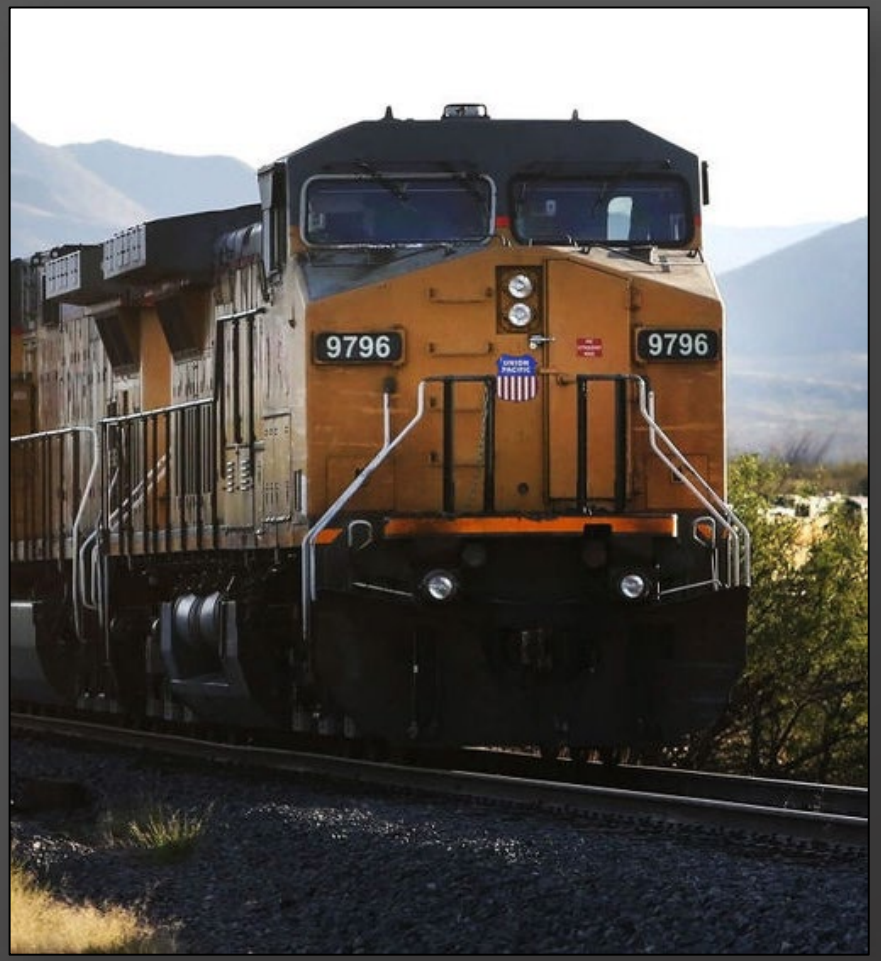
Moving Trains on the Railroad

Peter Kazmir

June 2026

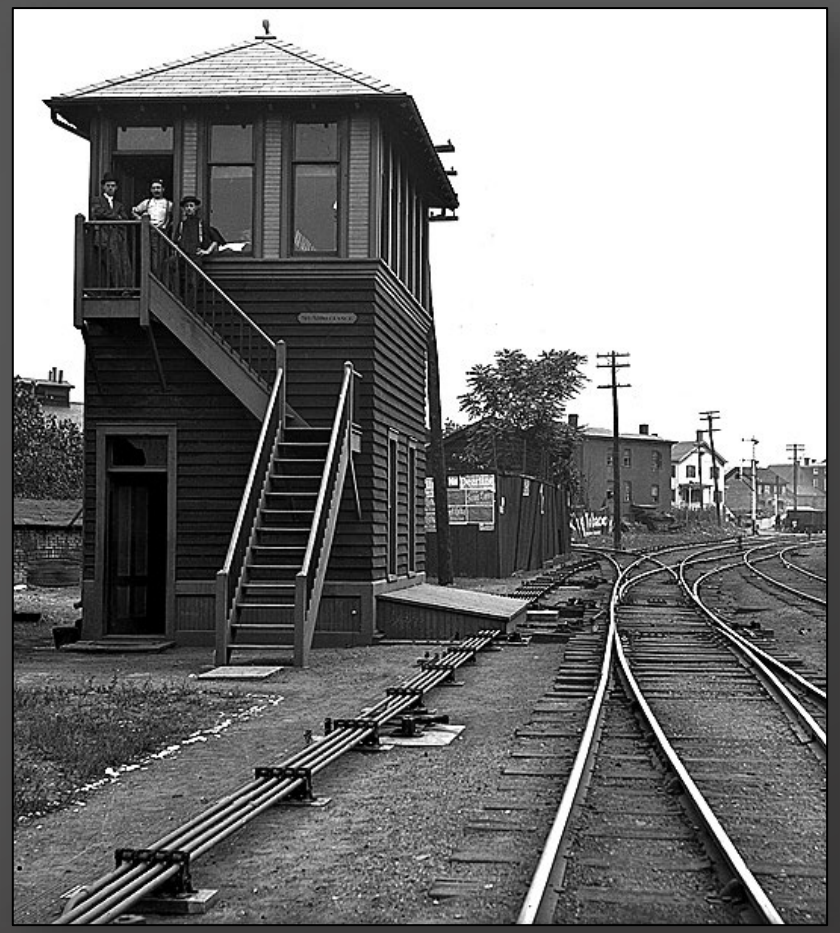
Introduction

- Controlling train movement
  - Maintaining safety and efficiency
- In the previous clinic we talked about communicating with the train crews
  - Signals, radio, phone, written orders, hand signals, flags, timetables and rules…
- But what information needs to be communicated?



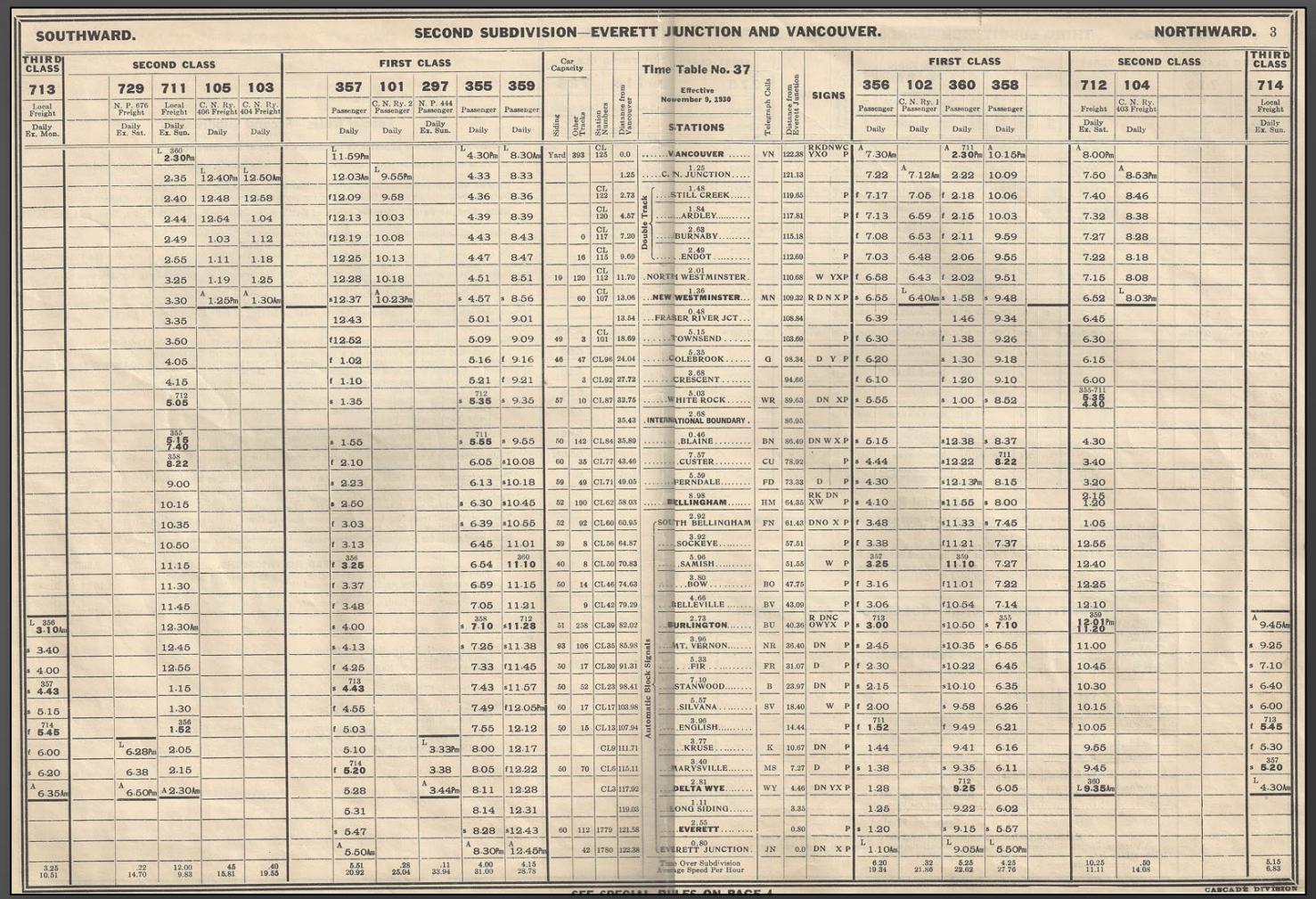
Blocks and Stations

- Blocks
  - Lengths vary, typically ½ to 2 miles long
- Stations
  - Typically locations where trains could pass each other
- Signalmen
  - Communicated how long ago the last train had passed
  - Evolved into dispatcher and operators



Timetables

- List of stations
- Times at which trains should arrive at and depart those stations
- Trains could not leave early
  - …and had to wait for scheduled meets
    - One late train could impact the entire schedule
- Trains assigned superiority



SOUTHWARD. SECOND SUBDIVISION—EVERETT JUNCTION AND VANCOUVER. NORTHWARD. 3

Time Table No. 37 — Effective November 9, 1930

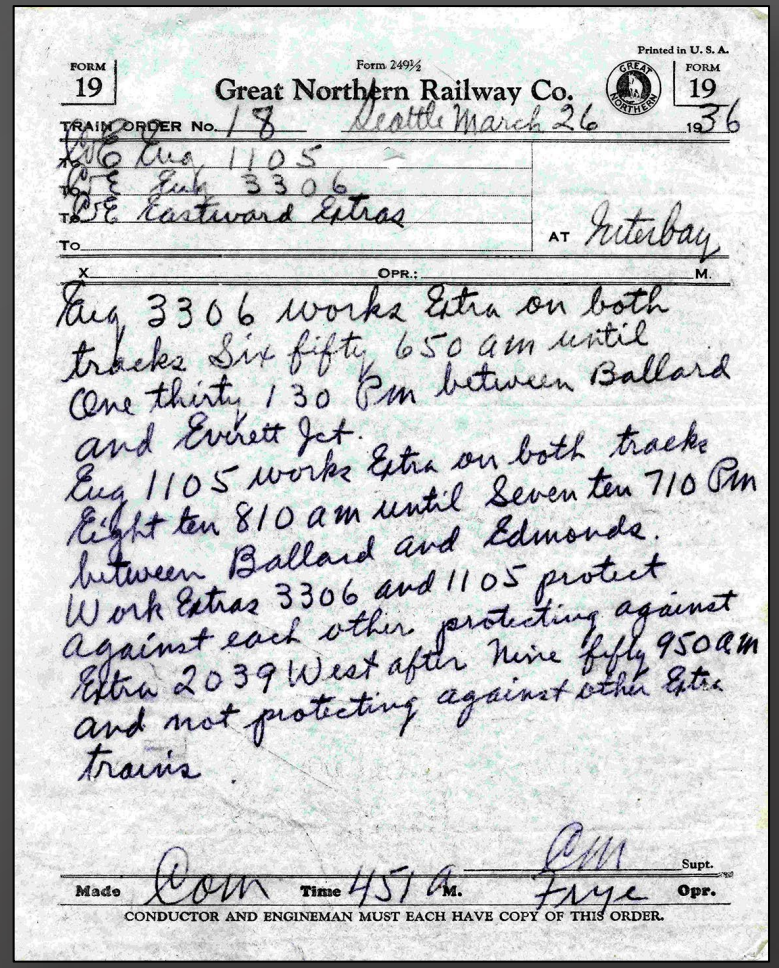
THIRD CLASS 713	SECOND CLASS 729	SECOND CLASS 711	SECOND CLASS 105	SECOND CLASS 103	FIRST CLASS 357	FIRST CLASS 101	FIRST CLASS 297	FIRST CLASS 355	FIRST CLASS 359	Car Capacity: Siding	Car Capacity: Other Tracks	Station Numbers	Distances from Vancouver	STATIONS	Telegraph Calls	Distance from Everett Junction	SIGNS	FIRST CLASS 356	FIRST CLASS 102	FIRST CLASS 360	FIRST CLASS 358	SECOND CLASS 712	SECOND CLASS 104	THIRD CLASS 714
Local Freight Daily Ex. Mon.	N. P. 676 Freight Daily Ex. Sat.	Local Freight Daily Ex. Sun.	C. N. Ry. 400 Freight Daily	C. N. Ry. 404 Freight Daily	Passenger Daily	C. N. Ry. 2 Passenger Daily	N. P. 444 Passenger Daily Ex. Sun.	Passenger Daily	Passenger Daily									Passenger Daily	C. N. Ry. 1 Passenger Daily	Passenger Daily	Passenger Daily	Freight Daily Ex. Sat.	C. N. Ry. 403 Freight Daily	Local Freight Daily Ex. Sun.
		L 360 2.30Pm			L 11.59Pm			L 4.30Pm	L 8.30Am	Yard	393	CL 125	0.0	..VANCOUVER..	VN	122.38	RKDNWC VXG P	A 7.30Am		A 711 2.30Pm	A 10.15Pm	A 8.00Pm		
		2.35	L 12.40Pm	L 12.50Pm	12.03Am	L 9.55Pm		4.33	8.33				1.25	C. N. JUNCTION		121.13		7.22	A 7.12Am	2.22	10.09	7.50	A 8.53Pm	
		2.40	12.48	12.58	f12.09	9.58		4.36	8.36			CL 122	2.73	STILL CREEK		119.65	P	f 7.17	7.05	f 2.18	10.06	7.40	8.46	
		2.44	12.54	1.04	f12.13	10.03		4.39	8.39			CL 120	4.57	ARDLEY		117.81	P	f 7.13	6.59	f 2.15	10.03	7.32	8.38	
		2.49	1.03	1.12	f12.19	10.08		4.43	8.43		0	CL 117	7.20	BURNABY		115.18		f 7.08	6.53	f 2.11	9.59	7.27	8.28	
		2.55	1.11	1.18	12.25	10.13		4.47	8.47		16	CL 115	9.69	ENDOT		112.60	P	7.03	6.48	2.06	9.55	7.22	8.18	
		3.25	1.19	1.25	12.28	10.18		4.51	8.51	19	120	CL 112	11.70	NORTH WESTMINSTER		110.68	W YXP	f 6.58	6.43	f 2.02	9.51	7.15	8.08	
		3.30	A 1.25Pm	A 1.30Am	f12.37	A 10.23Pm		s 4.57	s 8.56		60	CL 107	13.06	NEW WESTMINSTER	MN	109.32	R D N X P	s 6.55	L 6.40Am	s 1.58	s 9.48	6.52	L 8.03Pm	
		3.35			12.43			5.01	9.01				13.54	FRASER RIVER JCT		108.84		6.39		1.46	9.34	6.45		
		3.50			f12.52			5.09	9.09	49	3	CL 101	18.69	TOWNSEND		103.69	P	f 6.30		f 1.38	9.26	6.30		
		4.05			f 1.02			5.16	f 9.16	46	47	CL96	24.04	COLEBROOK	G	98.34	D Y P	f 6.20		s 1.30	9.18	6.15		
		4.15			f 1.10			5.21	f 9.21		3	CL92	27.72	CRESCENT		94.66		f 6.10		f 1.20	9.10	6.00		
		712 5.05			s 1.35			712 s 5.35	s 9.35	57	10	CL87	32.75	WHITE ROCK	WR	89.63	DN XP	s 5.55		s 1.00	s 8.52	355-711 5.35 4.40		
													35.43	INTERNATIONAL BOUNDARY		86.95								
		355 5.15 7.40			s 1.55			711 s 5.55	s 9.55	50	142	CL84	35.89	BLAINE	BN	86.49	DN W X P	s 5.15		s 12.38	s 8.37	4.30		
		358 8.22			f 2.10			6.05	s10.08	60	35	CL77	43.46	CUSTER	CU	78.92	P	s 4.44		s12.22	711 8.22	3.40		
		9.00			s 2.23			6.13	s10.18	59	49	CL71	49.05	FERNDALE	FD	73.33	D P	s 4.30		s12.13Pm	8.15	3.20		
		10.15			s 2.50			s 6.30	s10.45	52	190	CL62	58.03	BELLINGHAM	HM	64.35	RK DN XW P	s 4.10		s11.55	s 8.00	2.15 1.20		
		10.35			f 3.03			s 6.39	s10.55	52	92	CL60	60.95	SOUTH BELLINGHAM	FN	61.43	DNO X P	f 3.48		s11.33	s 7.45	1.05		
		10.50			f 3.13			6.45	11.01	39	8	CL56	64.87	SOCKEYE		57.51	P	f 3.38		f11.21	7.37	12.55		
		11.15			f 356 3.25			6.54	360 11.10	40	8	CL50	70.83	SAMISH		51.55	W P	357 3.25		359 11.10	7.27	12.40		
		11.30			f 3.37			6.59	11.15	50	14	CL46	74.63	BOW	BO	47.75	P	f 3.16		f11.01	7.22	12.25		
		11.45			f 3.48			7.05	11.21		9	CL42	79.29	BELLEVILLE	BV	43.09	P	f 3.06		f10.54	7.14	12.10		
L 356 3.10Am		12.30Pm			s 4.00			358 s 7.10	712 s11.28	51	258	CL39	82.02	BURLINGTON	BU	40.36	R DNC QWYX P	719 s 3.00		s10.50	355 s 7.10	360 12.01Pm 11.20		A 9.45Am
s 3.40		12.45			s 4.13			s 7.25	s11.38	93	106	CL35	85.98	MT. VERNON	NR	36.40	DN P	s 2.45		s10.35	s 6.55	11.00		s 9.25
s 4.00		12.55			f 4.25			7.33	f11.45	50	17	CL30	91.31	FIR	FR	31.07	D P	f 2.30		s10.22	6.45	10.45		s 7.10
357 s 4.43		1.15			719 s 4.43			7.43	s11.57	50	52	CL23	98.41	STANWOOD	B	23.97	DN P	s 2.15		s10.10	6.35	10.30		s 6.40
s 5.15		1.30			f 4.55			7.49	f12.05Pm	60	17	CL17	103.98	SILVANA	SV	18.40	W P	f 2.00		s 9.58	6.26	10.15		s 6.00
714 f 5.45		356 1.52			f 5.03			7.55	12.12	50	15	CL13	107.94	ENGLISH		14.44	P	711 f 1.52		f 9.49	6.21	10.05		713 f 5.45
f 6.00	L 6.28Pm	2.05			5.10		L 3.33Pm	8.00	12.17			CL9	111.71	KRUSE	K	10.67	DN P	1.44		9.41	6.16	9.55		f 5.30
s 6.20	6.38	2.15			f 714 5.20		3.38	8.05	f12.22	50	70	CL6	115.11	MARYSVILLE	MS	7.27	D P	s 1.38		s 9.35	6.11	9.45		357 s 5.20
A 6.35Am	A 6.50Pm	A 2.30Am			5.28		A 3.44Pm	8.11	12.28			CL3	117.92	DELTA WYE	WY	4.46	DN YX P	1.28		712 9.25	6.05	360 L 9.35Am		L 4.30Am
					5.31			8.14	12.31				119.03	LONG SIDING		3.35		1.25		9.22	6.02			
					s 5.47			s 8.28	s12.43	60	112	1779	121.58	EVERETT		0.80	P	s 1.20		s 9.15	s 5.57			
					A 5.50Am			A 8.30Pm	A 12.45Pm		42	1780	122.38	EVERETT JUNCTION	JN	0.0	DN X P	L 1.10Am		L 9.05Am	L 5.50Pm			
3.25 10.51	22 14.70	12.00 9.83	45 15.81	40 19.55	5.51 20.92	28 25.04	11 33.94	4.00 21.00	4.15 28.75					Time Over Subdivision Average Speed Per Hour				6.20 19.34	32 21.86	5.25 22.62	4.25 27.76	10.25 11.11	50 14.08	5.15 6.83

Automatic Block Signals — Double Track

SEE SPECIAL RULES ON PAGE 4 — CASCADE DIVISION

Timetable and Train Order

- Added a centralized dispatcher with authority to override the timetable
  - Could define extra trains, annul a train, alter schedules, and more
- Communicated orders to operators at the stations
  - Relayed the order to passing trains



FORM 19 — Form 249½ — Printed in U. S. A.

Great Northern Railway Co.

TRAIN ORDER No. 18 — Seattle March 26 — 1936

To: Eng 1105
To: Eng 3306
To: Eastward Extras
To:

AT Interbay

X — OPR.: — M.

Eng 3306 works Extra on both tracks Six fifty 650 am until One thirty 130 Pm between Ballard and Everett Jct.
Eng 1105 works Extra on both tracks Eight ten 810 am until Seven ten 710 Pm between Ballard and Edmonds.
Work Extras 3306 and 1105 protect against each other protecting against Extra 2039 West after Nine fifty 950 am and not protecting against other Extra trains.

Made Com Time 457 A. M. — Supt. — Opr. Frye

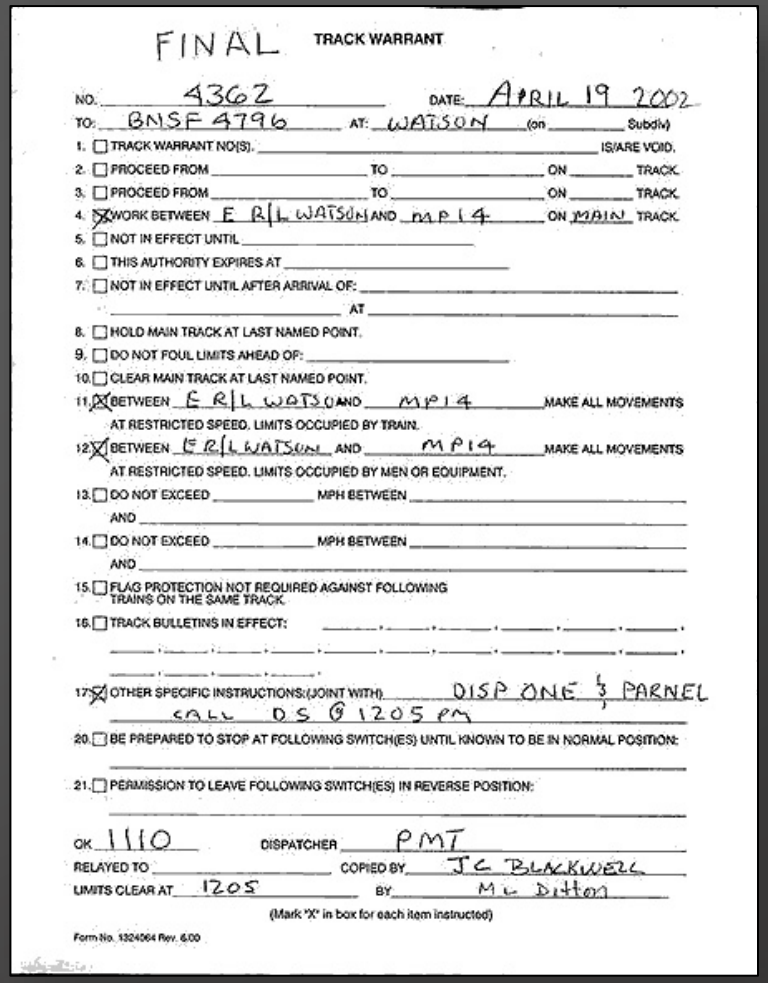
CONDUCTOR AND ENGINEMAN MUST EACH HAVE COPY OF THIS ORDER.

Timetable and Train Order

- Operators alert oncoming trains to pick up orders using a signal
  - In some cases, trains would stop and orders would be hand-delivered
  - Orders could also be posted trackside in a fork or hoop
- Operators would also report back to the dispatcher as trains passed their station
- Popular operating method for model railroaders
  - Typically utilizes a fast clock

Direct Traffic Control and Track Warrant Control

- Evolution of Train Orders
  - Dispatcher communicates directly with train crews
  - No station operators required
  - Exclusive track authority
  - Crews write, repeat, and release authority
- Both are used today, but TWC is more flexible
- Typically used in dark territory
- Popular in the US
  - Utilized by all Class I railroads
- Easy to implement on model railroad



FINAL **TRACK WARRANT**

NO. 4362 DATE: APRIL 19 2002

TO: BNSF 4796 AT: WATSON (on _____ Subdiv)

1. ☐ TRACK WARRANT NO(S). _____ IS/ARE VOID.
2. ☐ PROCEED FROM _____ TO _____ ON _____ TRACK.
3. ☐ PROCEED FROM _____ TO _____ ON _____ TRACK.
4. ☒ WORK BETWEEN E R/L WATSON AND MP 14 ON MAIN TRACK.
5. ☐ NOT IN EFFECT UNTIL _____
6. ☐ THIS AUTHORITY EXPIRES AT _____
7. ☐ NOT IN EFFECT UNTIL AFTER ARRIVAL OF: _____ AT _____
8. ☐ HOLD MAIN TRACK AT LAST NAMED POINT.
9. ☐ DO NOT FOUL LIMITS AHEAD OF: _____
10. ☐ CLEAR MAIN TRACK AT LAST NAMED POINT.
11. ☒ BETWEEN E R/L WATSON AND MP 14 MAKE ALL MOVEMENTS AT RESTRICTED SPEED. LIMITS OCCUPIED BY TRAIN.
12. ☒ BETWEEN E R/L WATSON AND MP 14 MAKE ALL MOVEMENTS AT RESTRICTED SPEED. LIMITS OCCUPIED BY MEN OR EQUIPMENT.
13. ☐ DO NOT EXCEED _____ MPH BETWEEN _____ AND _____
14. ☐ DO NOT EXCEED _____ MPH BETWEEN _____ AND _____
15. ☐ FLAG PROTECTION NOT REQUIRED AGAINST FOLLOWING TRAINS ON THE SAME TRACK.
16. ☐ TRACK BULLETINS IN EFFECT: _____
17. ☒ OTHER SPECIFIC INSTRUCTIONS:(JOINT WITH) DISP ONE & PARNEL CALL DS @ 1205 PM
20. ☐ BE PREPARED TO STOP AT FOLLOWING SWITCH(ES) UNTIL KNOWN TO BE IN NORMAL POSITION: _____
21. ☐ PERMISSION TO LEAVE FOLLOWING SWITCH(ES) IN REVERSE POSITION: _____

OK 1110 DISPATCHER PMT

RELAYED TO _____ COPIED BY JC BLACKWELL

LIMITS CLEAR AT 1205 BY ML Ditton

(Mark "X" in box for each item instructed)

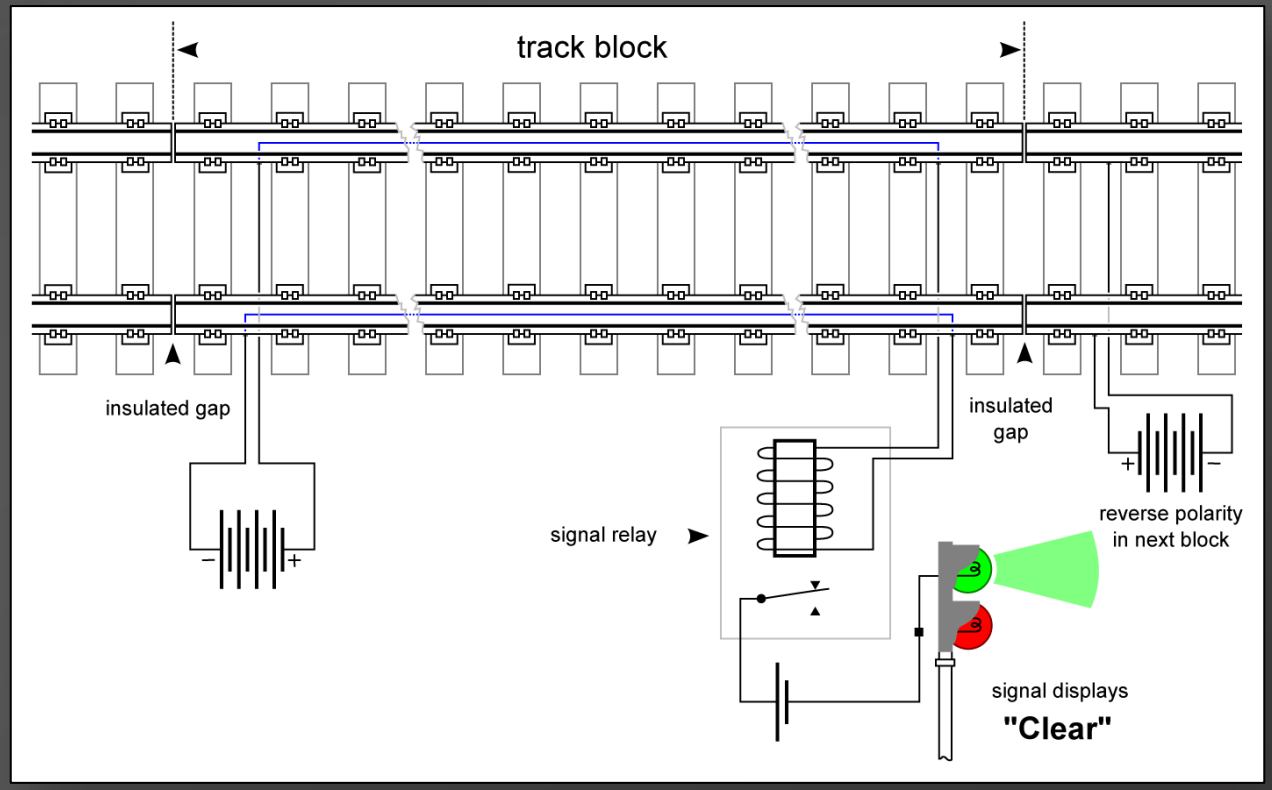
Form No. 1324064 Rev. 6.00

Automated Traffic Control Systems

- Methods described to this point all require direct contact with train crews
- Several methods for automatic control
  - Require train detection circuits

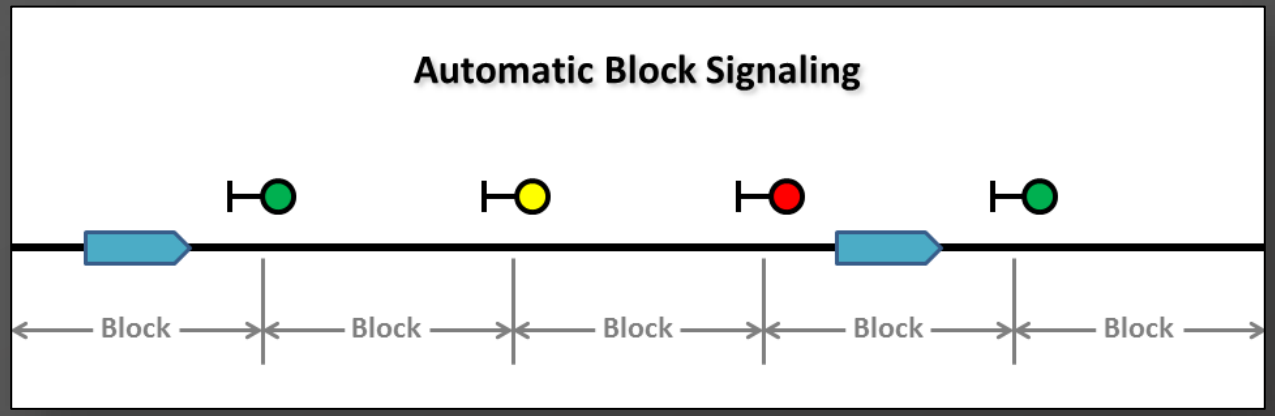
Train Detection Circuits

- First used in the UK in 1864
  - William Robertson's 1872 design is still in use today
- Power applied to rails and shorted by trains
  - Similar to most model railroad train detection circuits, though those rely on detecting a current
- Other circuits are used in different circumstances
- Cab signaling was originally piggybacked on train detection circuits



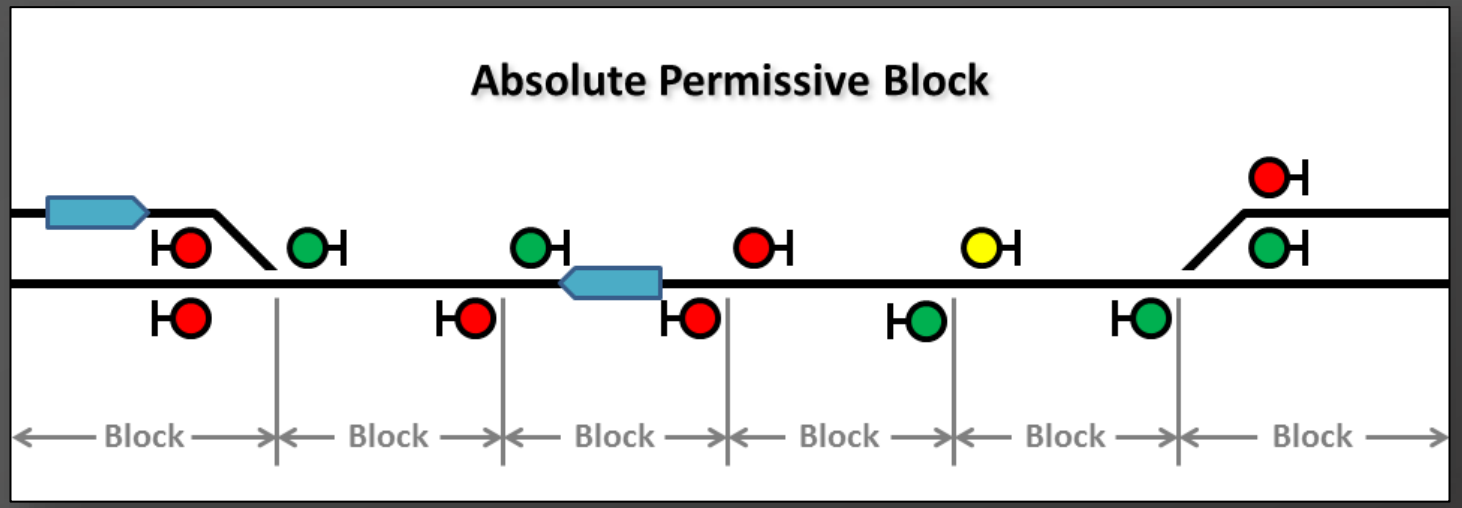
Automatic Block Signaling

- Invented in the US and first used in 1871
  - Grew in popularity during the first half of the 1900s
- Completely automated
  - Takes into account switch positions, more than one block at a time, and more
  - Protects against following trains, but not against opposing trains



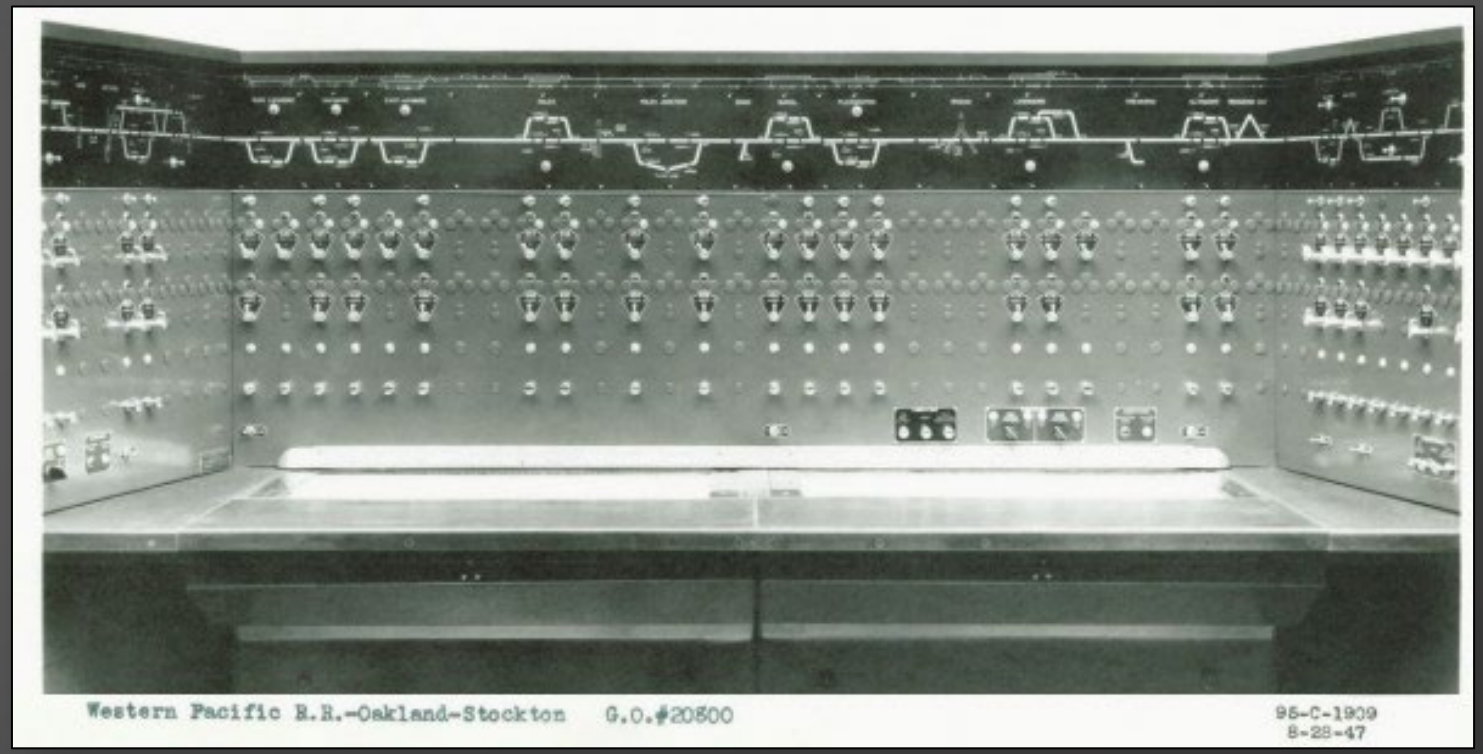
Absolute Permissive Block

- ABS enhancements to safely support bi-directional traffic
  - Establishes a direction of traffic
- Stretches of track without sidings are treated as if they are a single block
- Very popular with interurban streetcar lines



Centralized Traffic Control

- Dispatcher controls flow of traffic but communicates via signals
- System designed in such a way to prevent dispatcher from issuing unsafe orders
- Developed by the General Railway Signal Company
- First installed on the New York Central in 1927
- Expensive to implement

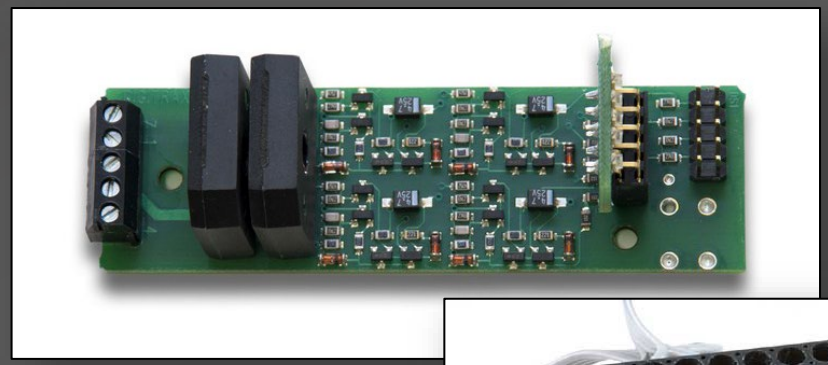


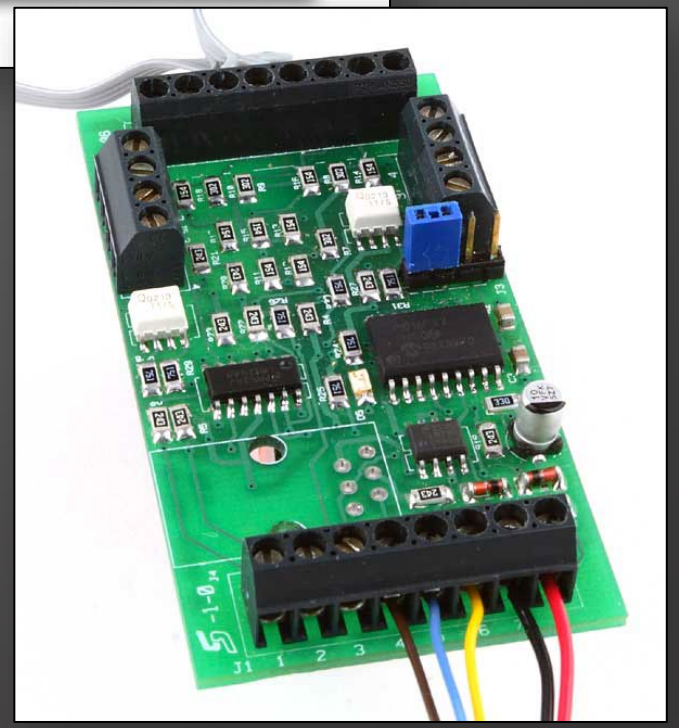
Centralized Traffic Control

- Have evolved and centralized over time
- Dispatchers do not determine signal indication
  - Logic in the system decides the most efficient safe indication
  - Additional “intermediate” signals on the system are not managed by dispatcher at all
- Typically combined with other operations methods
  - Track Warrant Control

Modeling Signaling Systems

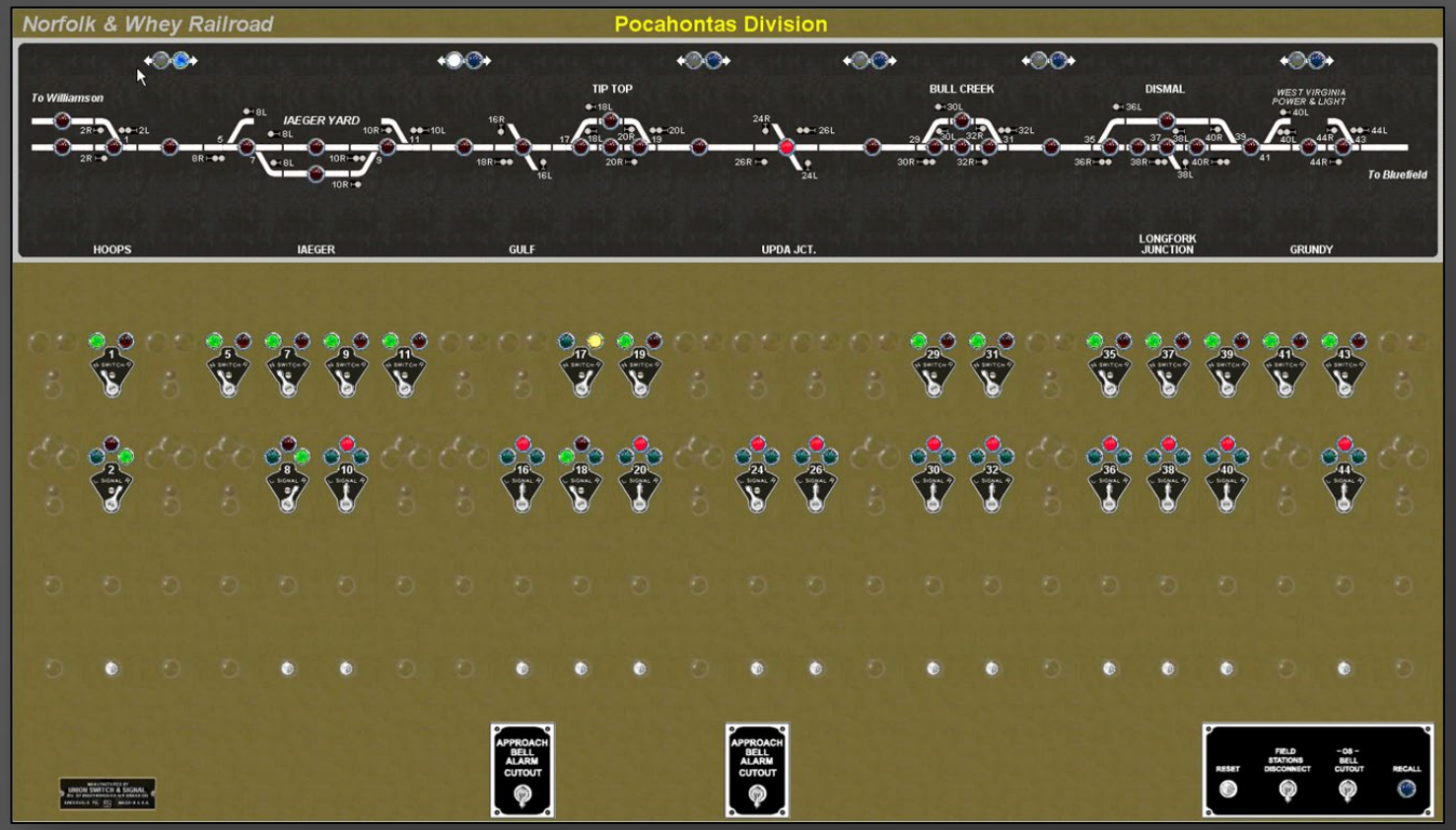
- Manually set signals
- Many manufacturers offer hardware and software to implement signaling systems
- You can even build the electronics yourself
  - Multiple articles in magazines over the years
  - Popular “non-commercial” system is C/RMI, developed by Bruce Chubb
    - http://www.jlcenterprises.net
  - Raspberry Pi based systems





Modeling Signaling Systems

- Connecting to a computer
  - Probably not needed for ABS or ATC
  - Several systems available
    - JMRI is free – http://www.jmri.org



Modeling Signaling Systems

- Some modelers go the extra mile and build (or buy) CTC machines
  - Typically integrated with a computer, which in turn is connected to the layout
- Very specific to railroad and era
- Radios or phone systems are usually utilized with CTC

Acknowledgements

- Realistic Model Railroad Operation, by Tony Koester
- https://en.wikipedia.org/wiki/Signalling_block_system
- https://en.wikipedia.org/wiki/Track_circuit
- https://en.wikipedia.org/wiki/Automatic_block_signaling
- https://en.wikipedia.org/wiki/Centralized_traffic_control
- http://www.jlcenterprises.net
- http://www.jmri.org
- http://www.ctcparts.com – Source for CTC panel parts
- http://www.ctcparts.com/engr/wpctcinfo.jpg - Explains Tommy Holt's CTC panel

Thank you!