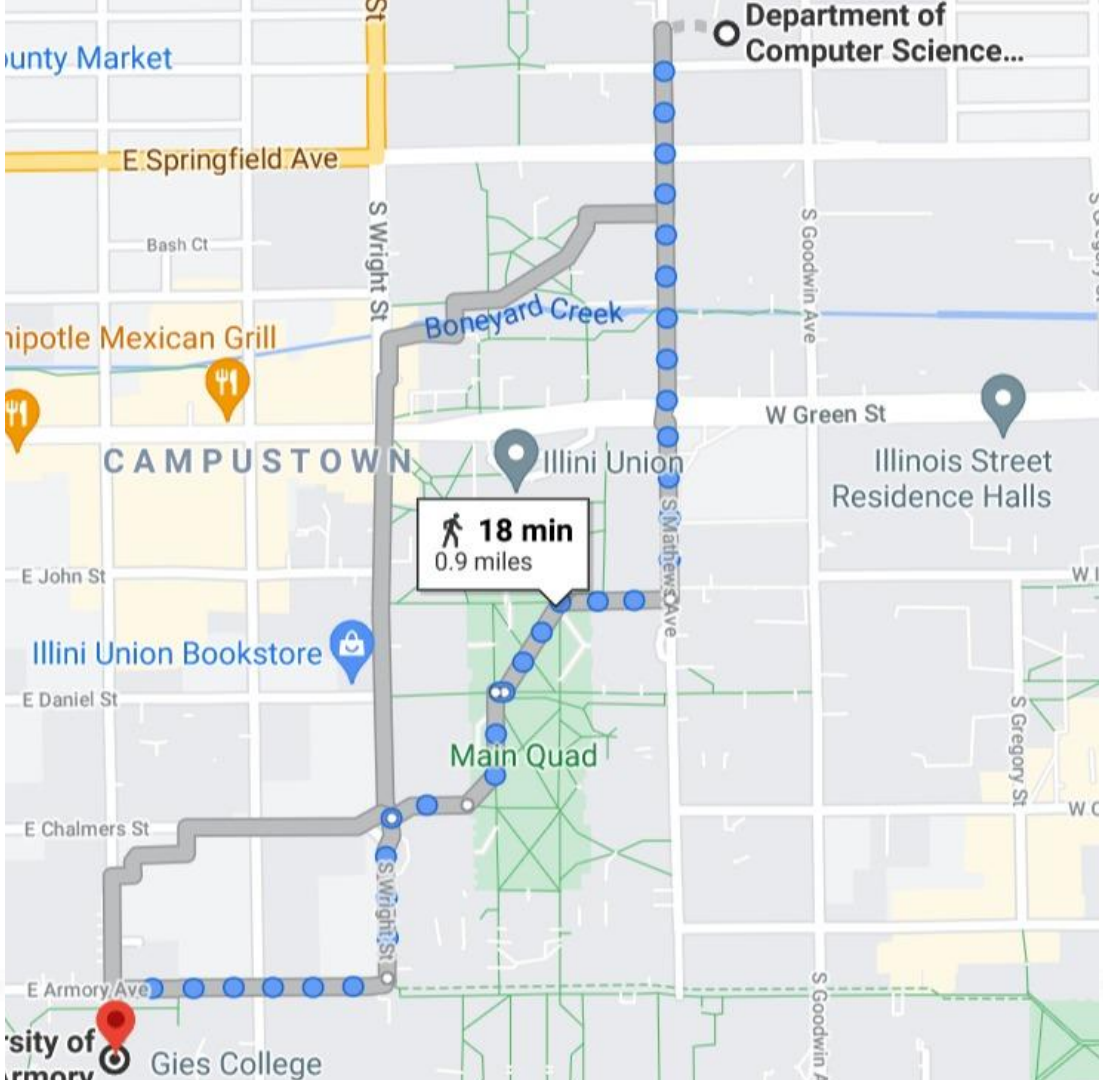

READY
DELETE
SEND
A
B
C
D
E


[redacted]
READY
DELETE
SEND
A
B
C
D
E


Golden Wok
Bearology
Beckman Institute
Taco Bell
Durst Cycle and Fitness
AutoZone Auto Parts
Electrical and Computer Engineering Building
Octave Apartments
Department of Computer Science, University of Illinois at...
E White St
S Wright St
Newmark Civil Engineering Laboratory
W Main St
N Lincoln Ave
Mulberry All
W Clark St
County Market
University Place Christian Church
Burnham 310
Stoughton St
B18
E Springfield Ave
W Springfield Ave
B1
B21
901 Weste
Loomis Laboratory Of Physics, University...
Bash Ct
E Healey St
Bardeen Quadrangle
Everitt Laboratory
Hendrick House
Sakanaya
Target
W Green St
Illinois Street Residence Halls
Townsend Hall (ISR)
Kung Fu Tea
Wardall Hall (ISR)
S Mathews Ave
E John St
W Illinois
Illini Union Bookstore
Krannert Center for the Performing Arts
E Daniel St
Spurlock Museum
Illini Tower
Main Quad
The Bread Company
KoFusion Urbana
C9
W Nevada
St. John's Catholic Newman Center
Carl R. Woese Institute for Genomic Biology
Caffe Paradiso
Busey Evans Hall
University of Illinois Armory
Bevier Hall
Campus Recreation Center East
Gies College of Business
Undergraduate Library
W Iowa St
E Gregory Dr
W Gregory Dr
E12
W Ohio St
South Quad
Google


[redacted]
READY
DELETE
SEND
A
B
C
D
E


READY
DELETE
SEND
A
B
C
D
E

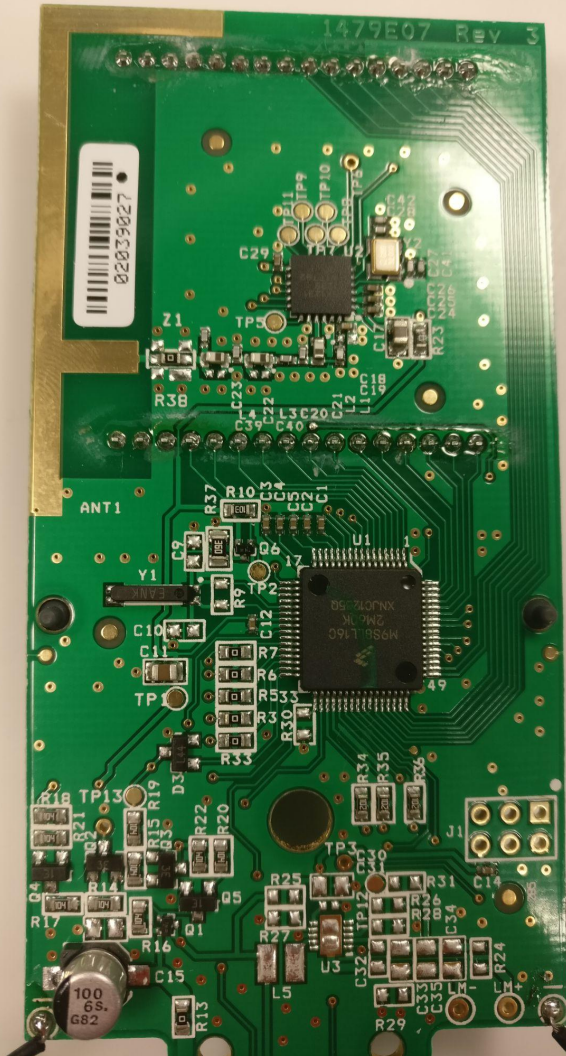

Department of Computer Science...
unty Market
E Springfield Ave
Bash Ct
S Wright St
Boneyard Creek
S Goodwin Ave
ipotle Mexican Grill
W Green St
CAMPUSTOWN
Illini Union
Illinois Street Residence Halls
18 min
0.9 miles
S Mathews Ave
E John St
Illini Union Bookstore
E Daniel St
Main Quad
S Gregory St
E Chalmers St
E Armory Ave
Gies College


READY
DELETE
SEND
A
B
C
D
E


by what you have to do
nor have

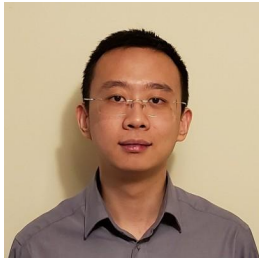

READY
DELETE
SEND
A
B
C
D
E


DELETE
SEND
A
B
C
D
E
Power/Change frequency
Select mode/Refresh
Change number/letter
Move cursor
Send answer
Delete number/letter
Multiple Choice
Select mode/Refresh
A-E Press A-E buttons
Numeric
Select mode/Refresh
Change number
Move cursor
Send answer
Alphanumeric
Select mode/Refresh
Change letter/number
Move cursor
Send answer
Display
Answer received
Answer not received
Battery low
CLOSED Polling not active
NO BASE No base found
Register
Visit iclicker.com for product registration and support.
IC: 6495A-RLR14
FCC ID: T24-RLR14
8F941803

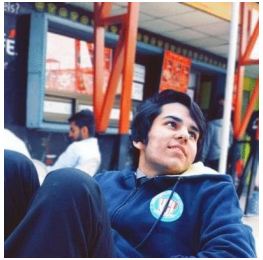

1479E07 Rev 3
020039027
ANT1
U1
Y1
TP1
TP2
TP3
TP13
J1
L5
LM-
LM+

Aaron Wisner

Jacob Glueck



Charles Cao



Ammar Askar

Cole Smith

Prof. Bruce Land (Advisor)

https://github.com/wizard97/iSkipper
https://github.com/charlescao460/iSkipper-Software

Reverse Engineering Classroom Polling: A Case Study

Daniel Wisner III, Jacob Glueck
developed 2/2017-5/2017, published 5/2019

Abstract—The [redacted] polling system is a widely used classroom voting system, which uses transmits the students' answers to the professor using an off the shelf 900 MHz radio. In this article, we completely reverse engineer the protocol used to transmit the answers, allowing an attacker to snoop on submitted answers, change students' answers by resubmitting them, and completely disable the system by flooding it rapidly with fake answers.

Index Terms—Classroom Voting, Reverse Engineering, Security

1 Introduction

In this case study, we investigate the security of the most commonly deployed in-class polling system in the US, the [redacted] by attempting to reverse engineering it.

While a major portion of this paper explores the reverse engineering process of an off the shelf commercial device, this was done so to investigate its security and create/demonstrate practical exploits that we believe make the device unsuitable for use in its intended application. We propose several exploits a nefarious individual with the correct equipment can perform that take advantage of inherit vulnerabilities, these exploits include:

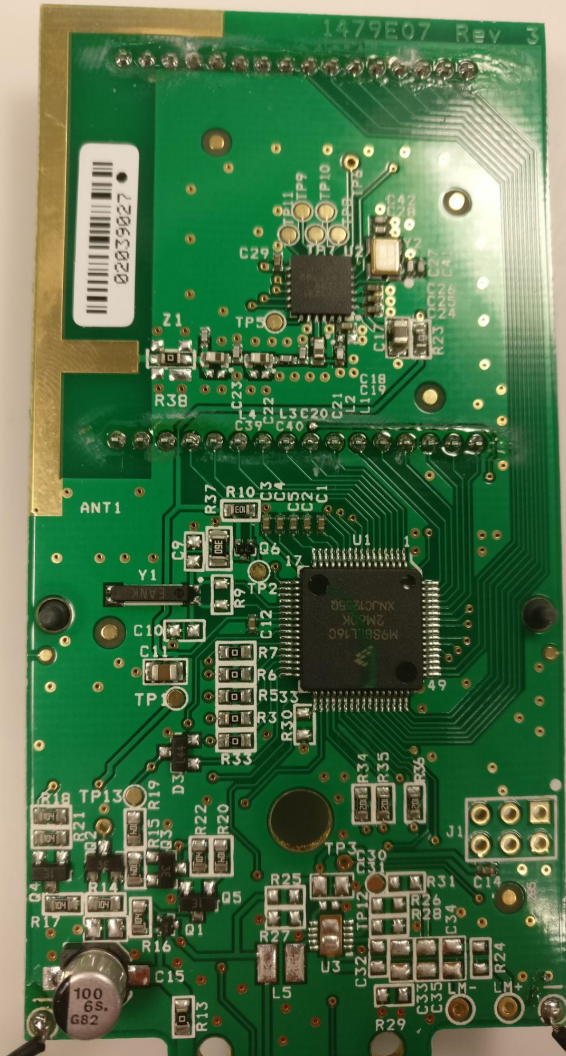
- Changing other respondees answers
- Creating an auto-answering device

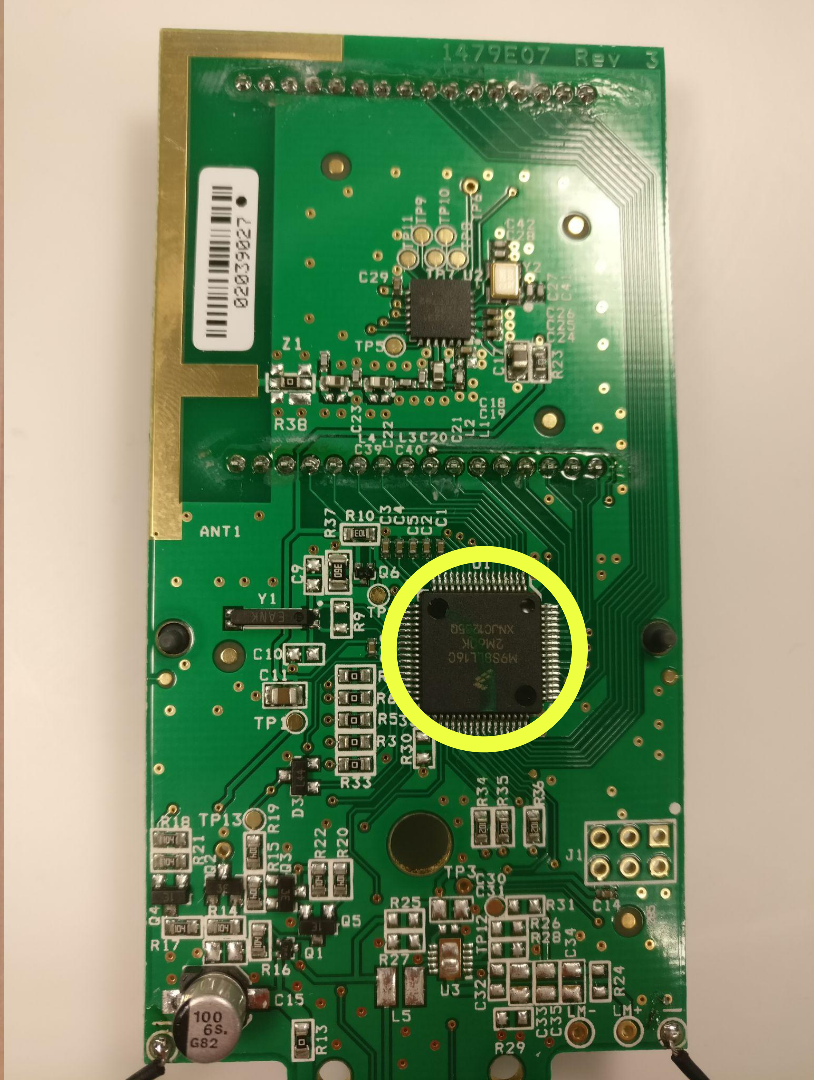
spent several several seconds submitting all 256 possible choices.

2 Background

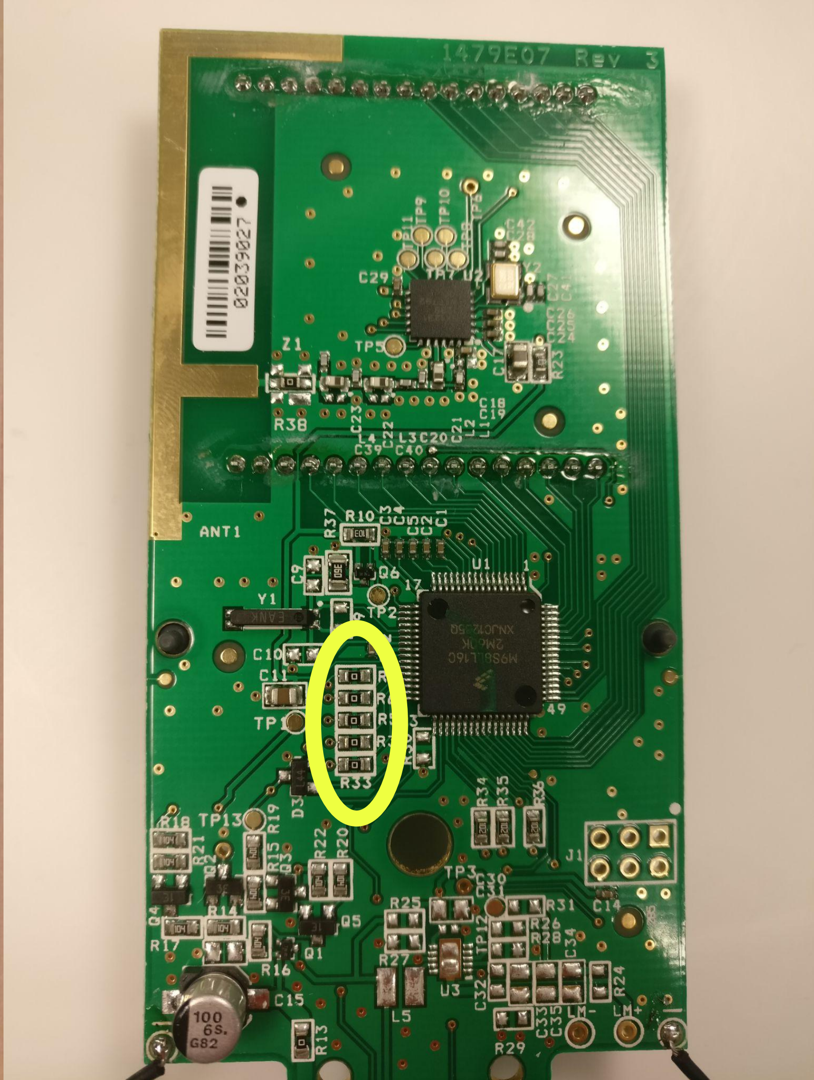
Universities across the globe have adopted electronic in-class polling devices for use in lecture-based classes. Generally, each student in the lecture possesses a wireless remote assigned to him/her, and throughout the lecture, a lecturer can pose questions to the audience that a student can respond to with his/her personal remote. A central base station, managed by the lecturer, receives these audiences' responses and records each student's response. [3]

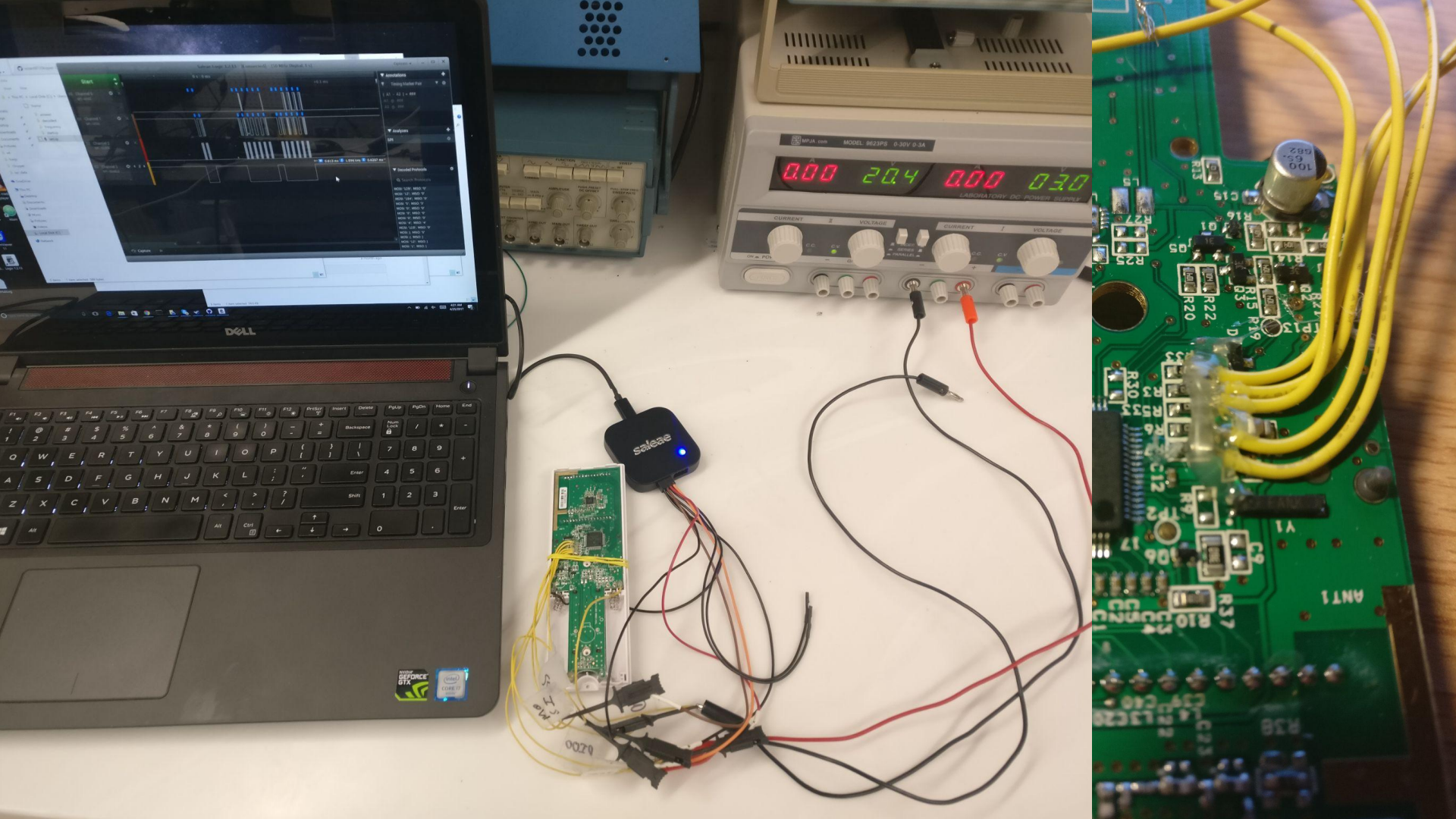

DELETE
SEND
A
B
C
D
E
Power/Change frequency
Select mode/Refresh
Change number/letter
Move cursor
Send answer
Delete number/letter
Multiple Choice
Select mode/Refresh
A-E Press A-E buttons
Numeric
Select mode/Refresh
Change number
Move cursor
Send answer
Alphanumeric
Select mode/Refresh
Change letter/number
Move cursor
Send answer
Display
Answer received
Answer not received
Battery low
CLOSED Polling not active
NO BASE No base found
Register
Visit iclicker.com for product registration and support.
IC: 6495A-RLR14
FCC ID: T24-RLR14
8F941803

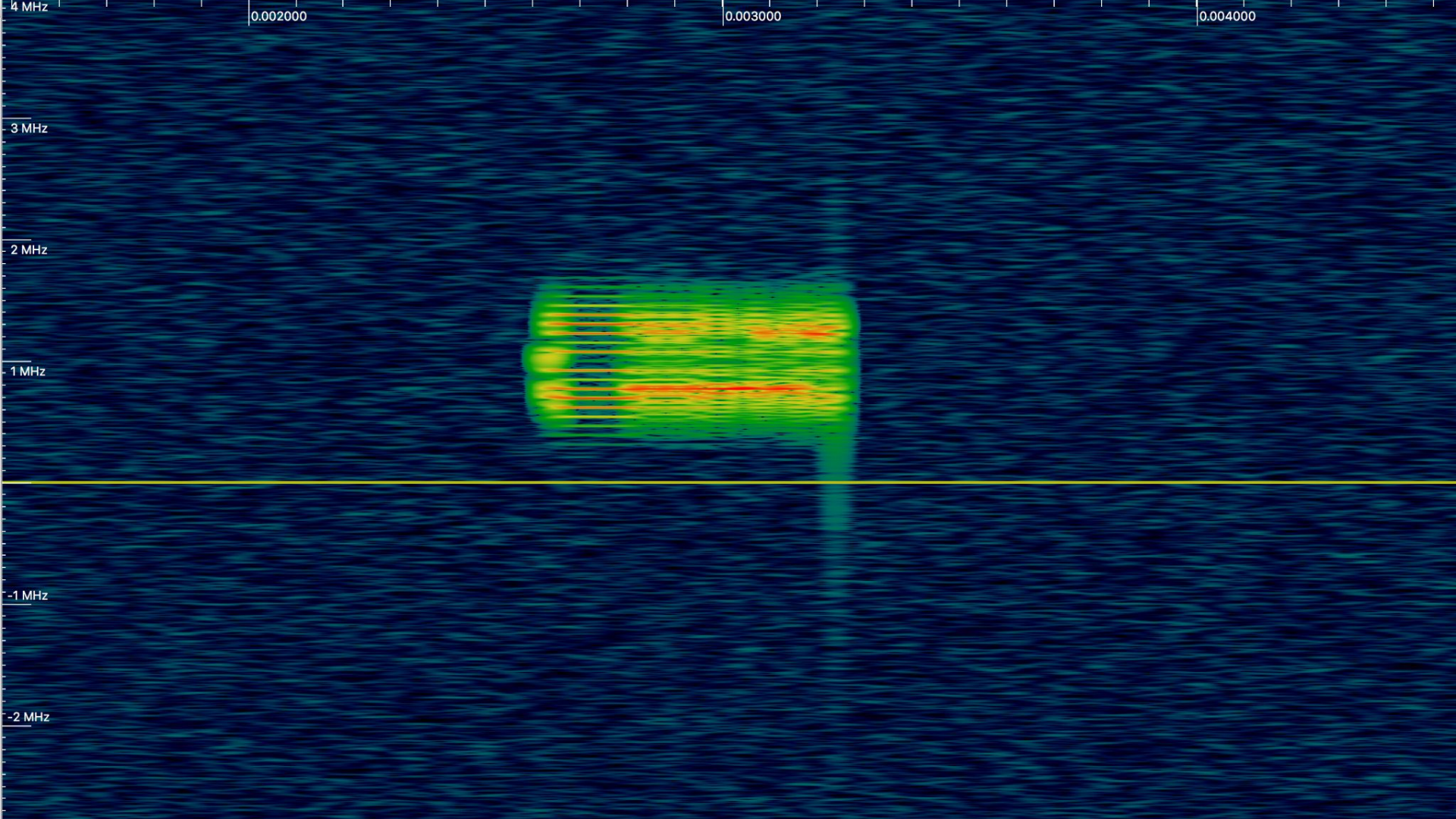

1479E07 Rev 3
020039027
ANT1
U1
Y1
TP1
TP2
TP3
TP13
J1
L5
LM-
LM+

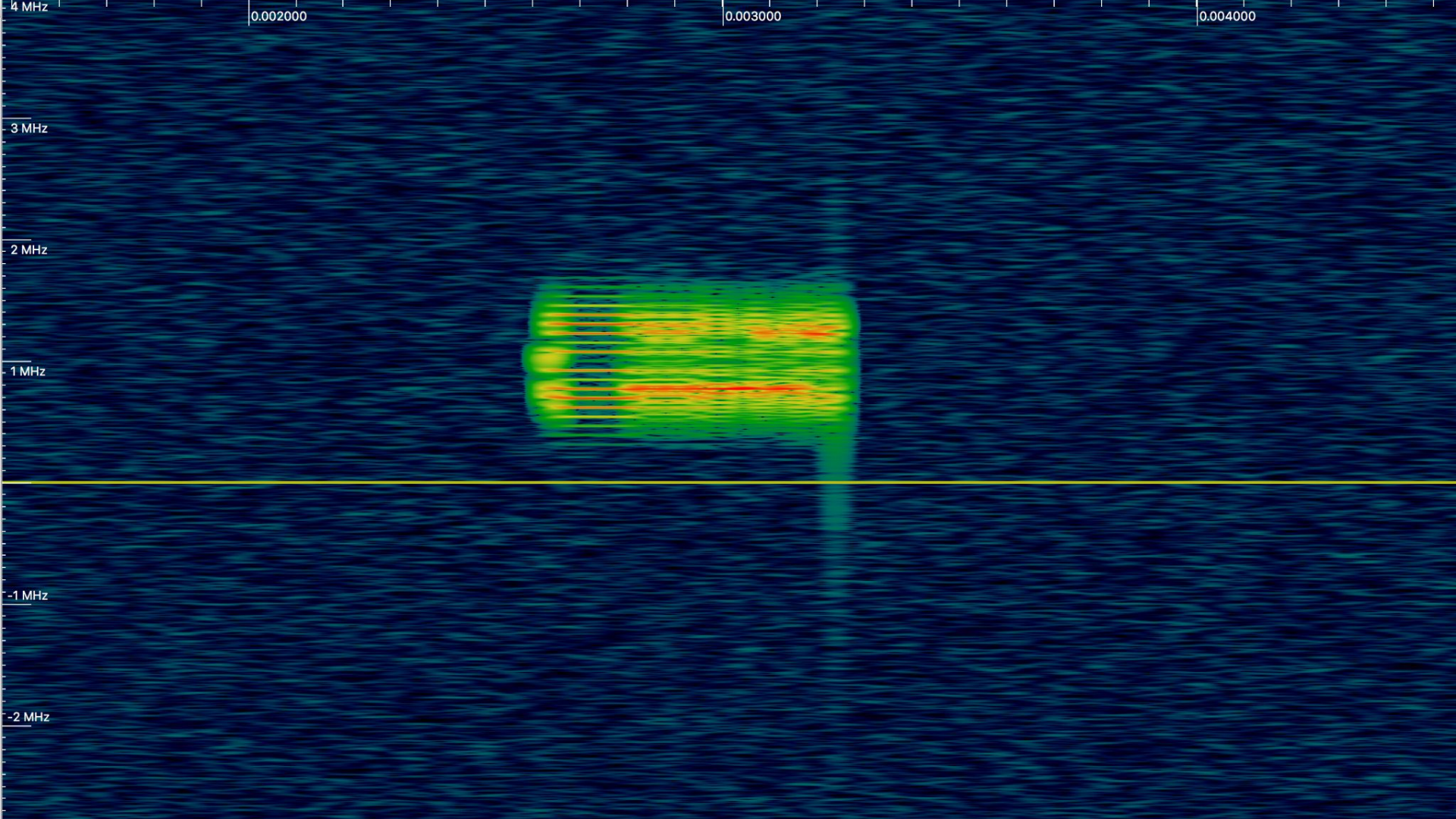

[redacted]
◀DELETE
SEND▶
A
B
C
D
E
[redacted]
Power/Change frequency
Select mode/Refresh
Change number/letter
Move cursor
Send answer
Delete number/letter
Multiple Choice
Select mode/Refresh
A-E Press A-E buttons
Numeric
Select mode/Refresh
Change number
Move cursor
Send answer
Alphanumeric
Select mode/Refresh
Change letter/number
Move cursor
Send answer
Display
Answer received
Answer not received
CLOSED
NO BASE No base found
Register
Visit iclicker.com for product
registration and support.
IC: 6495A-RLR14
FCC ID: T24-RLR14
8F941803
RESET

1479E07 Rev 3
02039027
ANT1
Y1
J1


[redacted]
DELETE
SEND
A
B
C
D
E
[redacted]
Power/Change frequency
Select mode/Refresh
Change number/letter
Move cursor
Send answer
Delete number/letter
Multiple Choice
Select mode/Refresh
A-E Press A-E buttons
Numeric
Select mode/Refresh
Change number
Move cursor
Send answer
Alphanumeric
Select mode/Refresh
Change letter/number
Move cursor
Send answer
Display
Answer received
Answer not received
CLOSED
NO BASE No base found
Register
Visit iclicker.com for product registration and support.
IC: 6495A-RLR14
FCC ID: T24-RLR14
8F941803
RESET
1479E07 Rev 3
02039027
ANT1


[redacted]
◀DELETE
SEND▶
A
B
C
D
E
[redacted]
Power/Change frequency
Select mode/Refresh
Change number/letter
Move cursor
Send answer
Delete number/letter
Multiple Choice
Select mode/Refresh
A-E Press A-E buttons
Numeric
Select mode/Refresh
Change number
Move cursor
Send answer
Alphanumeric
Select mode/Refresh
Change letter/number
Move cursor
Send answer
Display
Answer received
Answer not received
NO BASE No base found
Register
Visit iclicker.com for product registration and support.
IC: 6495A-RLR14
FCC ID: T24-RLR14
8F941803
RESET

1479E07 Rev 3
02039027
ANT1
U1
Y1
R10
R37
TP2
TP1
R33
J1
L5
U3


DELL
saleae
MODEL: 9623PS 0-30V 0-3A
0.00
20.4
0.00
0.30
LABORATORY DC POWER SUPPLY


4 MHz
0.002000
0.003000
0.004000
3 MHz
2 MHz
1 MHz
-1 MHz
-2 MHz


4 MHz
0.002000
0.003000
0.004000
3 MHz
2 MHz
1 MHz
-1 MHz
-2 MHz

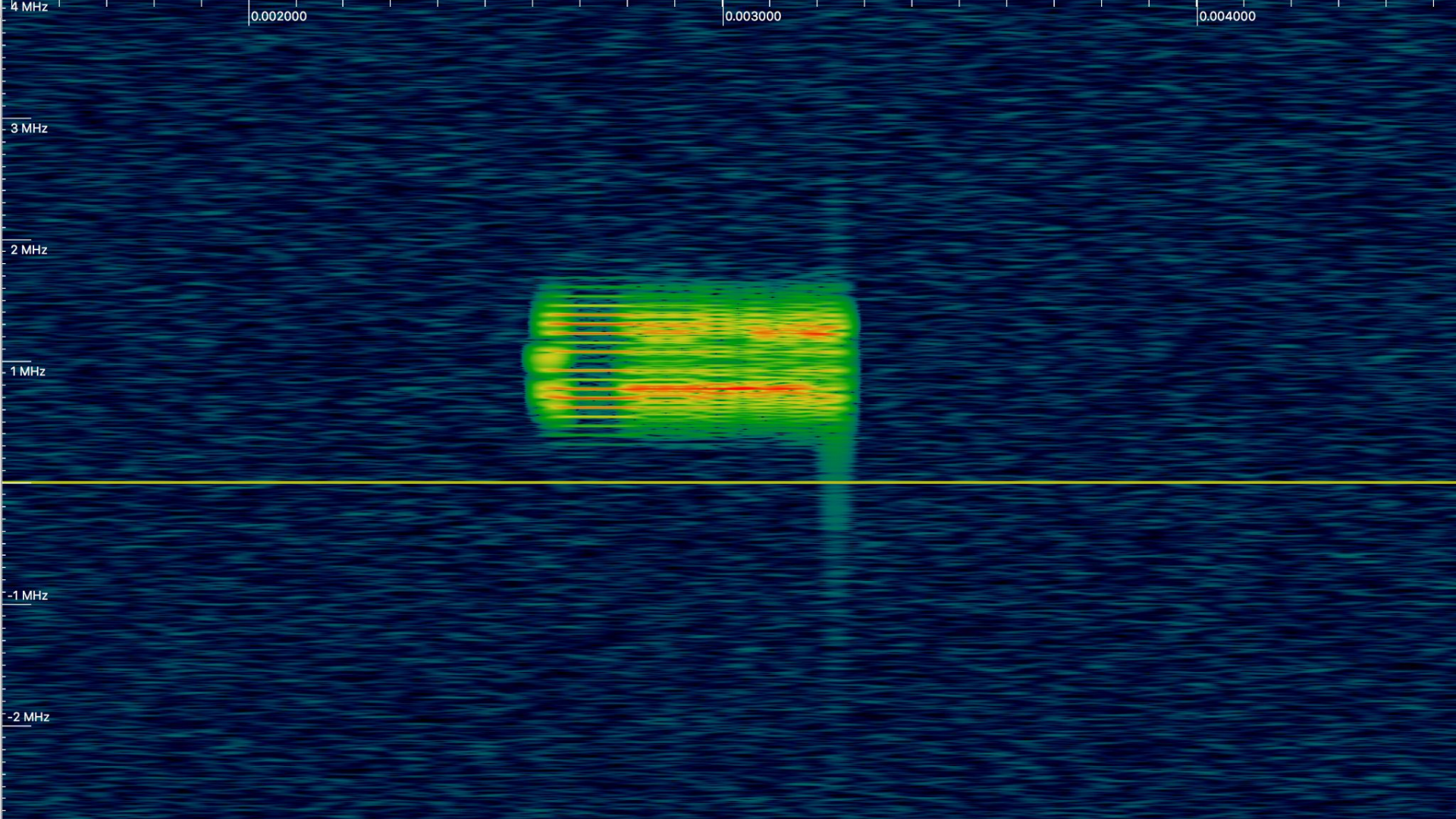

4 MHz
0.002000
0.003000
0.004000
3 MHz
2 MHz
1 MHz
-1 MHz
-2 MHz

TABLE 2
[redacted] Channel Frequencies

Channel	Transmit Frequency (MHz)	Receive Frequency (MHz)
AA	916.47	902.98
AB	912.47	903.98
AC	913.47	905.48
AD	914.47	906.98
BA	915.47	907.98
BB	918.48	909.48
BC	919.47	910.97
BD	920.47	911.97
CA	921.47	913.47
CB	922.47	914.97
CC	906.48	915.97
CD	907.48	917.47
DA	904.98	918.47
DB	908.48	919.97
DC	910.48	921.47
DD	909.48	922.47

TABLE 2
[redacted] Channel Frequencies

Channel	Transmit Frequency (MHz)	Receive Frequency (MHz)
AA	916.47	902.98
AB	912.47	903.98
AC	913.47	905.48
AD	914.47	906.98
BA	915.47	907.98
BB	918.48	909.48
BC	919.47	910.97
BD	920.47	911.97
CA	921.47	913.47
CB	922.47	914.97
CC	906.48	915.97
CD	907.48	917.47
DA	904.98	918.47
DB	908.48	919.97
DC	910.48	921.47
DD	909.48	922.47

TABLE 1
Answer Packet Contents

Answer	Packet Contents
A	0x7d, 0x28, 0x0c, 0x01, 0xb2
B	0x7d, 0x28, 0x0c, 0x05, 0xb6
C	0x7d, 0x28, 0x0c, 0x0d, 0xbe
D	0x7d, 0x28, 0x0c, 0x0e, 0xbf
E	0x7d, 0x28, 0x0c, 0x0a, 0xbb

TABLE 1
Answer Packet Contents

Answer	Packet Contents
A	0x7d, 0x28, 0x0c, 0x01, 0xb2
B	0x7d, 0x28, 0x0c, 0x05, 0xb6
C	0x7d, 0x28, 0x0c, 0x0d, 0xbe
D	0x7d, 0x28, 0x0c, 0x0e, 0xbf
E	0x7d, 0x28, 0x0c, 0x0a, 0xbb

TABLE 1
Answer Packet Contents

Answer	Packet Contents
A	0x7d, 0x28, 0x0c, 0x01, 0xb2
B	0x7d, 0x28, 0x0c, 0x05, 0xb6
C	0x7d, 0x28, 0x0c, 0x0d, 0xbe
D	0x7d, 0x28, 0x0c, 0x0e, 0xbf
E	0x7d, 0x28, 0x0c, 0x0a, 0xbb

TABLE 1
Answer Packet Contents

Answer	Packet Contents
A	0x7d, 0x28, 0x0c, 0x01, 0xb2
B	0x7d, 0x28, 0x0c, 0x05, 0xb6
C	0x7d, 0x28, 0x0c, 0x0d, 0xbe
D	0x7d, 0x28, 0x0c, 0x0e, 0xbf
E	0x7d, 0x28, 0x0c, 0x0a, 0xbb

TABLE 1
Answer Packet Contents

Answer	Packet Contents
A	0x7d, 0x28, 0x0c, 0x01, 0xb2
B	0x7d, 0x28, 0x0c, 0x05, 0xb6
C	0x7d, 0x28, 0x0c, 0x0d, 0xbe
D	0x7d, 0x28, 0x0c, 0x0e, 0xbf
E	0x7d, 0x28, 0x0c, 0x0a, 0xbb

TABLE 3
ID Encoding

(Transposition Cipher)

Byte 0	$I_0[4]$	$I_0[3]$	$I_0[2]$	$I_0[1]$	$I_0[0]$	$I_0[7]$	0	$I_1[7]$
Byte 1	$I_1[6]$	$I_1[5]$	$I_1[4]$	$I_1[3]$	$I_1[2]$	$I_1[1]$	0	$I_0[6]$
Byte 2	$I_1[0]$	$I_2[7]$	$I_2[6]$	$I_2[5]$	$I_2[4]$	$I_2[3]$	0	$I_0[5]$
Byte 3	$I_2[2]$	$I_2[1]$	$I_2[0]$	$I_2[0]$	0	0	0	0

TABLE 1
Answer Packet Contents

Answer	Packet Contents
A	0x7d, 0x28, 0x0c, 0x01, 0xb2
B	0x7d, 0x28, 0x0c, 0x05, 0xb6
C	0x7d, 0x28, 0x0c, 0x0d, 0xbe
D	0x7d, 0x28, 0x0c, 0x0e, 0xbf
E	0x7d, 0x28, 0x0c, 0x0a, 0xbb

Device ID Checksum:

8F941803

0x8F ⊕ 0x94 ⊕ 0x18 = 0x03

TABLE 3
ID Encoding

(Transposition Cipher)

Byte 0	$I_0[4]$	$I_0[3]$	$I_0[2]$	$I_0[1]$	$I_0[0]$	$I_0[7]$	0	$I_1[7]$
Byte 1	$I_1[6]$	$I_1[5]$	$I_1[4]$	$I_1[3]$	$I_1[2]$	$I_1[1]$	0	$I_0[6]$
Byte 2	$I_1[0]$	$I_2[7]$	$I_2[6]$	$I_2[5]$	$I_2[4]$	$I_2[3]$	0	$I_0[5]$
Byte 3	$I_2[2]$	$I_2[1]$	$I_2[0]$	$I_2[0]$	0	0	0	0

TABLE 1
Answer Packet Contents

Answer	Packet Contents
A	0x7d, 0x28, 0x0c, 0x01, 0xb2
B	0x7d, 0x28, 0x0c, 0x05, 0xb6
C	0x7d, 0x28, 0x0c, 0x0d, 0xbe
D	0x7d, 0x28, 0x0c, 0x0e, 0xbf
E	0x7d, 0x28, 0x0c, 0x0a, 0xbb

TABLE 1
Answer Packet Contents

Answer	Packet Contents
A	0x7d, 0x28, 0x0c, 0x01, 0xb2
B	0x7d, 0x28, 0x0c, 0x05, 0xb6
C	0x7d, 0x28, 0x0c, 0x0d, 0xbe
D	0x7d, 0x28, 0x0c, 0x0e, 0xbf
E	0x7d, 0x28, 0x0c, 0x0a, 0xbb

TABLE 4
4th Byte Least Significant Nibble Answer Encoding

Answer	Least Significant Nibble of 4th Byte
A	0x1
B	0x5
C	0xd
D	0xe
E	0xa

TABLE 1
Answer Packet Contents

Answer	Packet Contents
A	0x7d, 0x28, 0x0c, 0x01, 0xb2
B	0x7d, 0x28, 0x0c, 0x05, 0xb6
C	0x7d, 0x28, 0x0c, 0x0d, 0xbe
D	0x7d, 0x28, 0x0c, 0x0e, 0xbf
E	0x7d, 0x28, 0x0c, 0x0a, 0xbb

TABLE 6
Last Byte of Answer Packet

Answer	**Last Byte of Answer Packet**
A	$\text{bytesum}(\text{packet}[0:5]) \mod 256 + 1$
B	$\text{bytesum}(\text{packet}[0:5]) \mod 256 + 5$
C	$\text{bytesum}(\text{packet}[0:5]) \mod 256 + 13$
D	$\text{bytesum}(\text{packet}[0:5]) \mod 256 + 14$
E	$\text{bytesum}(\text{packet}[0:5]) \mod 256 + 10$
Ping	$\text{bytesum}(\text{packet}[0:5]) \mod 256 + 2$

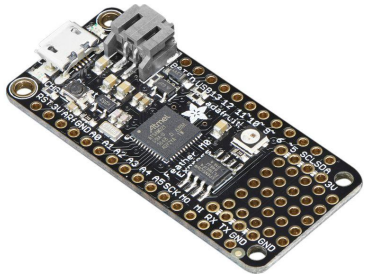
4 [redacted] PROTOCOL

With the packet encoding figured out, the answer submission process can concisely be described as follows:

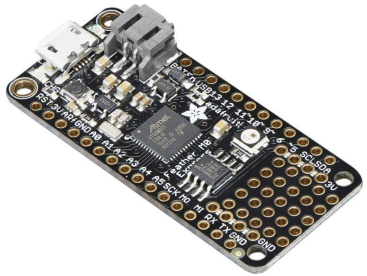
1) Generate first 3 bytes and 1 nibble of answer packet by encoding the 4 byte remote ID using Table 3
2) Set the least significant nibble of the 4th byte based on answer choice using Table 4
3) Set the 5th byte based on answer using Table 6
4) Transmit the following with 2-FSK modulation (frequency deviation of 222.833 KHz) at 152 kb/s at the transmit frequency defined in Table 2:

    - 3 bytes of preamble (`0x55` or `0xAA`)
    - The 3 byte sync address: `0x85`, `0x85`, `0x85`
    - The encoded 5 byte answer packet created above

5) The base station will acknowledge receipt of the answer by sending back (ignoring the preamble) a 9 byte packet: the first 2 bytes are the first 2 bytes of the encoded remote ID (sync address), followed by an unknown 7-byte payload.


RST
3V
A0
A1
A2
SCK
MO
MI
RX
TX
D4
D5
D6
D9
D10
D11
D12
D13
SCL
SDA
GND

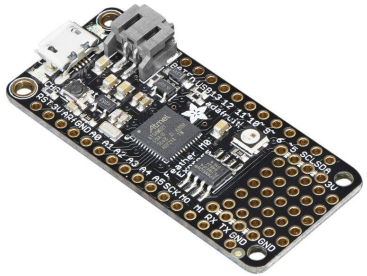
https://github.com/VCNinc/Time-Turner



```
#include <SPI.h>
#include <Wire.h>
#include <Adafruit_GFX.h>
#include <Adafruit_SSD1306.h>
#include "iClickerEmulator.h"
#include <RingBufCPP.h>
#include <string.h>

#define MY_CLICKER_ID 0x0000AAAA
#define BUTTON_A  9
#define BUTTON_B  6
#define BUTTON_C  5
#define IS_RFM69HW true
#define IRQ_PIN 3
#define CSN 8
#define VBATPIN A7
#define MAX_BUFFERED_PACKETS 100
#define THRESHOLD 1000
#define MAX_RECVD 500
#define RAND_LOW 35
#define RAND_HIGH 75

uint8_t clicker_id[4];
int hij = 0;
int dos = 0;

Adafruit_SSD1306 display = Adafruit_SSD1306(128, 32, &Wire);
iClickerAnswerPacket recvd[MAX_RECVD];
uint32_t num_recvd = 0;
iClickerEmulator clicker(CSN, IRQ_PIN, digitalPinToInterrupt(IRQ_PIN), IS_RFM69HW);
RingBufCPP<iClickerPacket, MAX_BUFFERED_PACKETS> recvBuf;

int mode = 0;
int ans = 0;
bool active = false;
int ctr = 0;
bool a_state = true;
bool b_state = true;
bool c_state = true;
int sent = -1;
float measuredvbat = 0;
int batpercentage;

void input() {
  float measuredvbat = round((((float(analogRead(VBATPIN))/1024)*2*3.3) - 3.2) * 100);
  bool a_read = (measuredvbat < -140);
  bool b_read = digitalRead(BUTTON_B);
  bool c_read = digitalRead(BUTTON_C);
  if(a_read && a_read != a_state) {
    mode = (mode + 1) % 6;
    active = false;
  }
  if(b_read && b_read != b_state) {
    ans = (ans + 1) % 5;
```

```
display.setTextColor(SSD1306_WHITE);
display.setCursor(100,24);
display.println(String(batpercentage) + "%");
display.setCursor(0,0);
switch(mode) {
  case 0:
    display.println("A) Mode: View Votes");
    break;
  case 1:
    display.println("A) Mode: Fake Votes");
    break;
  case 2:
    display.println("A) Mode: Change Votes");
    break;
  case 3:
    display.println("A) Mode: DoS Attack");
    break;
  case 4:
    display.println("A) Mode: Copy Votes");
    break;
  case 5:
    display.println("A) Mode: Vote Choice");
    break;
}
switch(ans) {
  case 0:
    display.println("B) Choice: A");
    break;
  case 1:
    display.println("B) Choice: B");
    break;
  case 2:
    display.println("B) Choice: C");
    break;
  case 3:
    display.println("B) Choice: D");
    break;
  case 4:
    display.println("B) Choice: E");
    break;
}
if(active) {
  display.println("C) Active: Yes");
  ctr = (++ctr) % 50;
  if (ctr == 0) sent = -1;
  if(mode == 0 || mode == 4 || mode == 5) {
      char tmp[100];
      uint16_t res[NUM_ANSWER_CHOICES] = { 0 };
      for (uint32_t i = 0; i < num_recvd; i++) {
        res[recvd[i].answer]++;
      }
      snprintf(tmp, sizeof(tmp), "A%u B%u C%u D%u E%u",
      if(mode == 5) {
        switch(ans) {
          case 0:
```

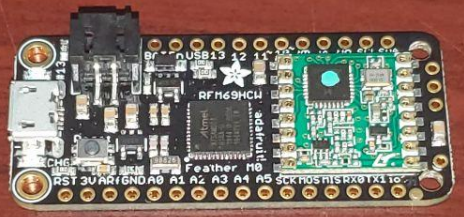
https://github.com/VCNinc/Time-Turner

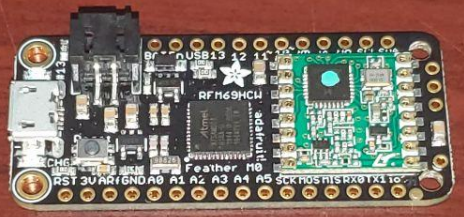


```
#include <SPI.h>
#include <Wire.h>
#include <Adafruit_GFX.h>
#include <Adafruit_SSD1306.h>
#include "iClickerEmulator.h"
#include <RingBufCPP.h>
#include <string.h>

#define MY_CLICKER_ID 0x0000AAAA
#define BUTTON_A  9
#define BUTTON_B  6
#define BUTTON_C  5
#define IS_RFM69HW true
#define IRQ_PIN 3
#define CSN 8
#define VBATPIN A7
#define MAX_BUFFERED_PACKETS 100
#define THRESHOLD 1000
#define MAX_RECVD 500
#define RAND_LOW 35
#define RAND_HIGH 75

uint8_t clicker_id[4];
int hij = 0;
int dos = 0;

Adafruit_SSD1306 display = Adafruit_SSD1306(128, 32, &Wire);
iClickerAnswerPacket recvd[MAX_RECVD];
uint32_t num_recvd = 0;
iClickerEmulator clicker(CSN, IRQ_PIN, digitalPinToInterrupt(IRQ_PIN), IS_RFM69HW);
RingBufCPP<iClickerPacket, MAX_BUFFERED_PACKETS> recvBuf;

int mode = 0;
int ans = 0;
bool active = false;
int ctr = 0;
bool a_state = true;
bool b_state = true;
bool c_state = true;
int sent = -1;
float measuredvbat = 0;
int batpercentage;

void input() {
  float measuredvbat = round((((float(analogRead(VBATPIN))/1024)*2*3.3) - 3.2) * 100);
  bool a_read = (measuredvbat < -140);
  bool b_read = digitalRead(BUTTON_B);
  bool c_read = digitalRead(BUTTON_C);
  if(a_read && a_read != a_state) {
    mode = (mode + 1) % 6;
    active = false;
  }
  if(b_read && b_read != b_state) {
    ans = (ans + 1) % 5;
```

```
display.setTextColor(SSD1306_WHITE);
display.setCursor(100,24);
display.println(String(batpercentage) + "%");
display.setCursor(0,0);
switch(mode) {
  case 0:
    display.println("A) Mode: View Votes");
    break;
  case 1:
    display.println("A) Mode: Fake Votes");
    break;
  case 2:
    display.println("A) Mode: Change Votes");
    break;
  case 3:
    display.println("A) Mode: DoS Attack");
    break;
  case 4:
    display.println("A) Mode: Copy Votes");
    break;
  case 5:
    display.println("A) Mode: Vote Choice");
    break;
}
switch(ans) {
  case 0:
    display.println("B) Choice: A");
    break;
  case 1:
    display.println("B) Choice: B");
    break;
  case 2:
    display.println("B) Choice: C");
    break;
  case 3:
    display.println("B) Choice: D");
    break;
  case 4:
    display.println("B) Choice: E");
    break;
}
if(active) {
  display.println("C) Active: Yes");
  ctr = (++ctr) % 50;
  if (ctr == 0) sent = -1;
  if(mode == 0 || mode == 4 || mode == 5) {
      char tmp[100];
      uint16_t res[NUM_ANSWER_CHOICES] = { 0 };
      for (uint32_t i = 0; i < num_recvd; i++) {
        res[recvd[i].answer]++;
      }
      snprintf(tmp, sizeof(tmp), "A%u B%u C%u D%u E%u",
      if(mode == 5) {
        switch(ans) {
          case 0:
```

DEMO 2


RFM69HCW
Feather M0
RST 3V AREF GND A0 A1 A2 A3 A4 A5 SCK MOSI MISO RX0 TX1


RFM69HCW
Feather M0
RST 3V AREF GND A0 A1 A2 A3 A4 A5 SCK MOSI MISO RX0 TX1

i>Skipper

Multiple

DEMO 3

Status: Capturing

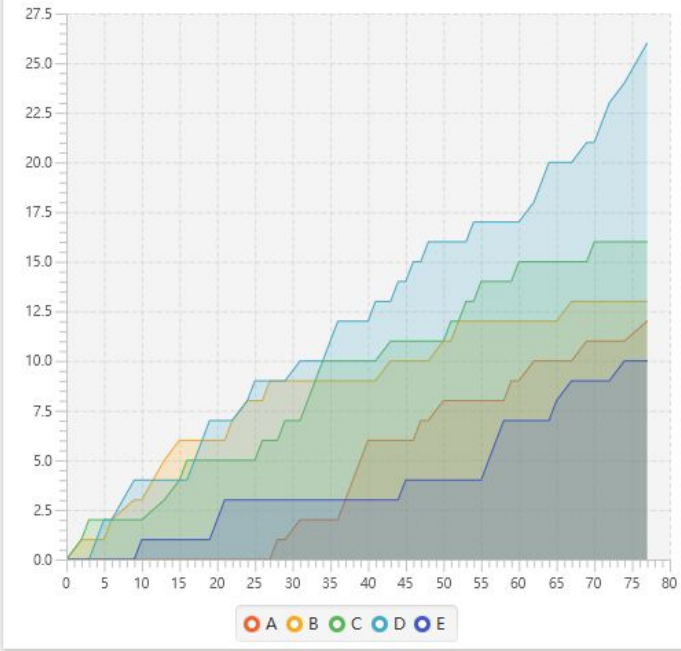
Channel: AA

ID: CDCDCDCD

ID Count: 77

Response Count: 77

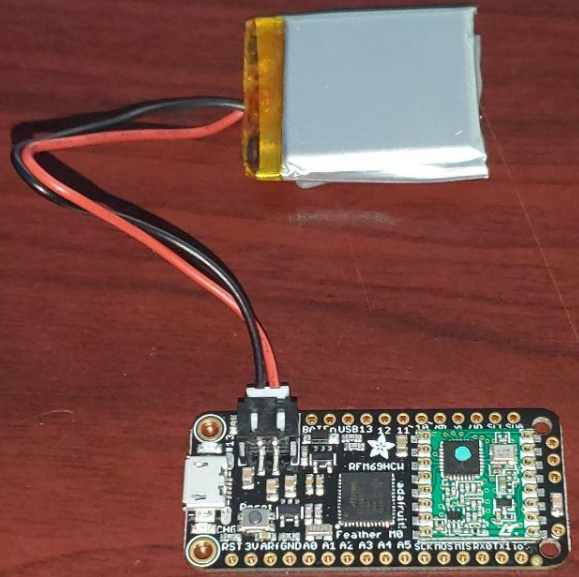
A:12 B:13 C:16 D:26 E:10

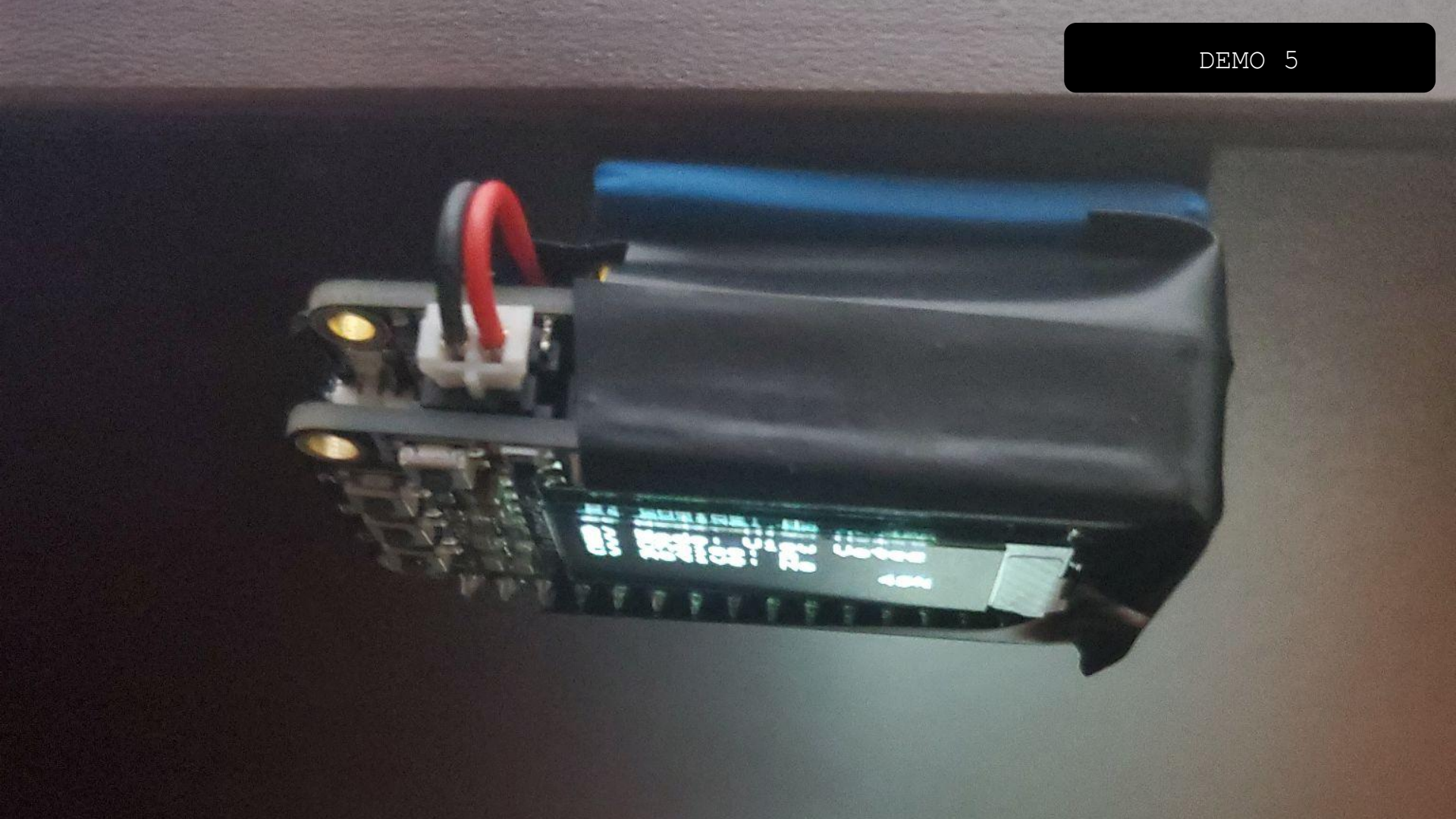


“Time Turner” Protocol

1. Remain idle until the class is about to begin
2. Turn on and start emulating both a remote and a base station
3. Wait until device overhears a burst of radio traffic
4. Determine most popular student response using base station emulator
5. Broadcast most popular response from remote emulator
6. Repeat 2-5 until the expected end time of the class

DEMO 4

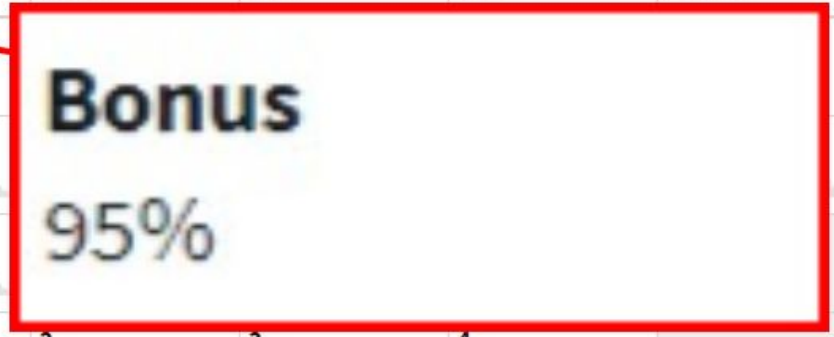



DEMO 5


DEMO 6
iClicker 2
A
NO BASE
DELETE
SEND
A
B
C
D
E


Mode: Copy Votes
Active: No
Mode: Fake Votes
Active: No
Mode: View Votes
Active: No
Mode: Vote Choice
Mode: Change Votes
Changed: 133

Assignment Name	Point Breakdown							
Bonus 95%	**1.** 100.0%	**2.** 100.0%	**3.** 0.0%	**4.** 0.0%	**5.** 100.0%	**6.** 100.0%	**7.** 100.0%	**8.** 100.0%
Checkpoints 100%	**1.** 100.0%					**6.** 100.0%	**7.** 100.0%	**8.** 100.0%
Discussions 95%	**Quiz 1** 0.0% (EX)					**Quiz 6** 100.0%	**Quiz 7** 100.0%	**Quiz 8** 100.0%
Exams 94%	**1.** 97.1%							
Exams - Scaled 94%	**1.** 97.1%	**2.** 87.0%	**3.** 93.6%	**4.** 96.8%				
Homework 98%	**1.** 100.0%					**6.** 97.5%	**7.** 99.5%	**8.** 98.7%
James Scholar	**1.**							
Labs 98%	**1.** 0.0% (EX)					**6.** 100.0%	**7.** 100.0%	**8.** 100.0%
Attendance 96%	**1.** 100.0%	**2.** 100.0%	**3.** 0.0%	**4.** 0.0%	**5.** 100.0%	**6.** 100.0%	**7.** 100.0%	**8.** 100.0%
Prelectures 100%	**1.** 100.0%	**2.** 100.0%	**3.** 100.0%	**4.** 100.0%	**5.** 100.0%	**6.** 100.0%	**7.** 100.0%	**8.** 100.0%



Authentication

Authentication

An authentication mechanism can be:

Authentication

An authentication mechanism can be:

1. Something you know (eg. passwords)

Authentication

An authentication mechanism can be:

1. Something you know (eg. passwords)
2. Something you have (eg. U2F keys)

Authentication

An authentication mechanism can be:

1. Something you know (eg. passwords)
2. Something you have (eg. U2F keys)
3. Something you are (eg. biometrics)

Authentication

An authentication mechanism can be:

1. Something you know (eg. passwords)
2. Something you have (eg. U2F keys)
3. Something you are (eg. biometrics)
4. Polling devices???

TABLE 3
ID Encoding

Byte 0	$I_0[4]$	$I_0[3]$	$I_0[2]$	$I_0[1]$	$I_0[0]$	$I_0[7]$	0	$I_1[7]$
Byte 1	$I_1[6]$	$I_1[5]$	$I_1[4]$	$I_1[3]$	$I_1[2]$	$I_1[1]$	0	$I_0[6]$
Byte 2	$I_1[0]$	$I_2[7]$	$I_2[6]$	$I_2[5]$	$I_2[4]$	$I_2[3]$	0	$I_0[5]$
Byte 3	$I_2[2]$	$I_2[1]$	$I_2[0]$	$I_2[0]$	0	0	0	0

Kerckhoffs's Principle

A system should be secure even if everything except the key is public knowledge.

TABLE 3
ID Encoding

Byte 0	$I_0[4]$	$I_0[3]$	$I_0[2]$	$I_0[1]$	$I_0[0]$	$I_0[7]$	0	$I_1[7]$
Byte 1	$I_1[6]$	$I_1[5]$	$I_1[4]$	$I_1[3]$	$I_1[2]$	$I_1[1]$	0	$I_0[6]$
Byte 2	$I_1[0]$	$I_2[7]$	$I_2[6]$	$I_2[5]$	$I_2[4]$	$I_2[3]$	0	$I_0[5]$
Byte 3	$I_2[2]$	$I_2[1]$	$I_2[0]$	$I_2[0]$	0	0	0	0

Kerckhoffs's Principle

A system should be secure even if everything except the key is public knowledge.

TABLE 3
ID Encoding

Byte 0	$I_0[4]$	$I_0[3]$	$I_0[2]$	$I_0[1]$	$I_0[0]$	$I_0[7]$	0	$I_1[7]$
Byte 1	$I_1[6]$	$I_1[5]$	$I_1[4]$	$I_1[3]$	$I_1[2]$	$I_1[1]$	0	$I_0[6]$
Byte 2	$I_1[0]$	$I_2[7]$	$I_2[6]$	$I_2[5]$	$I_2[4]$	$I_2[3]$	0	$I_0[5]$
Byte 3	$I_2[2]$	$I_2[1]$	$I_2[0]$	$I_2[0]$	0	0	0	0

Kerckhoffs's Principle

A system should be secure even if everything except the key is public knowledge.

TABLE 3
ID Encoding

Byte 0	$I_0[4]$	$I_0[3]$	$I_0[2]$	$I_0[1]$	$I_0[0]$	$I_0[7]$	0	$I_1[7]$
Byte 1	$I_1[6]$	$I_1[5]$	$I_1[4]$	$I_1[3]$	$I_1[2]$	$I_1[1]$	0	$I_0[6]$
Byte 2	$I_1[0]$	$I_2[7]$	$I_2[6]$	$I_2[5]$	$I_2[4]$	$I_2[3]$	0	$I_0[5]$
Byte 3	$I_2[2]$	$I_2[1]$	$I_2[0]$	$I_2[0]$	0	0	0	0

CIA Properties

CIA Properties

- Confidentiality

CIA Properties

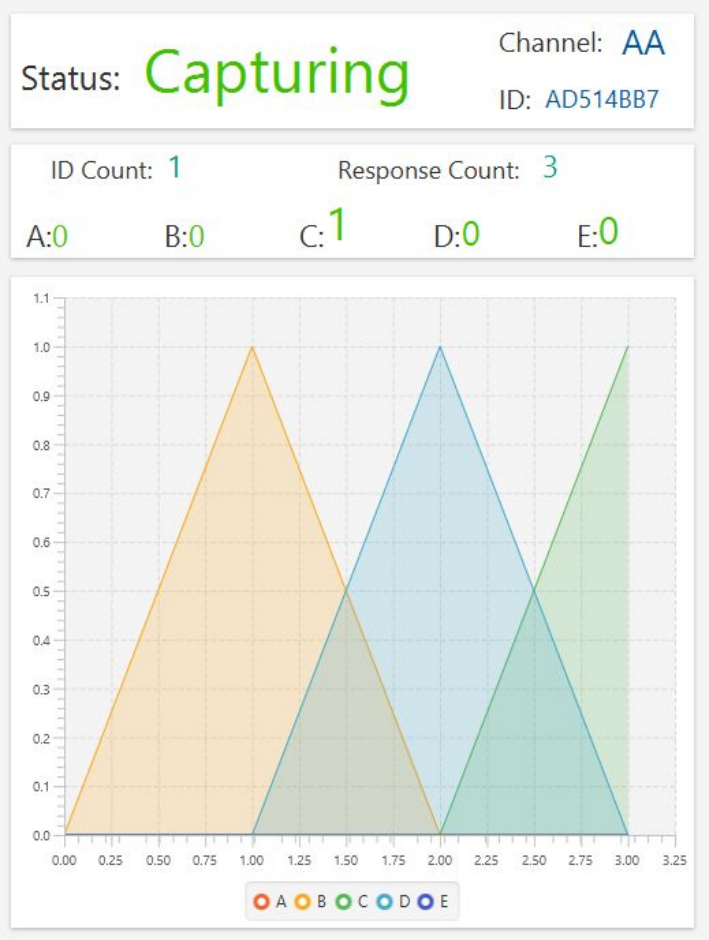
- Confidentiality
- Integrity

CIA Properties

- Confidentiality
- Integrity
- Availability

CIA Properties

- **Confidentiality**
- Integrity
- Availability

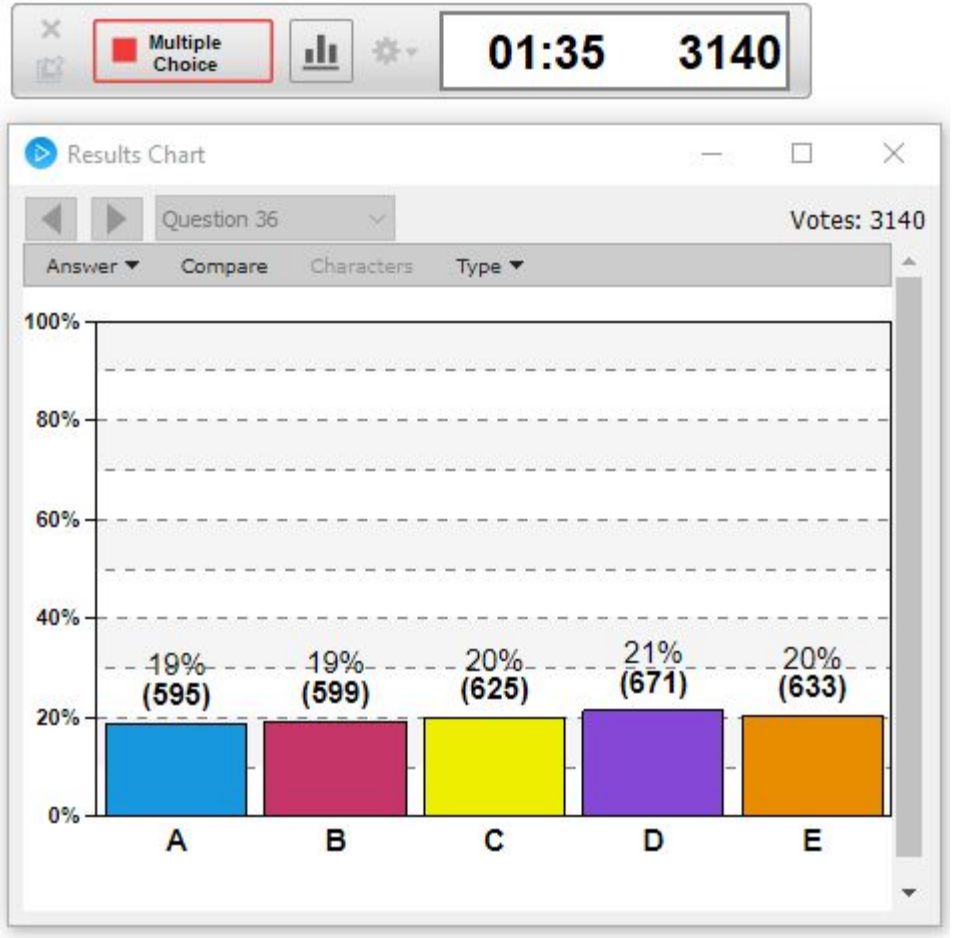


CIA Properties

- Confidentiality
- **Integrity**
- Availability

CIA Properties

- Confidentiality
- Integrity
- **Availability**



Availability

TABLE 2
[redacted]Channel Frequencies

Channel	Transmit Frequency (MHz)	Receive Frequency (MHz)
AA	916.47	902.98
AB	912.47	903.98
AC	913.47	905.48
AD	914.47	906.98
BA	915.47	907.98
BB	918.48	909.48
BC	919.47	910.97
BD	920.47	911.97
CA	921.47	913.47
CB	922.47	914.97
CC	906.48	915.97
CD	907.48	917.47
DA	904.98	918.47
DB	908.48	919.97
DC	910.48	921.47
DD	909.48	922.47

Availability

TABLE 2
[redacted]Channel Frequencies

Channel	Transmit Frequency (MHz)	Receive Frequency (MHz)
AA	916.47	902.98
AB	912.47	903.98
AC	913.47	905.48
AD	914.47	906.98
BA	915.47	907.98
BB	918.48	909.48
BC	919.47	910.97
BD	920.47	911.97
CA	921.47	913.47
CB	922.47	914.97
CC	906.48	915.97
CD	907.48	917.47
DA	904.98	918.47
DB	908.48	919.97
DC	910.48	921.47
DD	909.48	922.47

Availability

TABLE 2
[redacted]Channel Frequencies

Channel	Transmit Frequency (MHz)	Receive Frequency (MHz)
AA	916.47	902.98
AB	912.47	903.98
AC	913.47	905.48
AD	914.47	906.98
BA	915.47	907.98
BB	918.48	909.48
BC	919.47	910.97
BD	920.47	911.97
CA	921.47	913.47
CB	922.47	914.97
CC	906.48	915.97
CD	907.48	917.47
DA	904.98	918.47
DB	908.48	919.97
DC	910.48	921.47
DD	909.48	922.47

TABLE 1
Answer Packet Contents

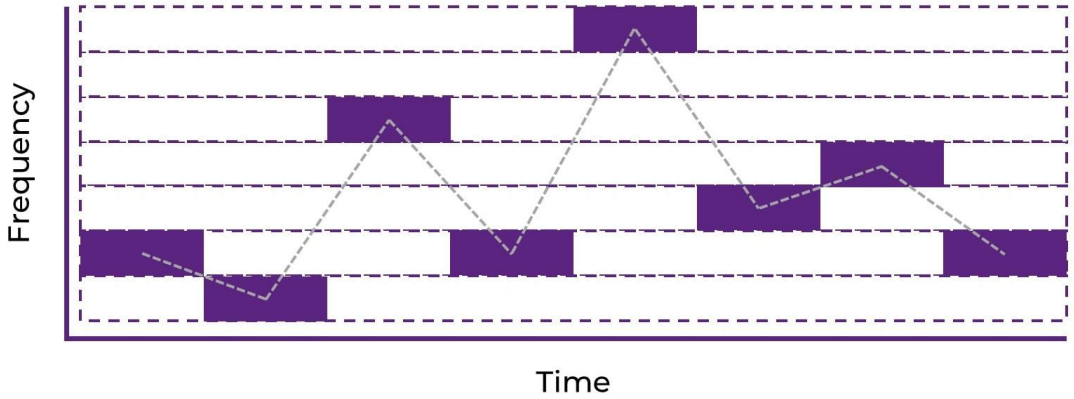
Answer	Packet Contents
A	0x7d, 0x28, 0x0c, 0x01, 0xb2
B	0x7d, 0x28, 0x0c, 0x05, 0xb6
C	0x7d, 0x28, 0x0c, 0x0d, 0xbe
D	0x7d, 0x28, 0x0c, 0x0e, 0xbf
E	0x7d, 0x28, 0x0c, 0x0a, 0xbb

Availability

TABLE 2
[redacted]Channel Frequencies

Channel	Transmit Frequency (MHz)	Receive Frequency (MHz)
AA	916.47	902.98
AB	912.47	903.98
AC	913.47	905.48
AD	914.47	906.98
BA	915.47	907.98
BB	918.48	909.48
BC	919.47	910.97
BD	920.47	911.97
CA	921.47	913.47
CB	922.47	914.97
CC	906.48	915.97
CD	907.48	917.47
DA	904.98	918.47
DB	908.48	919.97
DC	910.48	921.47
DD	909.48	922.47

Frequency-hopping spread spectrum

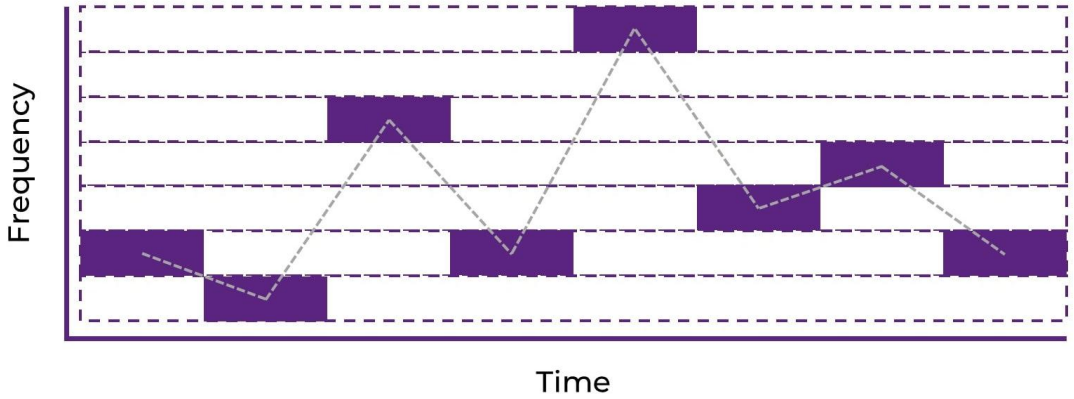


Availability

TABLE 2
[redacted]Channel Frequencies

Channel	Transmit Frequency (MHz)	Receive Frequency (MHz)
AA	916.47	902.98
AB	912.47	903.98
AC	913.47	905.48
AD	914.47	906.98
BA	915.47	907.98
BB	918.48	909.48
BC	919.47	910.97
BD	920.47	911.97
CA	921.47	913.47
CB	922.47	914.97
CC	906.48	915.97
CD	907.48	917.47
DA	904.98	918.47
DB	908.48	919.97
DC	910.48	921.47
DD	909.48	922.47

Frequency-hopping spread spectrum

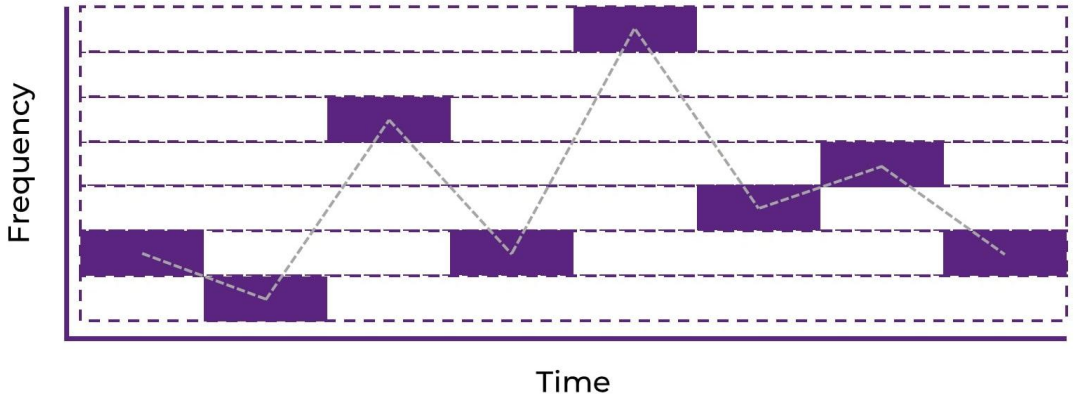


Availability

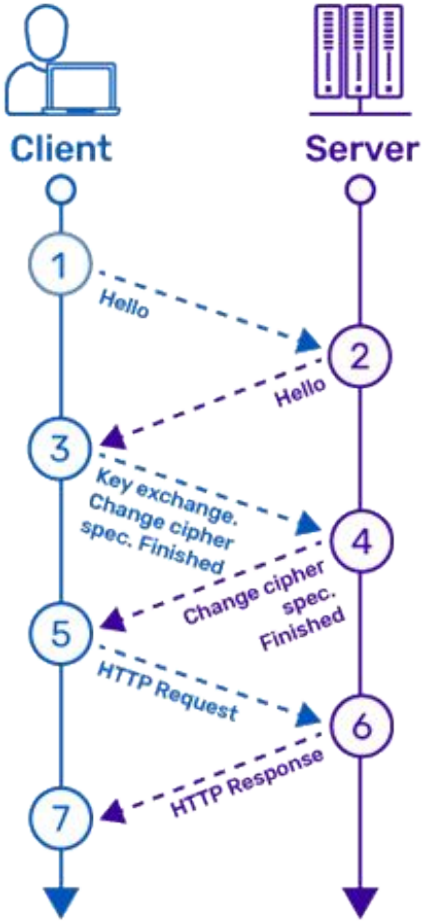
TABLE 2
[redacted]Channel Frequencies

Channel	Transmit Frequency (MHz)	Receive Frequency (MHz)
AA	916.47	902.98
AB	912.47	903.98
AC	913.47	905.48
AD	914.47	906.98
BA	915.47	907.98
BB	918.48	909.48
BC	919.47	910.97
BD	920.47	911.97
CA	921.47	913.47
CB	922.47	914.97
CC	906.48	915.97
CD	907.48	917.47
DA	904.98	918.47
DB	908.48	919.97
DC	910.48	921.47
DD	909.48	922.47

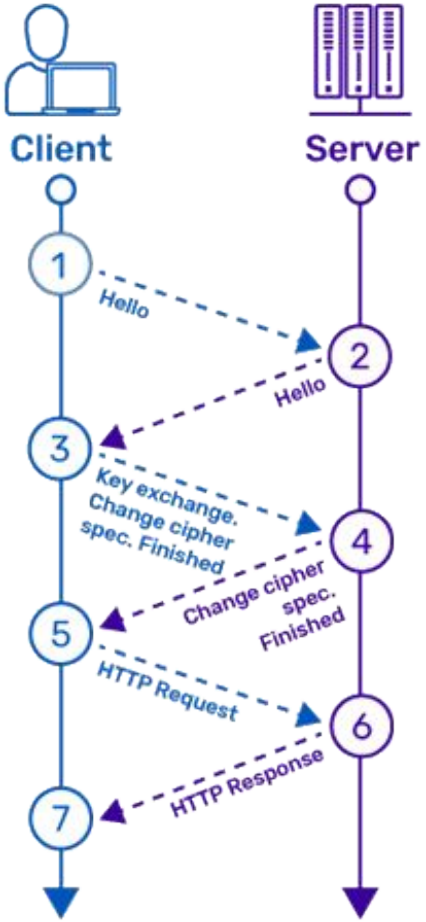
Frequency-hopping spread spectrum



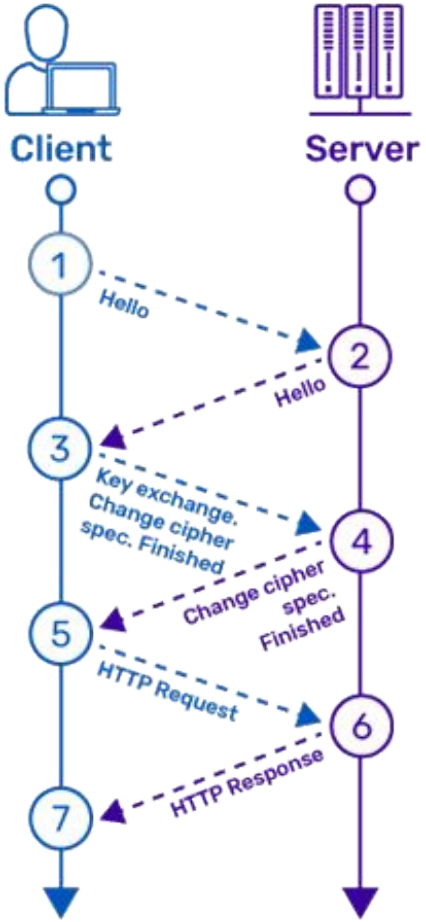
Confidentiality



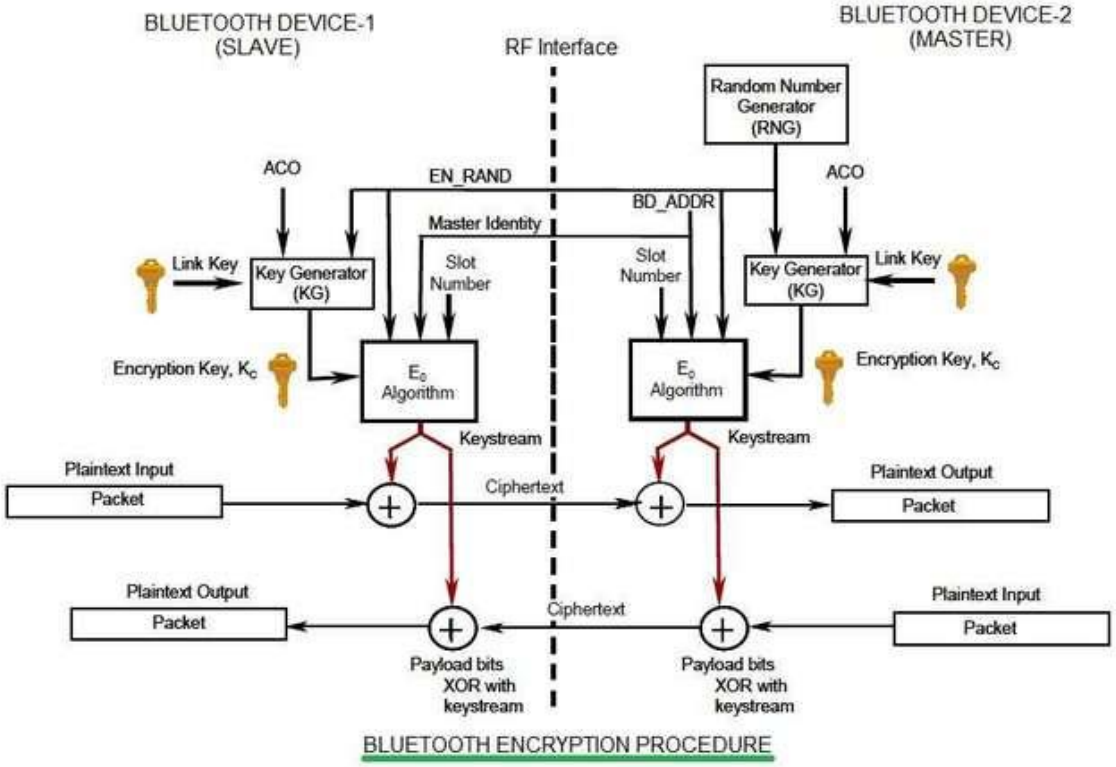
Confidentiality

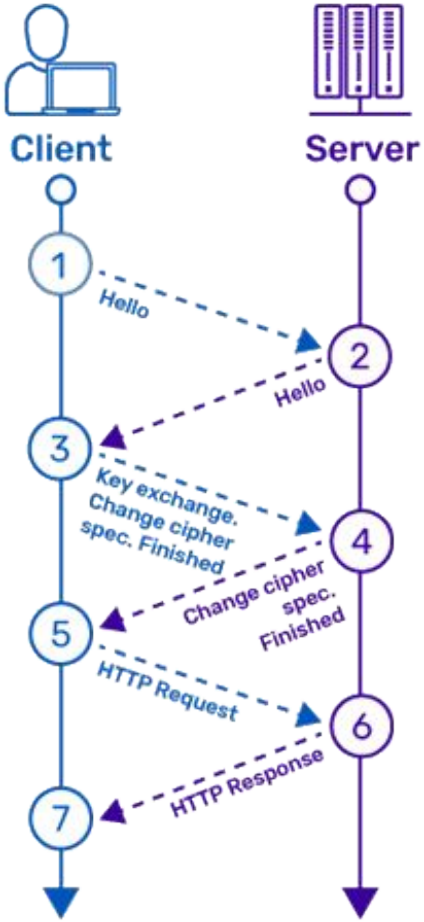


Confidentiality

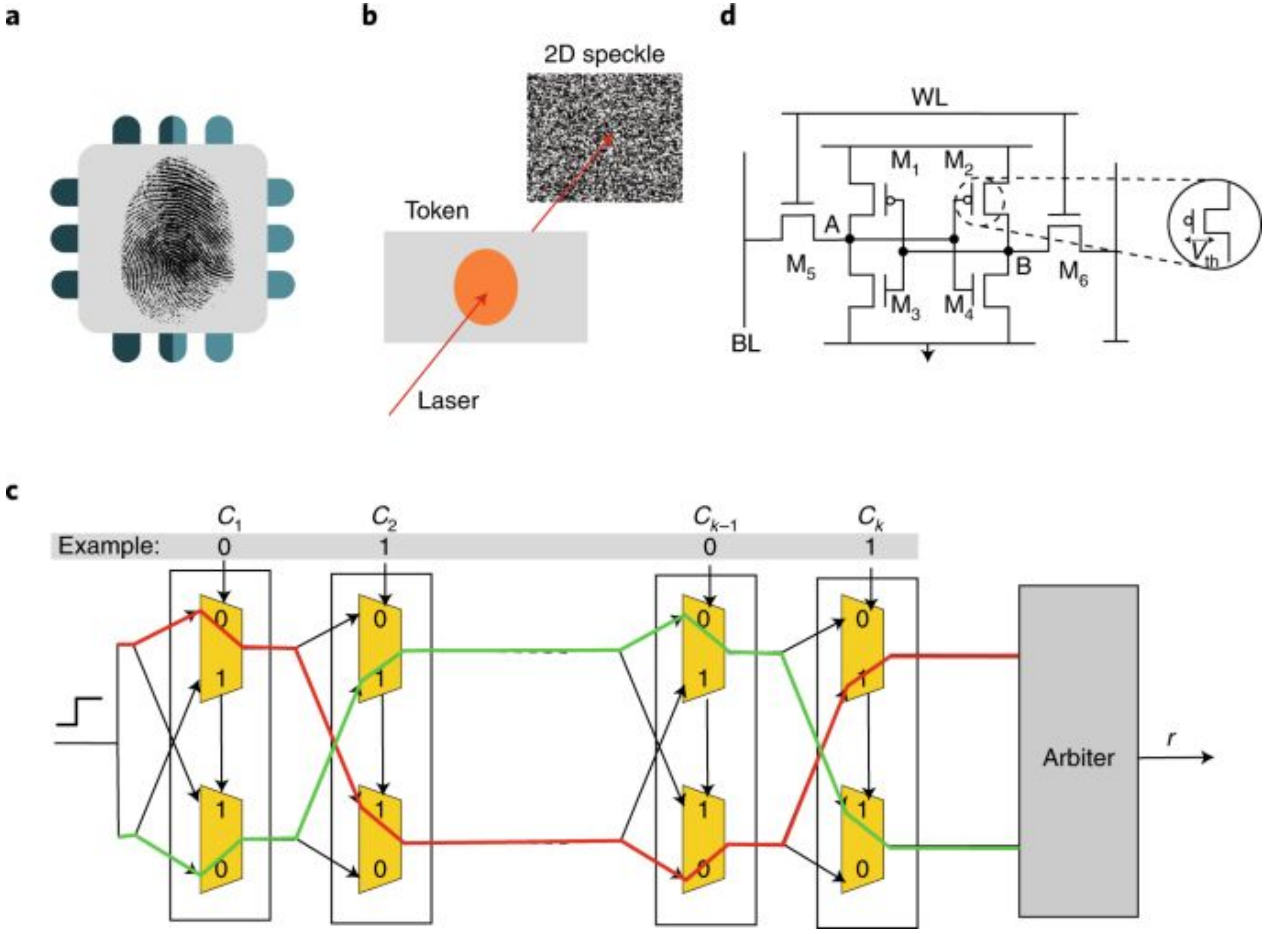


Confidentiality

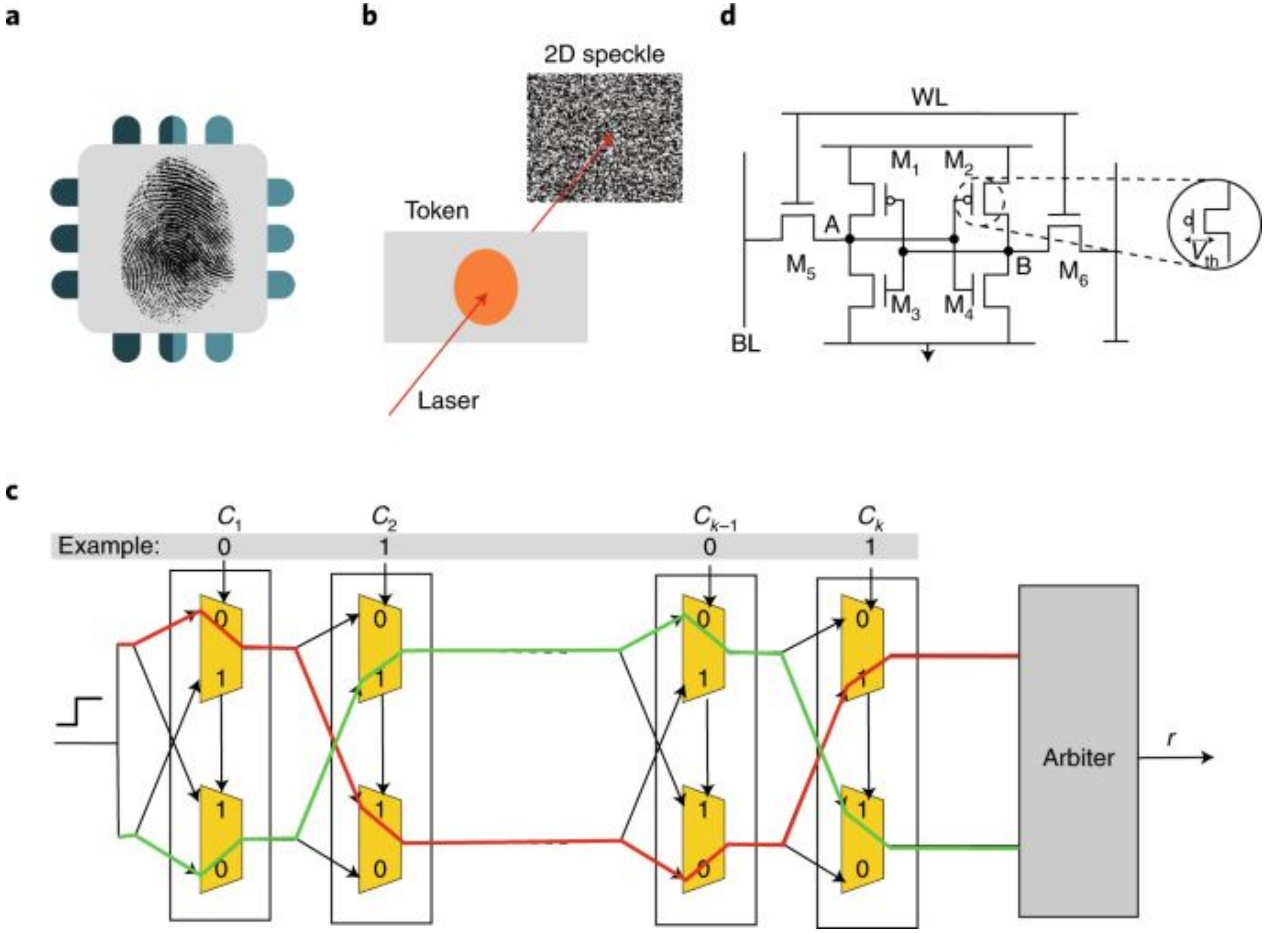




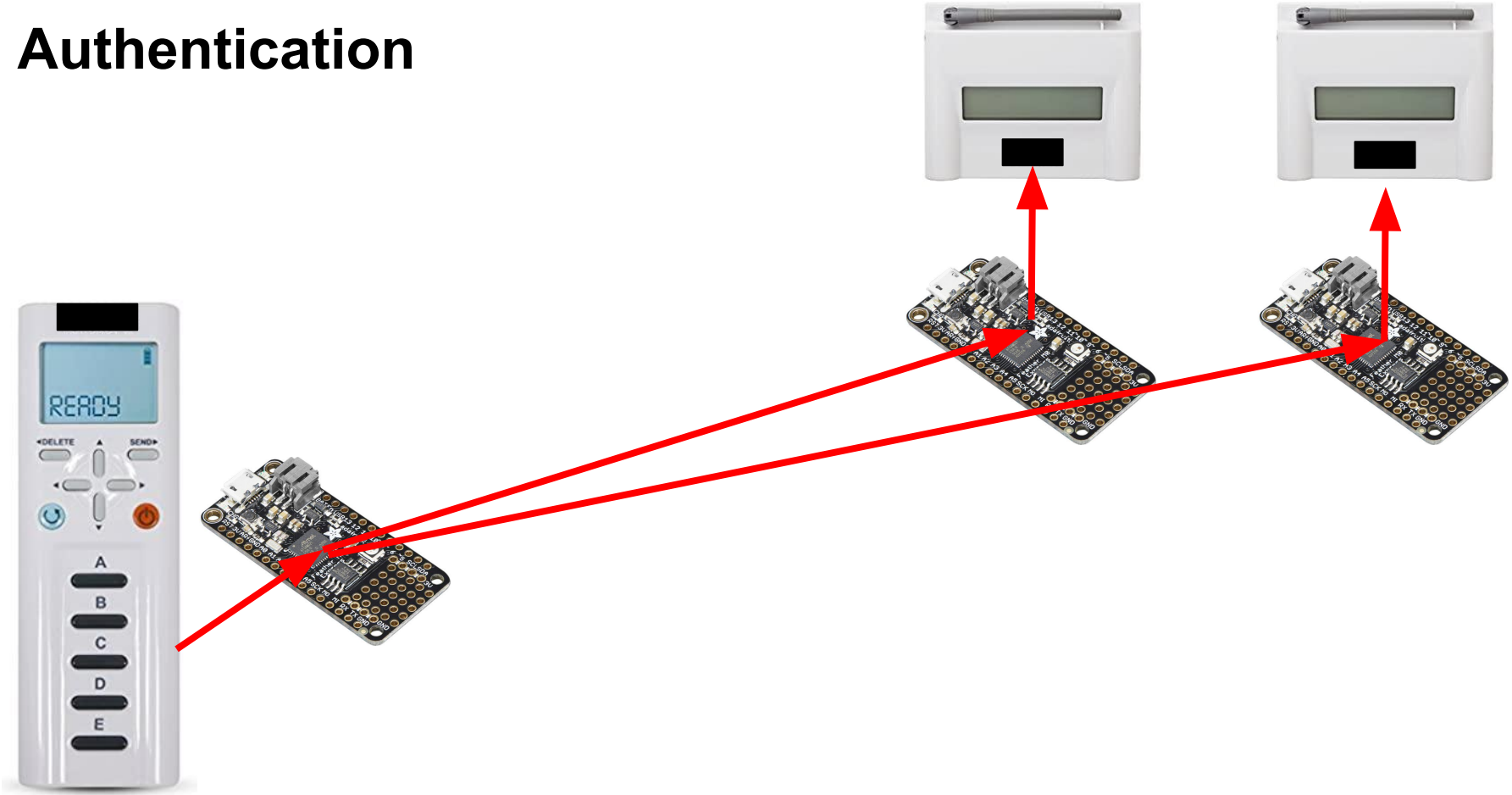
Integrity


a
b
2D speckle
Token
Laser
d
WL
M1
M2
A
B
M5
M6
M3
M4
BL
Vth
c
C1
C2
Ck−1
Ck
Example:
0
1
0
1
Arbiter
r

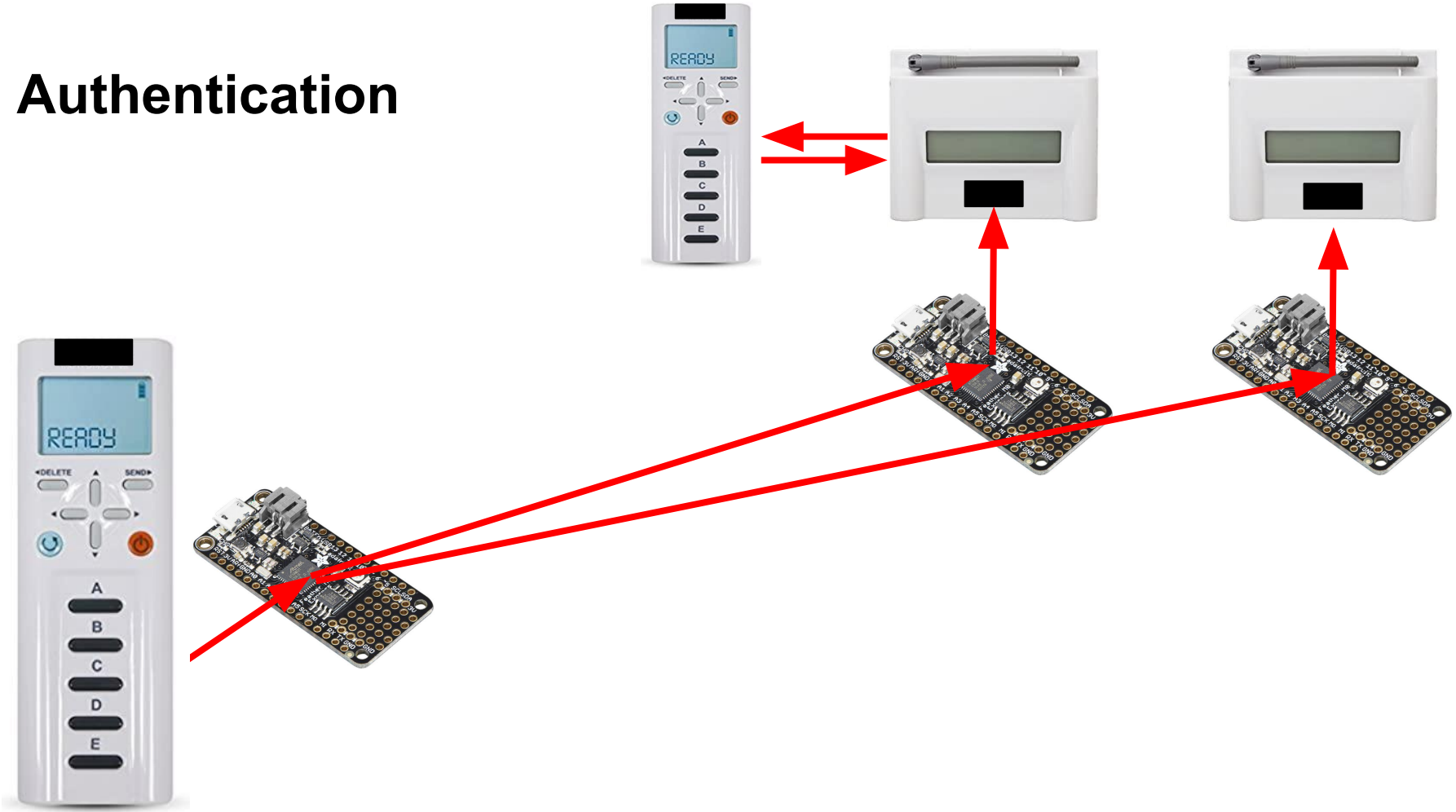
Integrity


a
b
2D speckle
Token
Laser
d
WL
M1
M2
A
B
M5
M6
M3
M4
BL
Vth
c
C1
C2
Ck−1
Ck
Example:
0
1
0
1
Arbiter
r

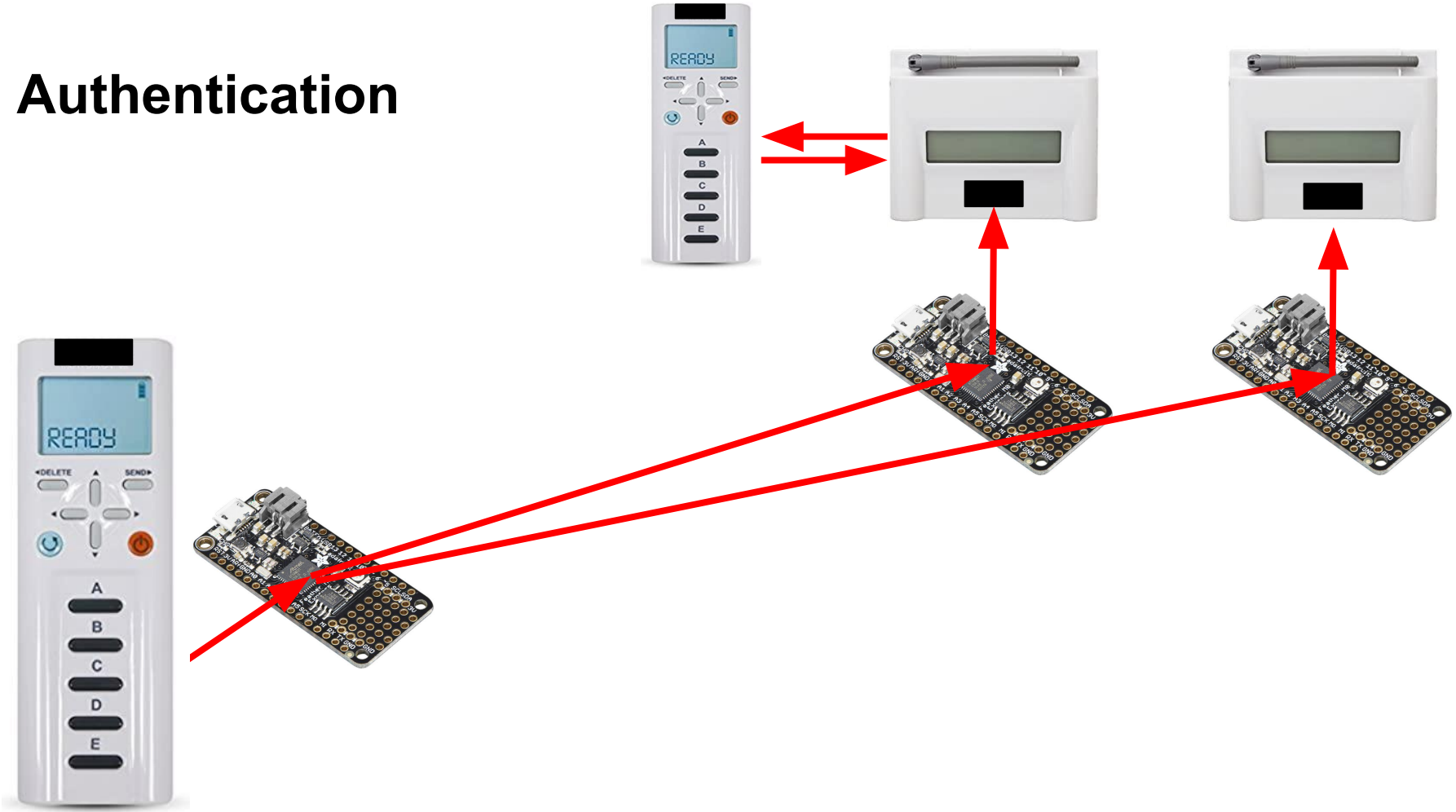
Authentication



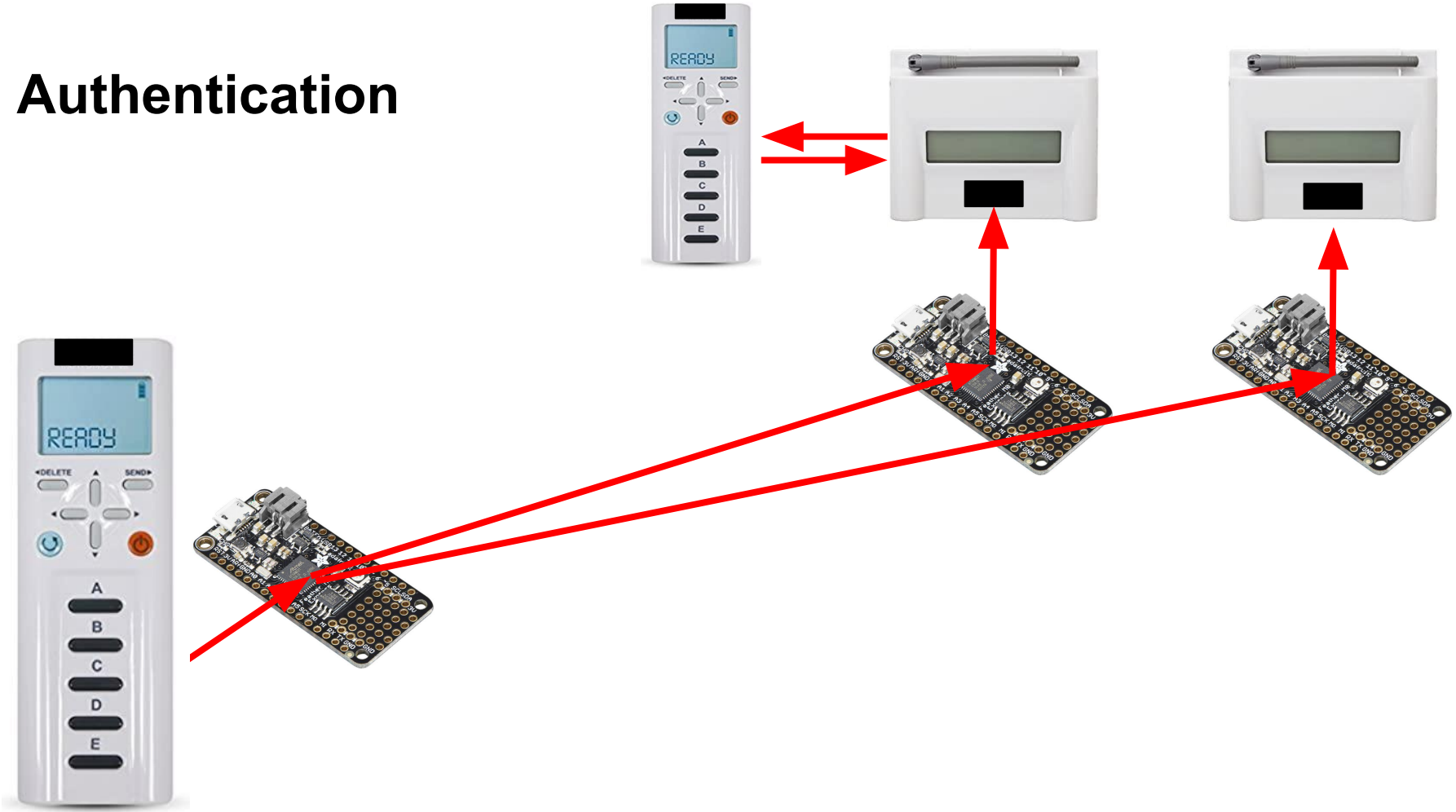
Authentication



Authentication



Authentication



Security Summary

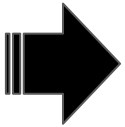
Security Summary

Security Summary

1. Use FHSS to avoid DoS attacks
2. Use encryption in transit

Security Summary

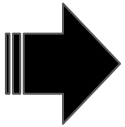
1. Use FHSS to avoid DoS attacks
2. Use encryption in transit



Bluetooth (or BLE)
(Kerckhoffs's Principle)

Security Summary

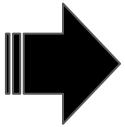
1. Use FHSS to avoid DoS attacks
2. Use encryption in transit
3. Use PUF
4. Use timed challenge-response



Bluetooth (or BLE)
(Kerckhoffs's Principle)

Security Summary

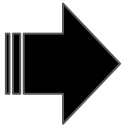
1. Use FHSS to avoid DoS attacks
2. Use encryption in transit
3. Use PUF
4. Use timed challenge-response



Bluetooth (or BLE)
(Kerckhoffs's Principle)

Security Summary

1. Use FHSS to avoid DoS attacks
2. Use encryption in transit
3. Use PUF
4. Use timed challenge-response



Bluetooth (or BLE)
(Kerckhoffs's Principle)

iClicker

from $27.99

ISBN:9781498603041

Innovative classroom response system

Rent (3 months)	$27.99
Rent (4 months)	$29.99
Rent (6 months)	$34.99
Rent (1 year)	$49.99
Buy	$53.99

MASSMAIL - [redacted] Online Strategy

[redacted]

to me

Mar 14, 2020, 9:56 AM

Greetings from [redacted]

As you know, the university recommends that beginning March 13, all in-person meetings be moved to an alternative solution. Our classes will be held remotely as of March 23, 2020. Below you will find an outline of our plans moving forward.

[redacted] Online Strategy

Online Components: Prelecture, Checkpoint and Homework will continue to be delivered using https://[redacted] without any changes.

Lectures: Lectures will be built using your responses to the checkpoint questions, recorded and available by 2:00 pm US Central time on the day of the lecture via a link on the course schedule https://[redacted] It is expected that all students will review the lecture and attempt the interactive questions therefore all will be awarded full participation and bonus points.

Discussion: Your discussion TA will send you a zoom link which will give you access to a virtual discussion room during your usual discussion time.

Discussion Quiz: A link to a pdf of the quiz will be posted on the course syllabus on Thursday at 6 PM US Central time. You will have 24 hours to complete the quiz, and upload a pdf version of your hand written solutions to this link https://[redacted] We have made a demo assignment that will allow you to upload a pdf right now just to test that the system works for you. Note, that you can upload as many times as you want before the deadline. The most recent submission will be grades. We are providing 24 hours to complete the quiz in order to accommodate a variety of schedules. However we expect that the work you submit is completed on your own, using only the course formula sheet and a calculator, just as we would do during class. Using any additional resources will considered a violation of academic integrity.

Lab: Complete your prelab as usual. Take a picture and upload it as a pdf using same upload link https://[redacted]

MASSMAIL - [redacted] Online Strategy

[redacted]

to me

Mar 14, 2020, 9:56 AM

Greetings from [redacted]

As you know, the university recommends that beginning March 13, all in-person meetings be moved to an alternative solution. Our classes will be held remotely as of March 22[redacted]

"Our classes will be held remotely"

Online Components: Prelecture, Checkpoint and Homework will continue to be delivered using https://[redacted] without any changes.

Lectures: Lectures will be built using your responses to the checkpoint questions, recorded and available by 2:00 pm US Central time on the day of the lecture via a link on the course schedule https://[redacted] It is expected that all students will review the lecture and attempt the interactive questions therefore all will be awarded full participation and bonus points.

Discussion: Your discussion TA will send you a zoom link which will give you access to a virtual discussion room during your usual discussion time.

"all will be awarded full participation and bonus points"

[redacted] We have made a demo assignment that will allow you to upload a pdf right now just to test that the system works for you. Note, that you can upload as many times as you want before the deadline. The most recent submission will be grades. We are providing 24 hours to complete the quiz in order to accommodate a variety of schedules. However we expect that the work you submit is completed on your own, using only the course formula sheet and a calculator, just as we would do during class. Using any additional resources will considered a violation of academic integrity.

Lab: Complete your prelab as usual. Take a picture and upload it as a pdf using same upload link https://[redacted]