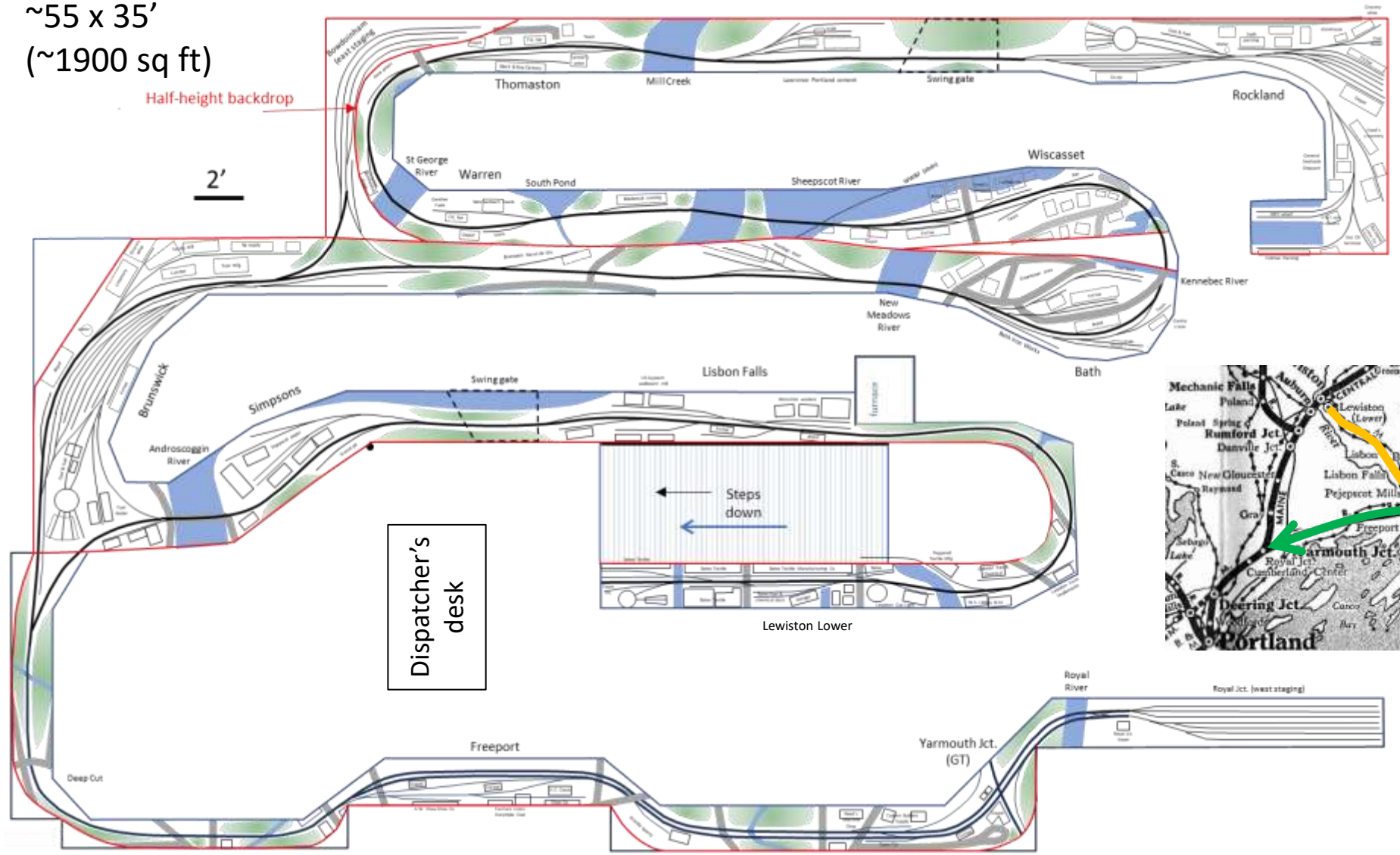
Arduinos and AI for developing a train order signal system…. and other projects

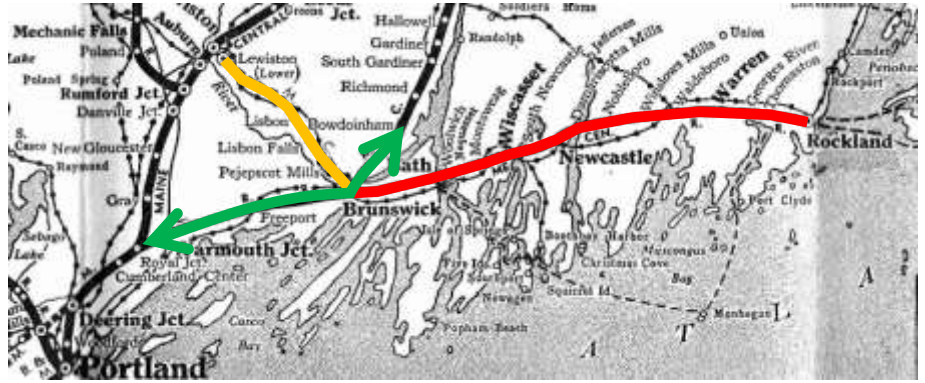
Bill Lund and Rich Gibson

June 2026

Maine Central Portland Division

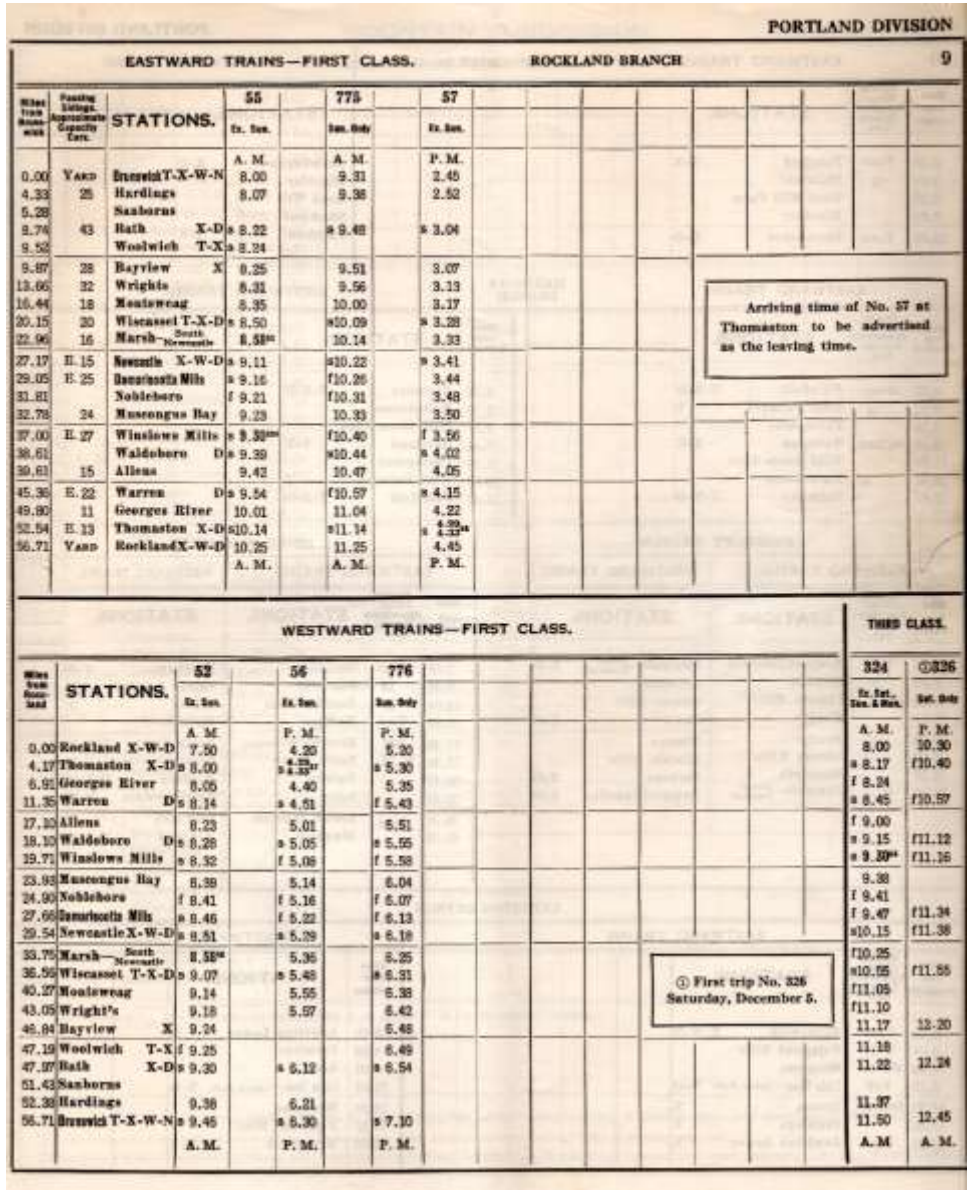
~55 x 35’
(~1900 sq ft)





- MEC mainline
- Lewiston Lower Br.
- Rockland Br.

Prototype timetable and train orders



PORTLAND DIVISION

EASTWARD TRAINS—FIRST CLASS. ROCKLAND BRANCH 9

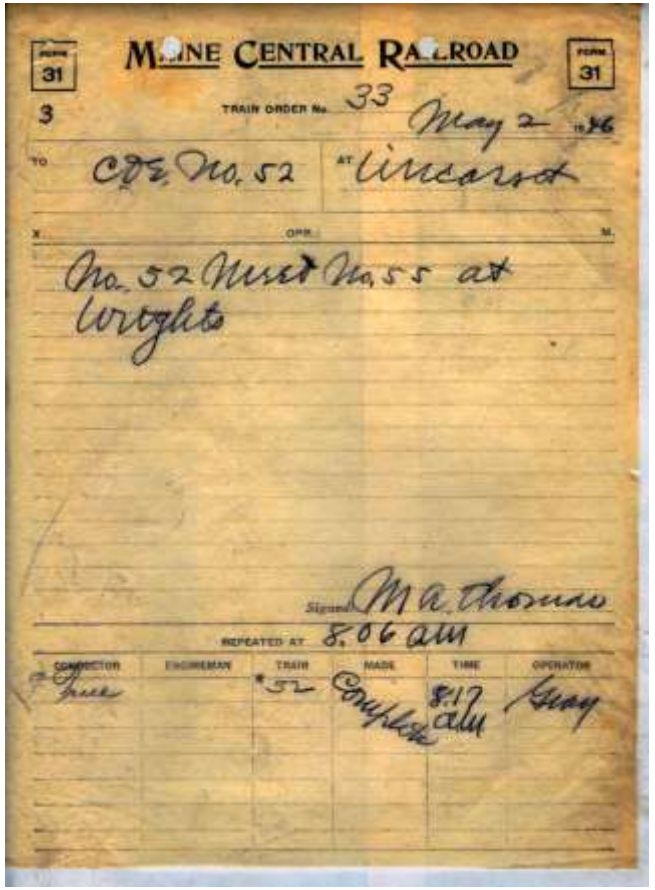
Miles from Rockland	Passing Sidings. Approximate Capacity Cars.	STATIONS.	55 Ex. Sun.	775 Sun. Only	57 Ex. Sun.
			A. M.	A. M.	P. M.
0.00	Yard	Brunswick T-X-W-N	8.00	9.31	2.45
4.33	25	Hardings	8.07	9.38	2.52
5.28		Sanborns			
9.74	43	Bath X-D	s 8.22	s 9.48	s 3.04
9.52		Woolwich T-X	s 8.24		
9.87	28	Bayview X	8.25	9.51	3.07
13.66	32	Wrights	8.31	9.56	3.13
16.44	18	Montsweag	8.35	10.00	3.17
20.15	30	Wiscasset T-X-D	s 8.50	s10.09	s 3.28
22.96	16	Marsh—South Newcastle	8.58[ss]	10.14	3.33
27.17	E. 15	Newcastle X-W-D	s 9.11	s10.22	s 3.41
29.05	E. 25	Damariscotta Mills	s 9.16	f10.26	3.44
31.81		Nobleboro	f 9.21	f10.31	3.48
32.78	24	Muscongus Bay	9.23	10.33	3.50
37.00	E. 27	Winslows Mills	s 9.33[ss]	f10.40	f 3.56
38.61		Waldoboro D	s 9.39	s10.44	s 4.02
39.61	15	Allens	9.42	10.47	4.05
45.36	E. 22	Warren D	s 9.54	f10.57	s 4.15
49.80	11	Georges River	10.01	11.04	4.22
52.54	E. 13	Thomaston X-D	s10.14	s11.14	s 4.39 / 4.33[ss]
56.71	Yard	Rockland X-W-D	10.25	11.25	4.45
			A. M.	A. M.	P. M.

Arriving time of No. 57 at Thomaston to be advertised as the leaving time.

WESTWARD TRAINS—FIRST CLASS. THIRD CLASS.

Miles from Rockland	STATIONS.	52 Ex. Sun.	56 Ex. Sun.	776 Sun. Only	324 Ex. Sat., Sun. & Mon.	①326 Sat. Only
		A. M.	P. M.	P. M.	A. M.	P. M.
0.00	Rockland X-W-D	7.50	4.20	5.20	8.00	10.30
4.17	Thomaston X-D	s 8.00	s 4.33 / 4.37[ss]	s 5.30	s 8.17	f10.40
6.91	Georges River	8.05	4.40	5.35	f 8.24	
11.35	Warren D	s 8.14	s 4.51	f 5.43	s 8.45	f10.57
17.10	Allens	8.23	5.01	5.51	f 9.00	
18.10	Waldoboro D	s 8.28	s 5.05	s 5.55	s 9.15	f11.12
19.71	Winslows Mills	s 8.32	f 5.08	f 5.58	s 9.33[ss]	f11.16
23.93	Muscongus Bay	8.39	5.14	6.04	9.38	
24.90	Nobleboro	f 8.41	f 5.16	f 6.07	f 9.41	
27.66	Damariscotta Mills	s 8.46	f 5.22	f 6.13	f 9.47	f11.34
29.54	Newcastle X-W-D	s 8.51	s 5.29	s 6.18	s10.15	f11.38
33.75	Marsh—South Newcastle	8.58[ss]	5.36	6.25	f10.25	
36.56	Wiscasset T-X-D	s 9.07	s 5.48	s 6.31	s10.55	f11.55
40.27	Montsweag	9.14	5.55	6.38	f11.05	
43.05	Wright's	9.18	5.57	6.42	f11.10	
46.84	Bayview X	9.24		6.48	11.17	12.20
47.19	Woolwich T-X	f 9.25		6.49	11.18	
47.37	Bath X-D	s 9.30	s 6.12	s 6.54	11.22	12.24
51.43	Sanborns					
52.38	Hardings	9.38	6.21		11.37	
56.71	Brunswick T-X-W-N	s 9.45	s 6.30	s 7.10	11.50	12.45
		A. M.	P. M.	P. M.	A. M.	A. M.

① First trip No. 326 Saturday, December 5.



FORM 31

MAINE CENTRAL RAILROAD

FORM 31

3

TRAIN ORDER No. 33 May 2 1936

TO C&E No. 52 AT Limerock

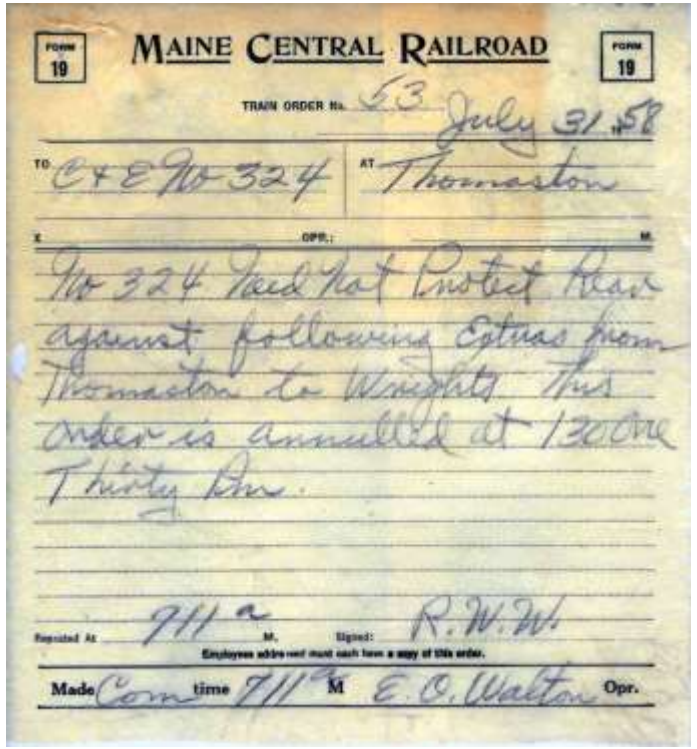
X OPR. M.

No. 52 Must No. 55 at Wrights

Signed M A Thomas

REPEATED AT 8.06 am

CONDUCTOR	ENGINEMAN	TRAIN	MADE	TIME	OPERATOR
Free		52	Complete	8.17 am	Gray



FORM 19

MAINE CENTRAL RAILROAD

FORM 19

TRAIN ORDER No. 53 July 31 1958

TO C&E No 324 AT Thomaston

X OPR. M.

No 324 Said Not Protect Rear against following Extras from Thomaston to Wrights This order is annulled at 1200 noon Thirty Min.

Repeated At 911a M. Signed: R.W.W.

Employees addressed must each have a copy of this order.

Made Com time 911a M E.O. Walton Opr.

Wiscasset depot with train order signals

Layout implementation of TT&TO

PORTLAND DIVISION - via BRUNSWICK

EASTWARD TRAINS - FIRST CLASS

Miles from Brunswick	Passing Sidings Approx. Cars	STATIONS.		1	55	57
					A.M.	P.M.
1.57		Portland				
13.30	west staging	Royal Jct.	N		7:35	2:22
15.09		Yarmouth Jct.	N-S		7:40	2:27
20.64		Freeport	D-S		7:50	2:37
29.21		Brunswick	W-N-S		8:00	2:47
36.90	east staging	Bowdoinham	D			
81.76		Waterville				
					A.M.	P.M.

WESTWARD TRAINS - FIRST CLASS

Miles from Rockland	Passing Sidings Approx. Cars	STATIONS.		52	12	56
				A.M.		P.M.
81.76		Waterville				
36.90	east staging	Bowdoinham	D			
29.21		Brunswick	W-N-S	9:30		3:59
20.64		Freeport	D-S	9:40		4:09
15.09		Yarmouth Jct.	N-S	9:50		4:19
13.30	west staging	Royal Jct.	N	9:55		4:24
1.57		Portland				
				A.M.		P.M.

WESTWARD TRAINS ARE SUPERIOR TO EASTWARD TRAINS OF THE SAME CLASS.

D or N train order office S station stop W water Train registers at Freeport and Brunswick

PORTLAND DIVISION - ROCKLAND BRANCH

EASTWARD TRAINS - FIRST CLASS

Miles from Brunswick	Passing Sidings Approx. Cars	STATIONS.		55	57	THIRD CLASS
				A.M.	P.M.	
0.00	yard	Brunswick	W-N-S	8:00	2:47 3:12	
4.33		Hardings		8:05	3:17	
8.74	11	Bath	D-S	8:16	3:27 66	
20.15	11	Wiscasset	D-S	8:20 62	3:32 3:57	
45.36		Warren	D-S	8:35	4:07	
52.54	6	Thomaston	D-S	8:45	4:17	
56.71	yard	Rockland	W-D-S	8:50	4:27	
				A.M.	P.M.	

WESTWARD TRAINS - FIRST CLASS

Miles from Rockland	Passing Sidings Approx. Cars	STATIONS.		52	56	324
				A.M.	P.M.	A.M.
0.00	yard	Rockland	W-D-S	7:50	2:45	10:30
4.33	6	Thomaston	D-S	8:00	2:50	10:55
8.74		Warren	D-S	8:10	3:01	11:20
20.15	11	Wiscasset	D-S	8:20 8:45 55	3:18	11:45
45.36	11	Bath	D-S	8:55	3:29 57	12:00
52.54		Hardings		9:05	3:34	12:05
56.71	yard	Brunswick	W-N-S	9:10 9:30	3:59	12:10
				A.M.	P.M.	P.M.

WESTWARD TRAINS ARE SUPERIOR TO EASTWARD TRAINS OF THE SAME CLASS.

D or N train order office S station stop W water Train registers at Brunswick, Bath, and Rockland.

PORTLAND DIVISION - LEWISTON BRANCH

EASTWARD TRAINS

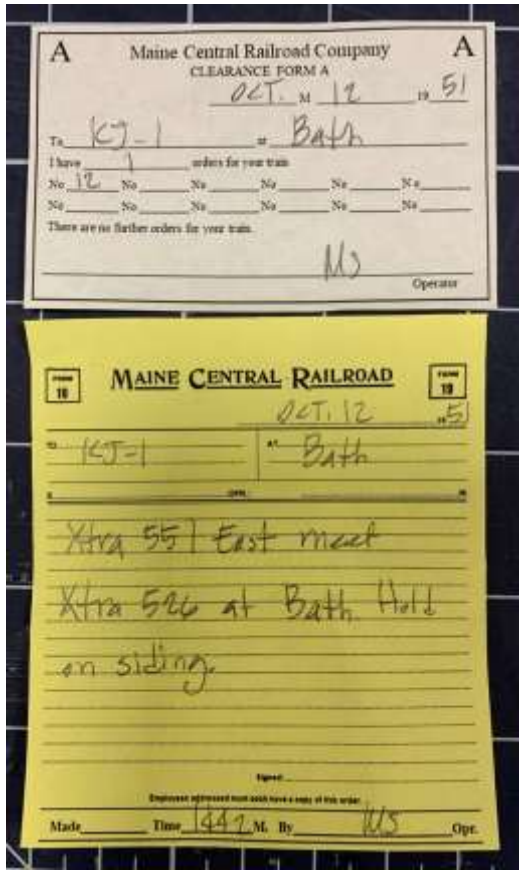
Miles from Brunswick	Passing Sidings Approx. Cars	STATIONS.		
0.00	yard	Brunswick	N-S	
5.99	mill spur	Simpsons		
8.74	9	Little River - Lisbon Falls	D	
19.63	yard	Lewiston Lower	W	

WESTWARD TRAINS - FIRST CLASS

Miles from Brunswick	Passing Sidings Approx. Cars	STATIONS.		
19.63	yard	Lewiston Lower	W	
8.74	9	Little River - Lisbon Falls	D	
5.99	mill spur	Simpsons		
0.00	yard	Brunswick	N-S	

WESTWARD TRAINS ARE SUPERIOR TO EASTWARD TRAINS OF THE SAME CLASS.

D or N train order office S station stop W water Train register at Brunswick and Lewiston Lower

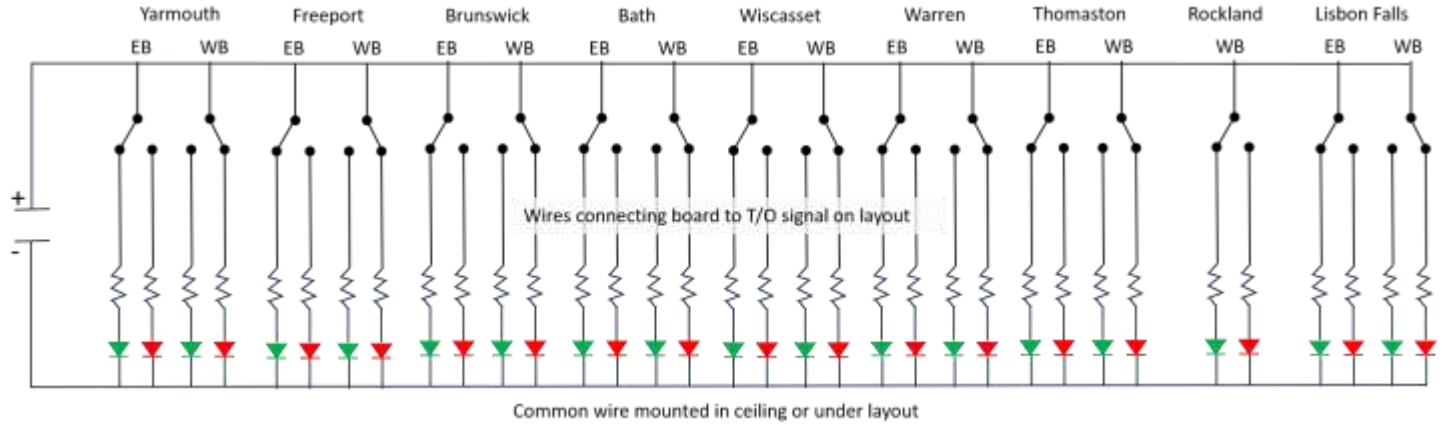


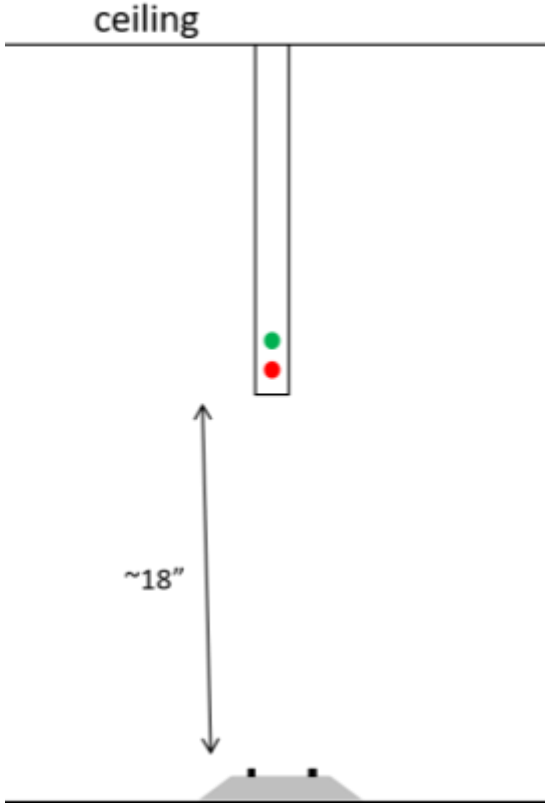
Dispatching

3:1 fast clock

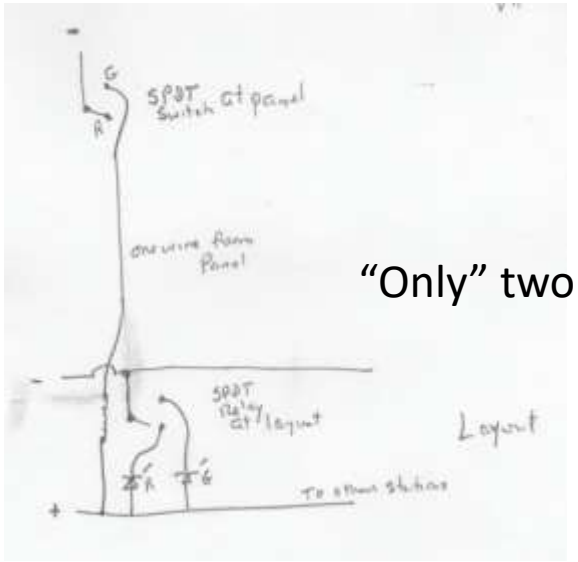
Is there a better way to implement T/O signals?

Of course there is…. control them from the dispatcher's desk





5 wires from panel to layout
for each T/O station!



"Only" two wires to layout for each T/O station

I bought the wire and needed components….

And then I met Bill….

"I'll bet we can do this wirelessly."

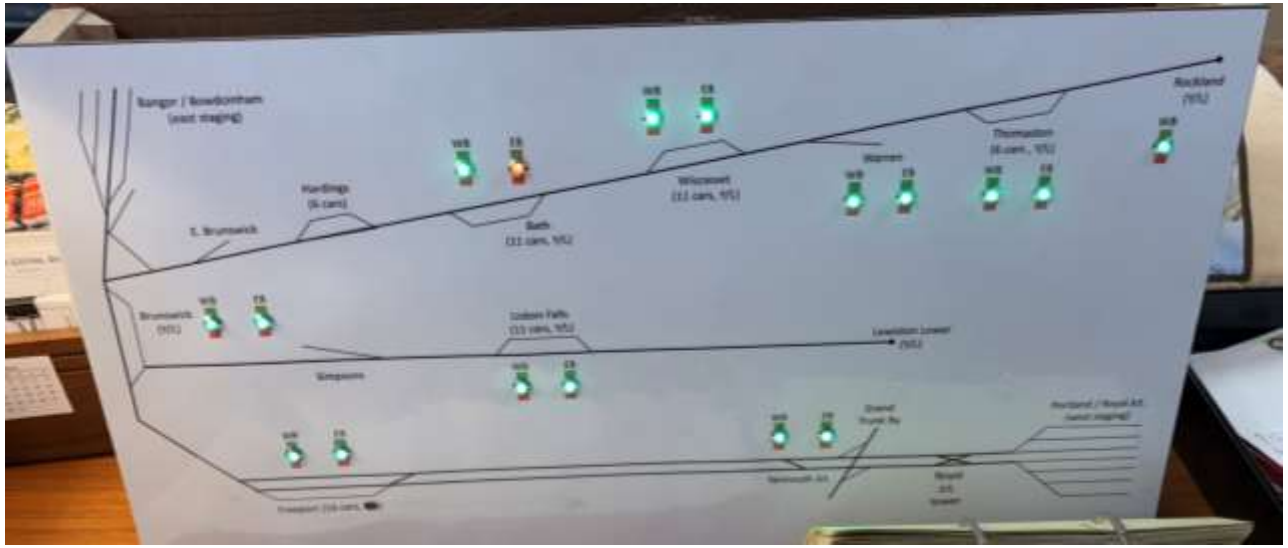
Bill had been researching things that could be done with ESP32 boards and seemed unafraid of trying anything.

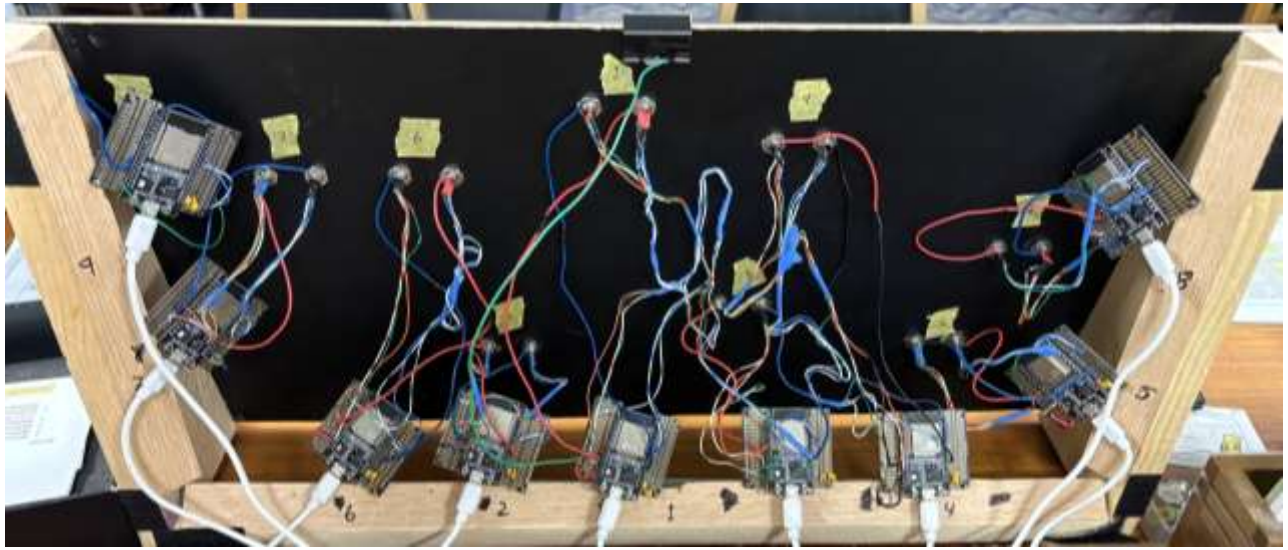
By that evening, Bill had an initial plan developed (using ChatGPT).

Three months later, we had a working system installed.

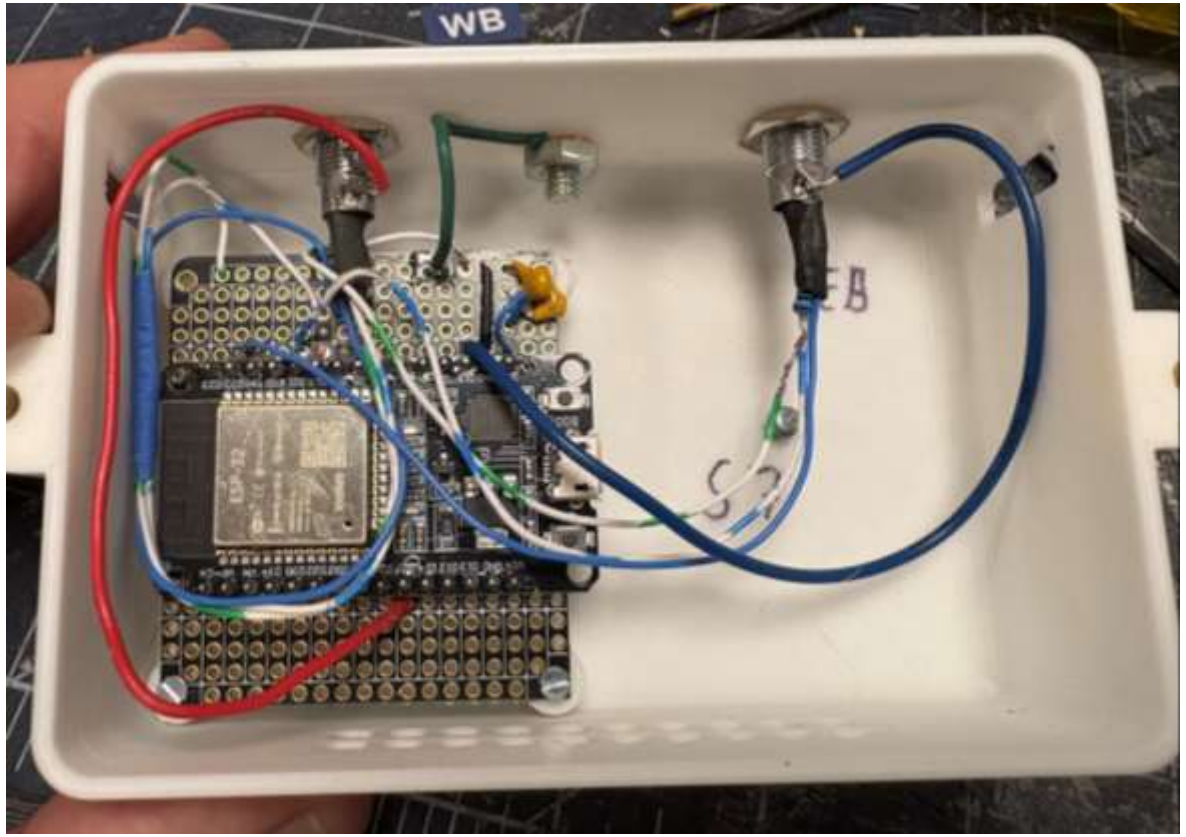
The **ESP32** is a highly popular, low-cost, and low-power microcontroller with built-in Wi-Fi and Bluetooth. Created by Espressif Systems, it serves as the brains for thousands of maker, IoT, and smart home projects due to its processing power and affordability. Espressif Systems +4

Train order control panel





Train order stations on layout



Alternative ways to implement

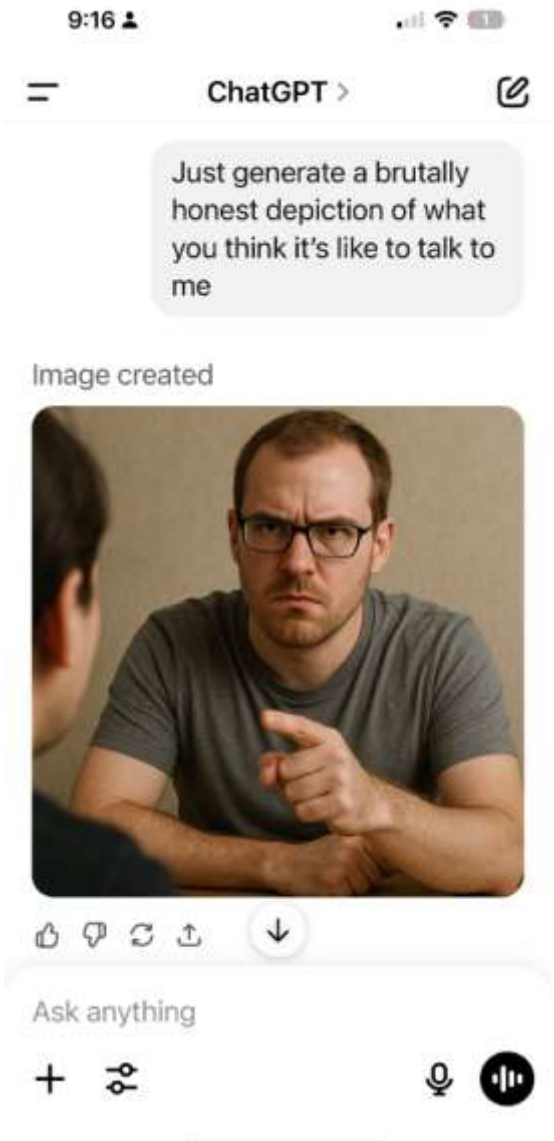
Dispatcher-only

Dispatcher with operator

Using AI + ESP32 for Model Railroad Electronics

Lessons Learned from the Dispatcher / Station ESP-NOW Project

Chats View of ME



The Honest Truth

Learning C++ coding is out of reach for most people.

I read recently that AI can write C++ code. This opened up a whole new world of possibilities.

The PIC processor led to the ESP32. I had never written serious C++ before this project.
Then I met Rich…

This led to the idea of using AI as my main programming partner to build a complete wireless system with 18 separate ESP32 boards (9 stations + 9 dispatchers).

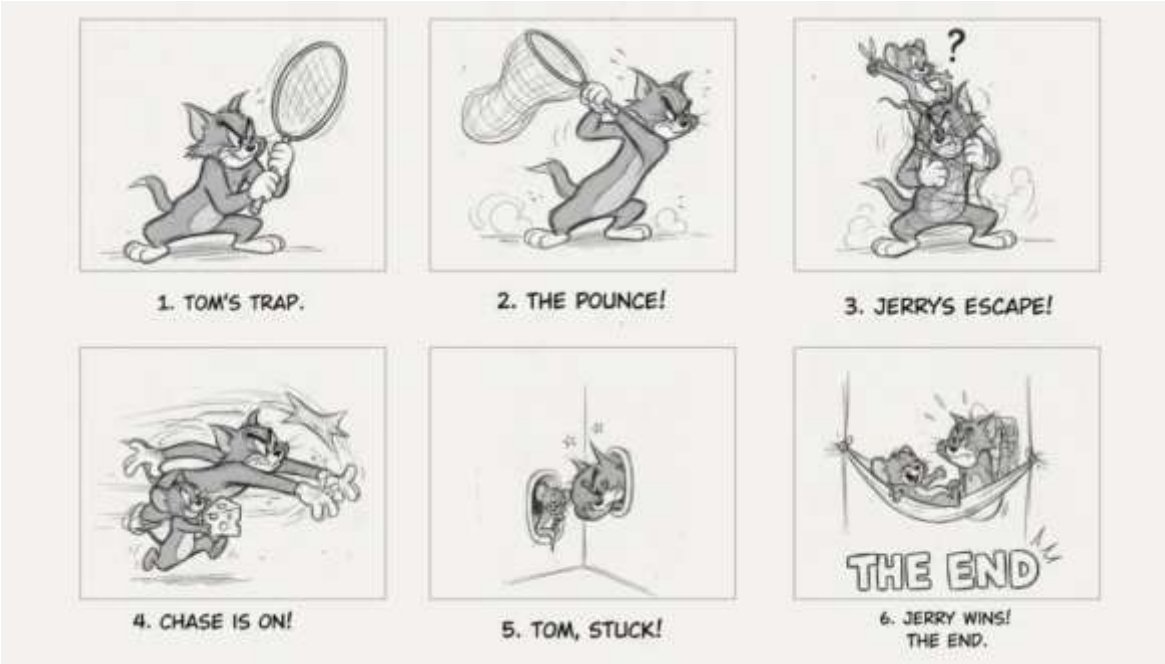
The Most Important Lesson

Stop Coding. Start Storyboarding.

Stop Coding. Start Storyboarding.
My biggest mistake was jumping into coding too early. The system quickly became chaotic and unpredictable — like a “Christmas tree” with lights flashing randomly.

Key Lesson: Fully storyboard the entire system first — including startup sequence, communication flow, touch logic, LED behavior, and error handling.

Other forms: Wireframes, Flow Charts, State Diagrams, Sequence Diagrams, System Maps



Why Storyboarding Changed Everything

Before storyboarding, I was coding blind.
I didn’t realize how many different things had to work together perfectly:

- When someone touched a panel
- How the two boards talked to each other wirelessly
- What the LEDs should do
- How to remember the current state

One small change in one area would break something else.
Storyboarding let me see all these connections upfront — and fix problems on paper instead of in the code.

The Power of Self-Identity

One of the best early decisions we made was giving each board a unique identity.

Instead of trying to track complicated combinations, we simply gave every station a **unique number**.

This one idea made pairing, communication, and remembering the current situation much easier.

Best of all — this number was saved in permanent memory, so each board always knew exactly who it was.

Final code was made and tested at my house
And HIGH FIVES when installed at Rich’s Layout

How AI Helped

AI was extremely useful for:

- Breaking large problems into small steps
- Explaining complex ESP32 behavior
- Designing modular architecture
- Brainstorming solutions
- Organizing clean code flow

Recommendations:

- Make small, surgical code changes
- Keep your own backup copies of working code
- Maintain clear context between sessions

Hardware & Real-World Lessons

- Test every ESP32 before soldering
- Use sockets whenever possible
- **Handle ESP32s carefully — they are very sensitive to static electricity**
- Keep metal away from antennas
- Power stability and decoupling capacitors are critical
- Touch sensors are very sensitive to enclosure material

Real Projects Possible with ESP32

- Wireless DCC Command Station with WiFi Throttles
- Capacitive touch control panels
- Smart LED signal logic
- Automated turntable indexing
- Servo control for semaphores and switch machines
- Real-time scale track weighing system
- Infrared train detection and block occupancy
- Automated water tank system with sound
- Animated coal loading and unloading sequences
- Automated ore tipple and mine operations

AI as Your Model Railroading Co-Pilot

- Generates realistic switch lists, waybills, and operating session paperwork
- Rewrites complex kit instructions into clear, bulletized steps
- Researches historical railroad details, photos, and documentation
- Transforms modern photos into accurate period scenes
- Brainstorms realistic track plans and operational concepts
- Suggests era-appropriate scenery and structures
- Helps troubleshoot DCC, wiring, and electronics problems
- Acts as a real-time modeling companion

Before

After

Final Takeaways

You do **not** need to be an expert C++ programmer to build sophisticated electronics anymore.
What matters most:

- Clear vision
- Storyboarding first
- Small surgical changes.
- Constant testing
- Simplicity over cleverness
- Patience

Demo

Scale Track System
(with ESP32 + CYD display)

Scale Track Story Board

Scale Track Storyboard

Screen 1: Main Screen (Train Overview)

•Background: Navy Blue
•Title at top center: “Scale Track” (white text)
•Layout: Two columns with three cars each
•Cars displayed with large text only (no series numbers here):

- Boxcar
- Gondola
- Flat Car
- Tank Car
- Short Reefer
- Long Reefer

Screen 2: Car Detail Screen

•Background: Navy Blue
•Top left: Back arrow button (white)
•Large text at top: Car Type (e.g. “BOXCAR”)
•Very large weight display in center:

- Normal: White text with green border
- Overweight (5% chance): Blinking Red text + small “OVERWEIGHT” warning in red

•Bottom section:

- Series range (e.g. “3000 - 3749”)
- Max Weight (e.g. “Max Weight: 72,300 lbs”)

Car Data Saved:

•Boxcar: 3000-3749, Max 72,300 lbs
•Gondola: 5500-5699, Max 82,500 lbs
•Flat Car: 6500-6544, Max 80,000 lbs
•Tank Car: UTLX 11000-11058, Max 65,000 lbs
•Short Reefer: 32-81, Max 62,000 lbs
•Long Reefer: 150-169, Max 84,000 lbs

Behavior:

•Touch a car on main screen → goes to detail screen and generates weight
•Tap back arrow → returns to main screen
•Weight is randomly 80-100% of max (normal) or over max (5% chance)