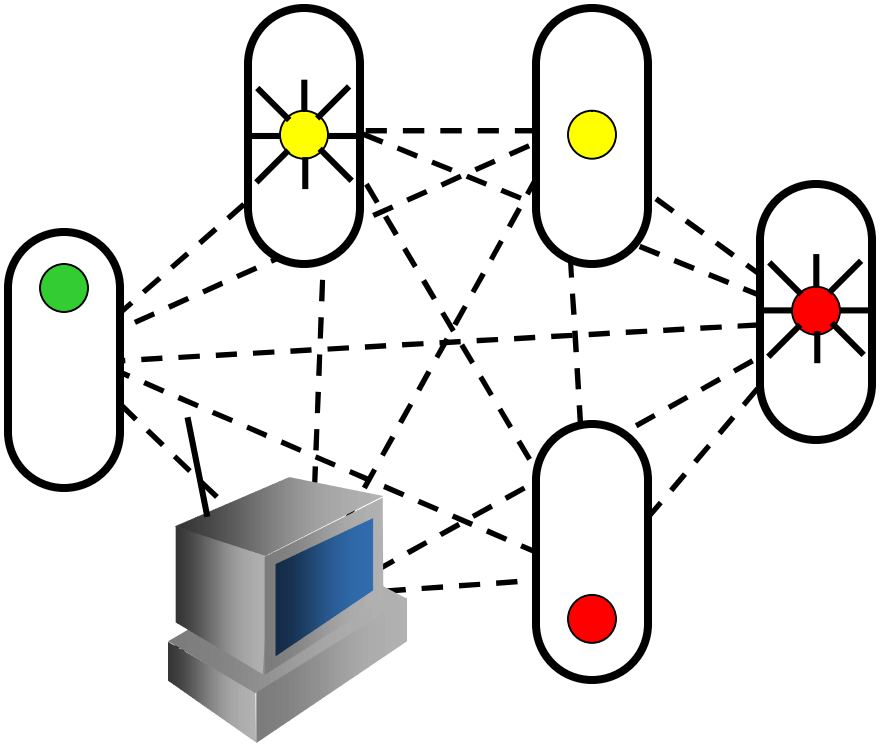
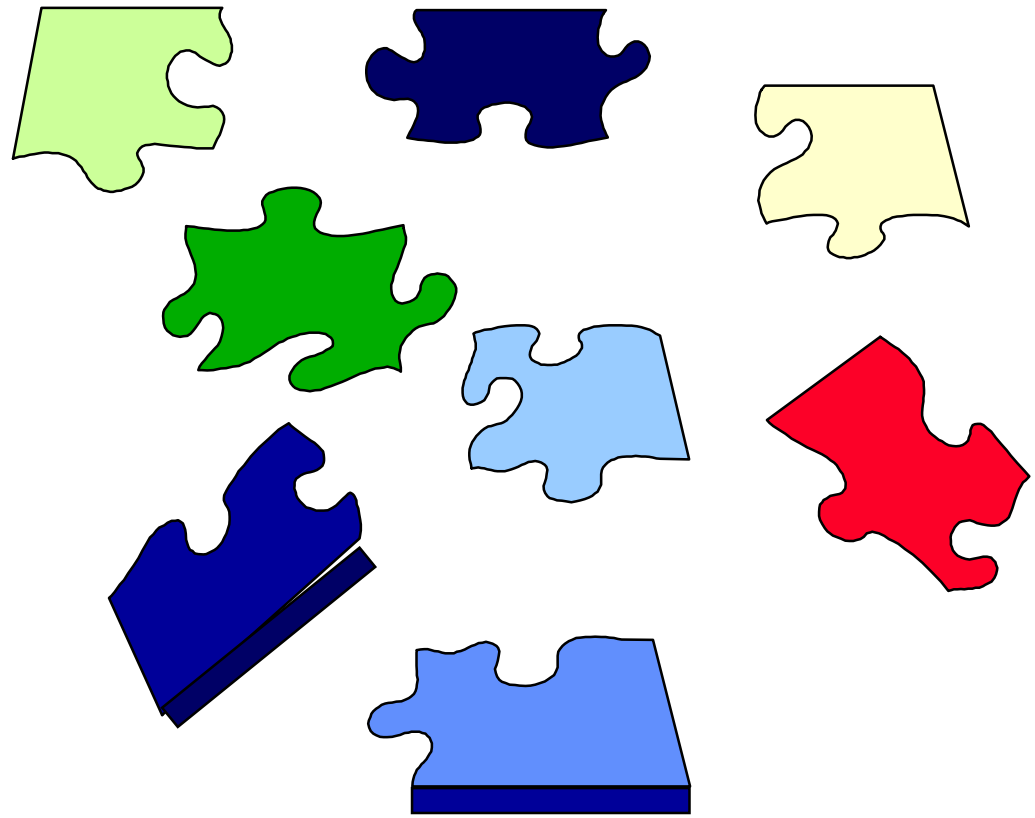
Signals



Thank You
For 5 years development
John Cooper
Dale Taylor
Veronica Taylor
Bill Farmer

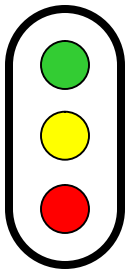
What we will cover

- Why Signals
- What the Signals Mean
- Where you will find Signals
- Operating Rules
- Technology
- Failures
- Next Generations
- Review of the Basics

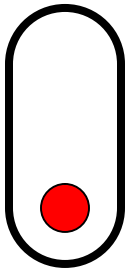


Strategy -- Signaled Bi-Directional Track

Half the Cost
Twice the Reach
Twice as Fast
Twice the Ride

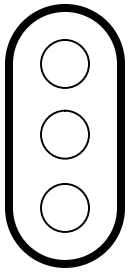


Three Lamps

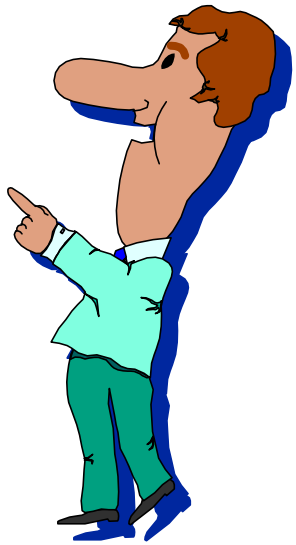


Stop on Solid Red ….

Repeat - **STOP** !!



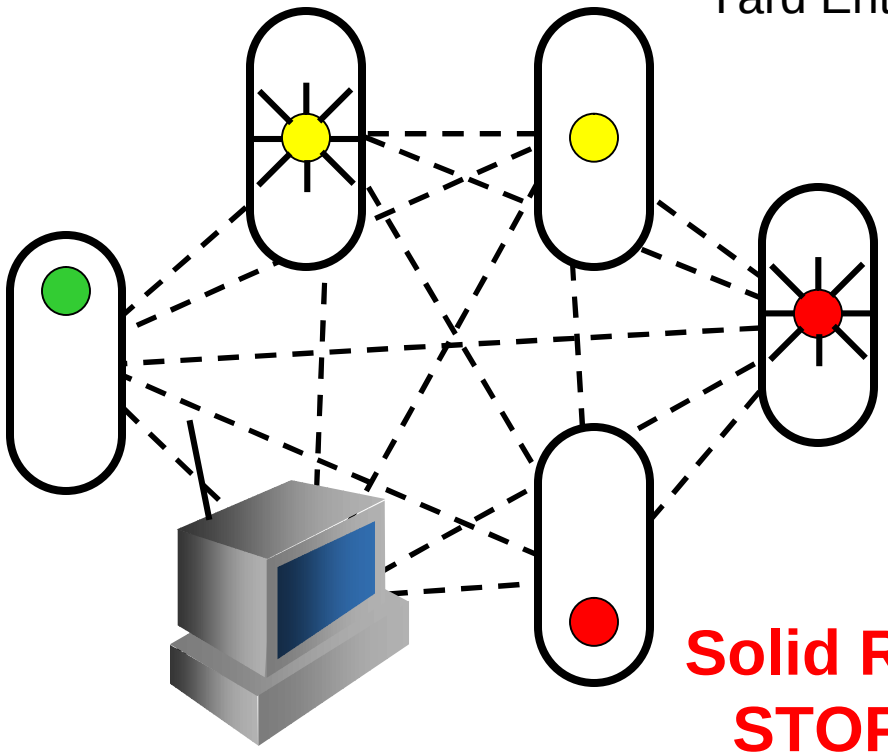
Go on Anything Else



Flashing Yellow
there is a reason to stop
1200-1800’ ahead
The next signal is Yellow

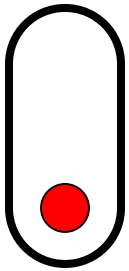
Yellow there is a reason to stop 600-1200’ ahead. The next signal is Red, Flashing Red, or a Yard Entry with Lunar White

Green = GO
Tracks are Clear



Flashing Red
there is a reason to stop
Less than 600’ ahead.
Proceed “on-your-own”.
Be Prepared to Stop.

Solid Red
STOP !!
Do Not Pass
This Signal



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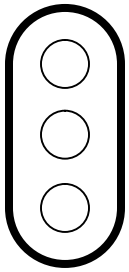
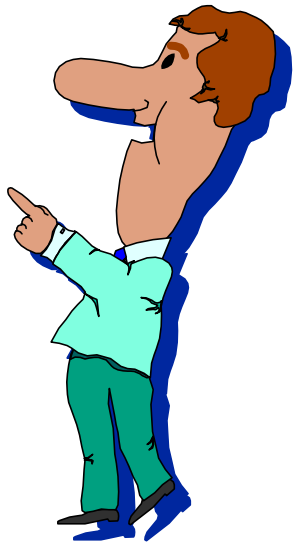


Go on Anything Else



Bi-Directional Operating Rules

- **Rules**
  - **Cell phones are required north of Farmersville Circle where FRS radios will not reach in an emergency.**
  - **No Trains over 140’ N of Farmersville**
  - **Metal wheels and uninsulated metal axles are required N of Farmersville**
  - **Trains may not reverse on Bidirectional track except to back up into a Wye at the Wye or to back up into a Siding at the Siding.**
  - **Trains must always back up into Wyes.**
  - **Trains cannot enter a Siding if there is already an opposing train in it…. Go to the far end and back up to get in the Siding.**

Operational Failures

- **Train moves beyond the Signal while waiting on Red Light**.
  - Operator has fouled the Main
  - Current of Traffic cannot be reversed
  - Operator will wait forever

- **Train too long to fit in 140’**
  - Train will foul the Main someplace
  - then Current of Traffic will not reverse

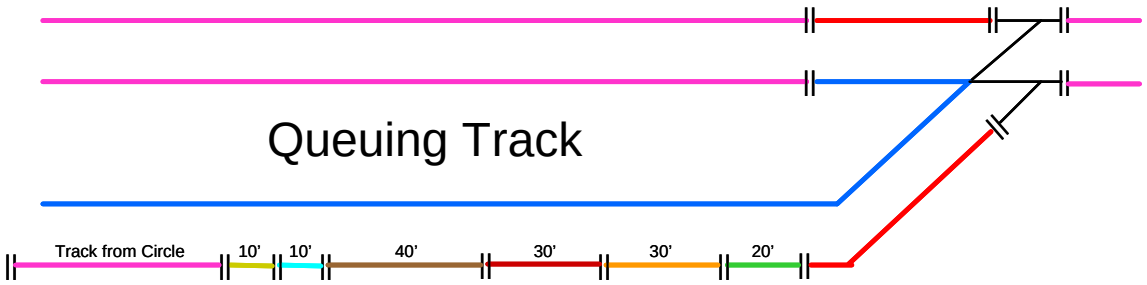
- **Train backs onto Mainline and Reverses Direction**
  - Will see solid Red lights
  - Will need to get off the main and re-enter… usually by backing into a Wye or Siding, then push the button & depart forward.

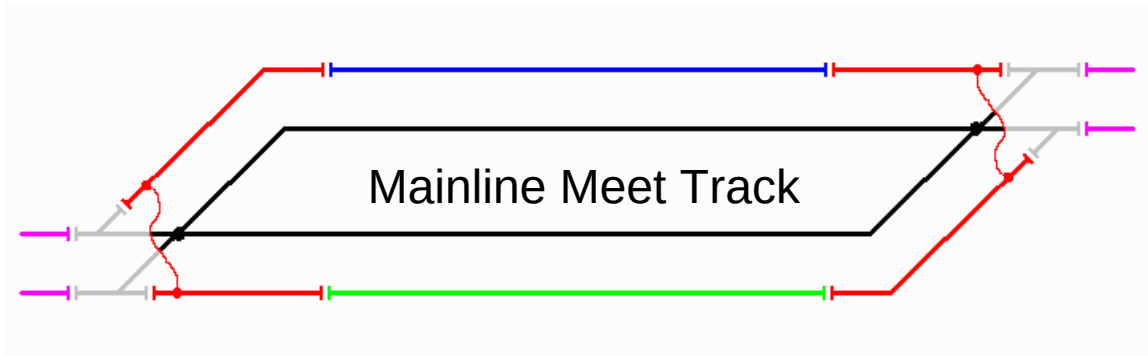
Wait Times in Minutes

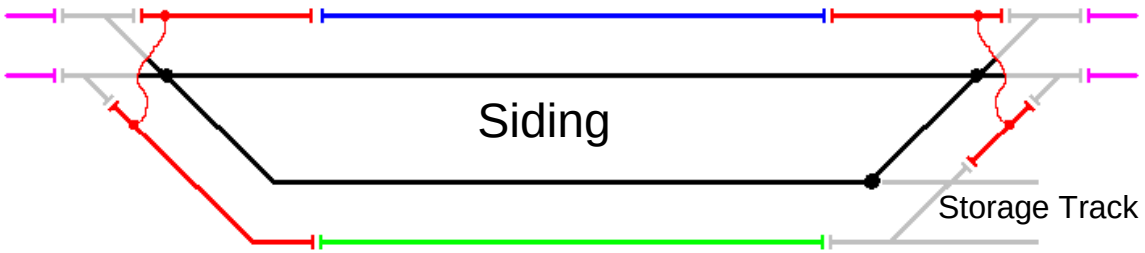
Speed - MPH	Average Wait Time For 3000’ train trip	Maximum Wait Time For 3000’ Train Trip
3 MPH	5.7	11.4
4 MPH	4.3	8.5
5 MPH	3.4	6.8
6 MPH	2.8	5.7
7 MPH	2.5	4.9

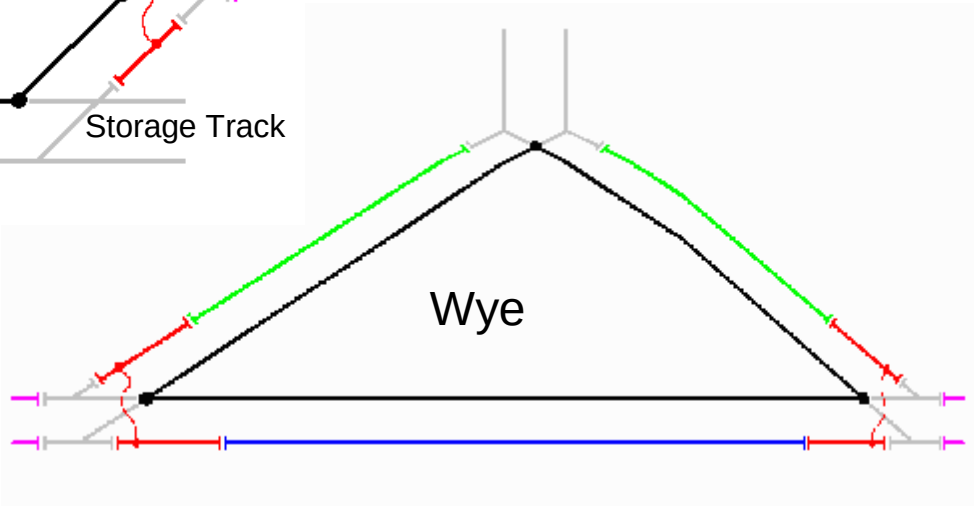
Etiquette = Go Quickly, Keep Moving

Four Basic Track Structures

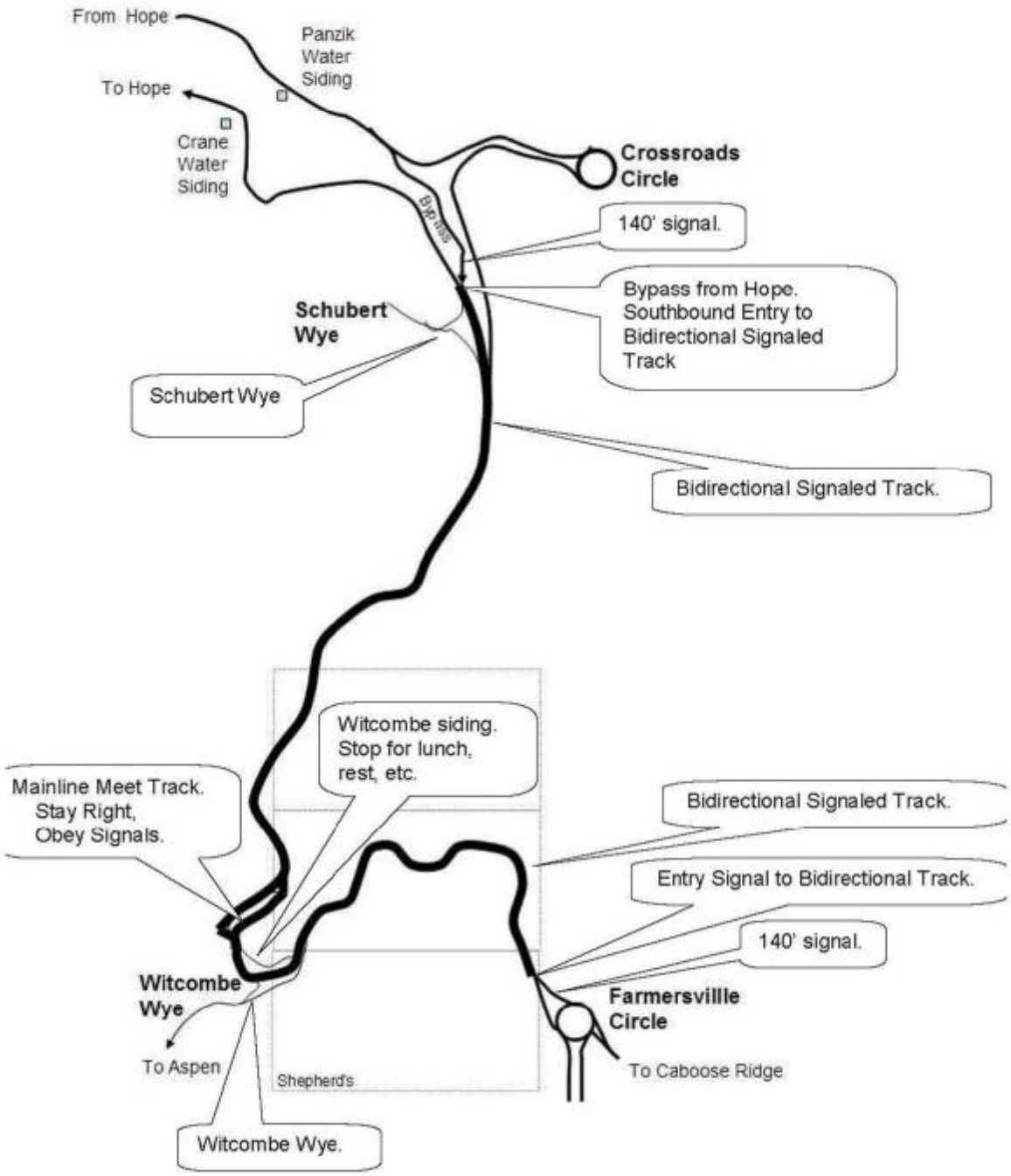




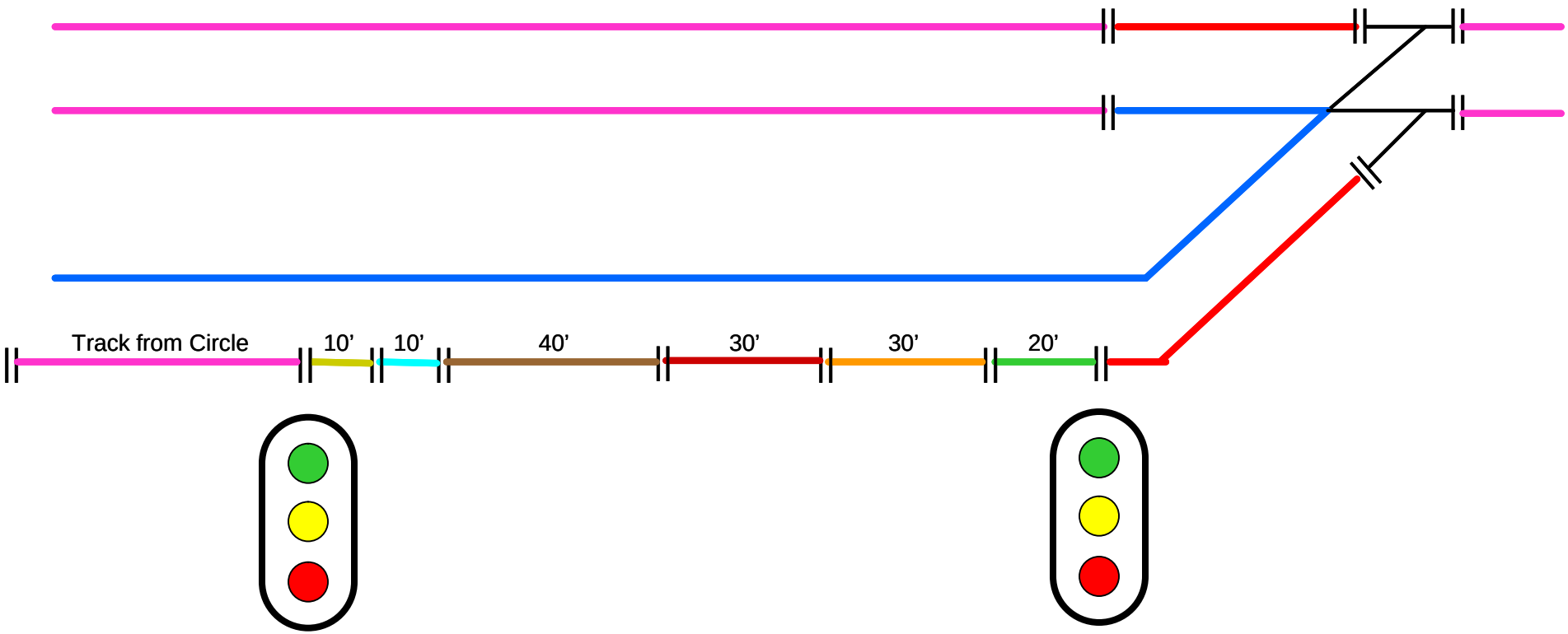


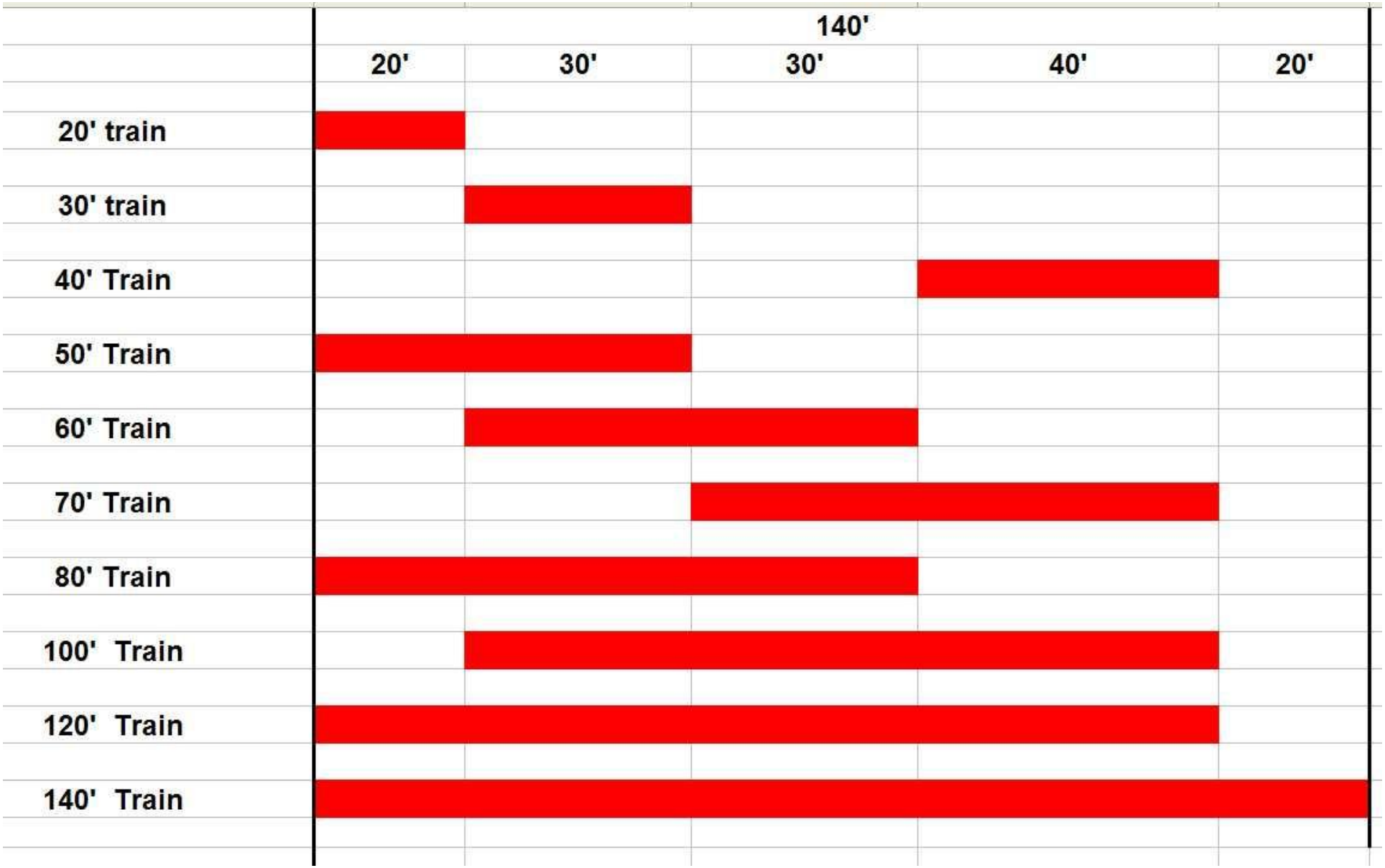


Map of First Bidirectional Territory

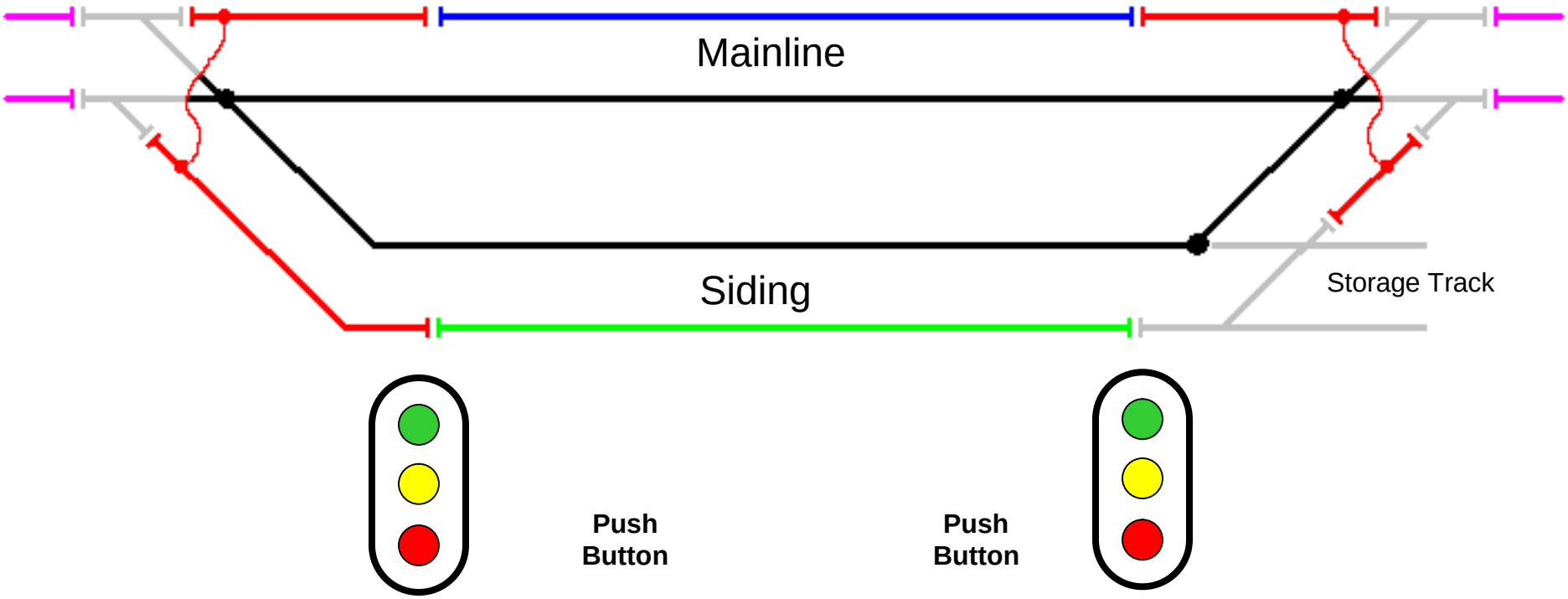


Queuing Tracks --- like Farmersville



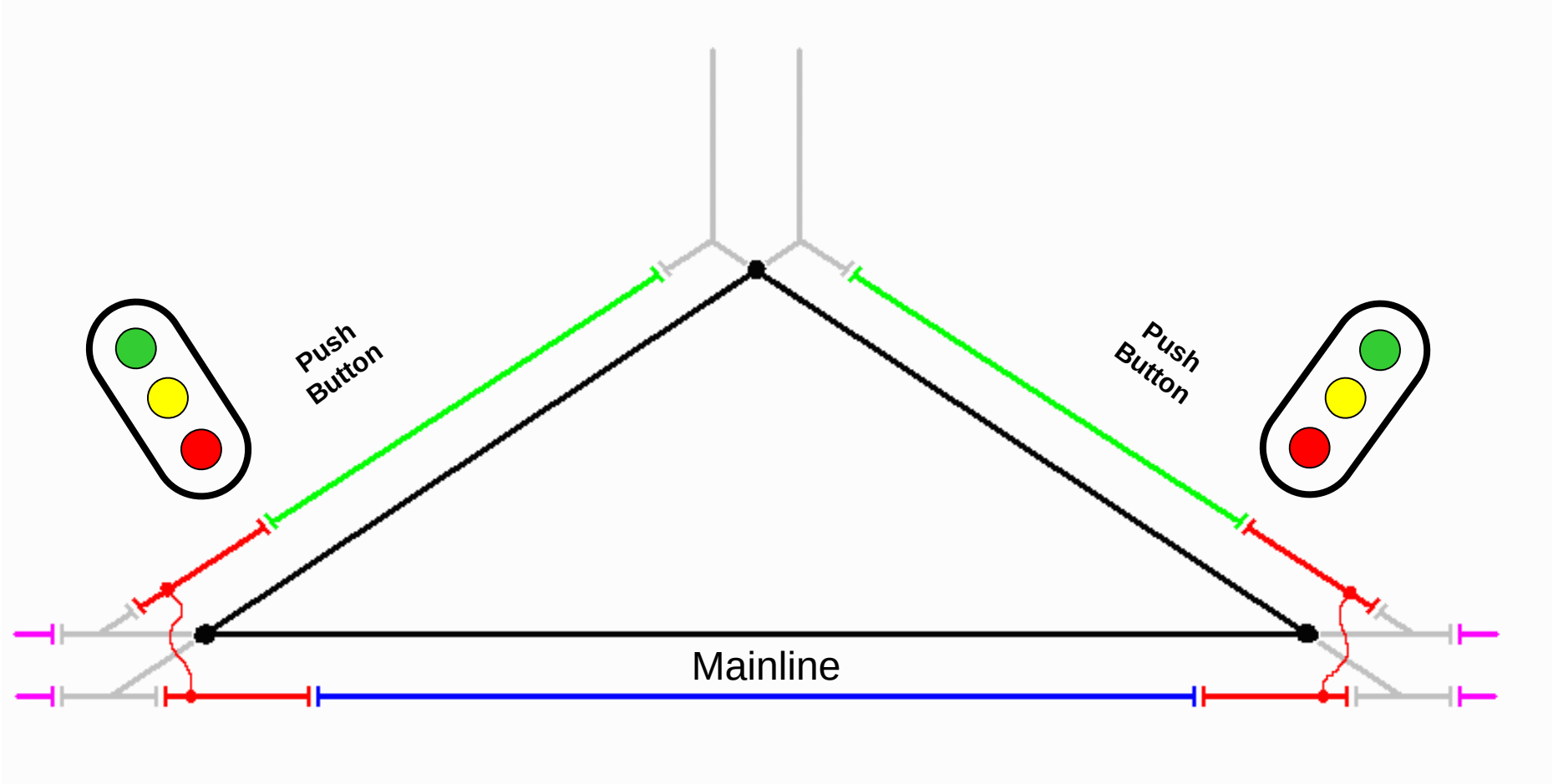

140'
20'
30'
30'
40'
20'
20' train
30' train
40' Train
50' Train
60' Train
70' Train
80' Train
100' Train
120' Train
140' Train

Sidings



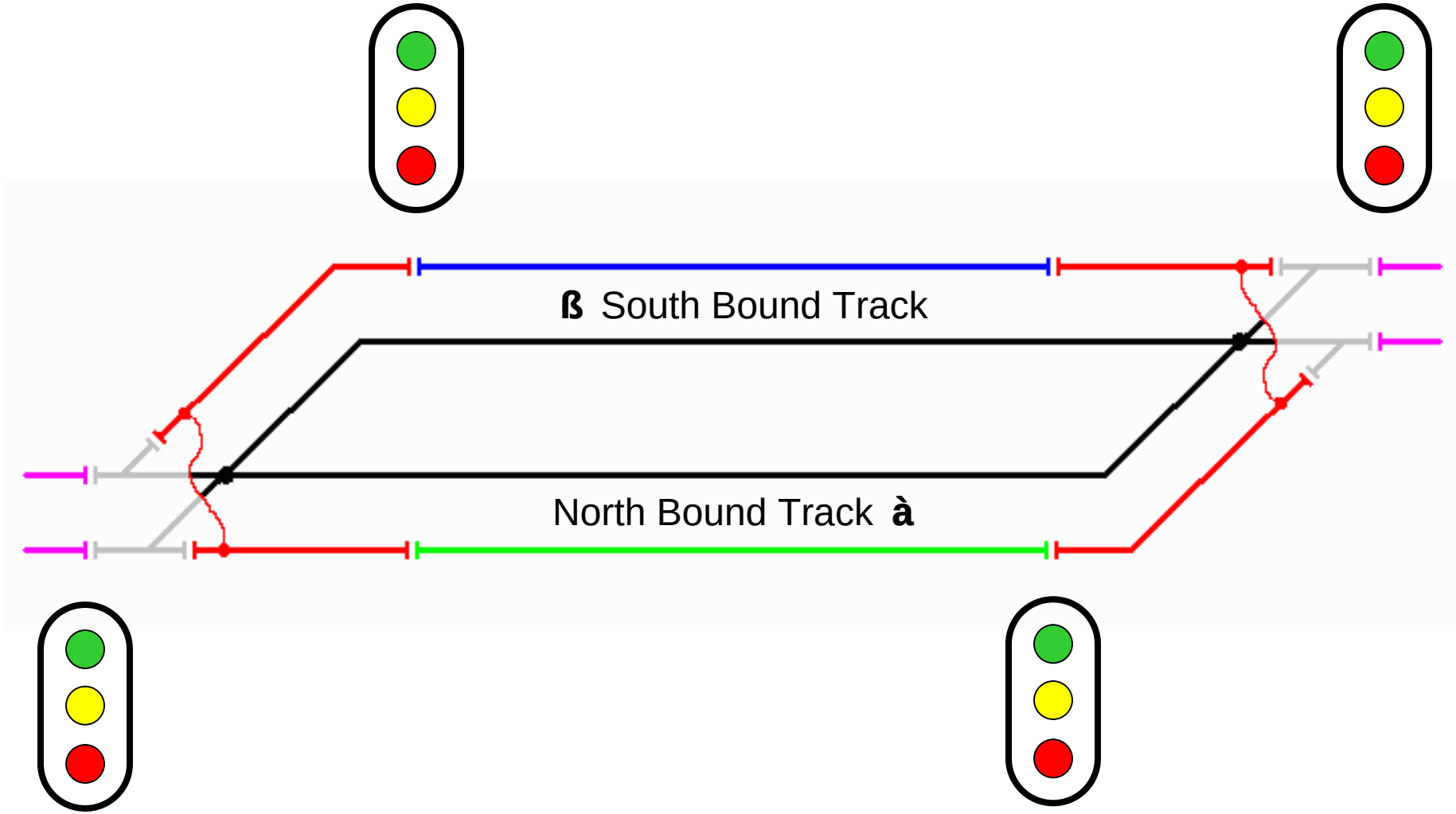
Always Leave a Siding Going Forward

Wyes



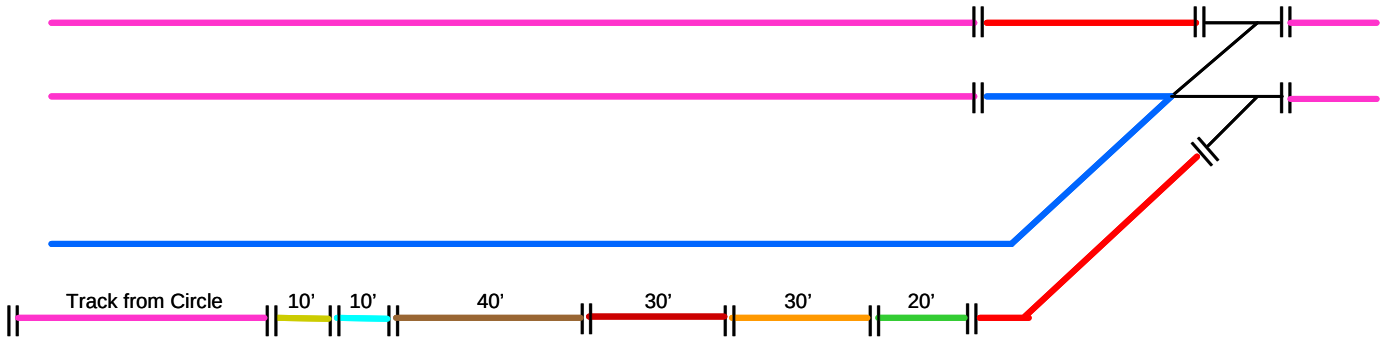
Always Back into Wyes, Leave going forward

Mainline Meet Tracks

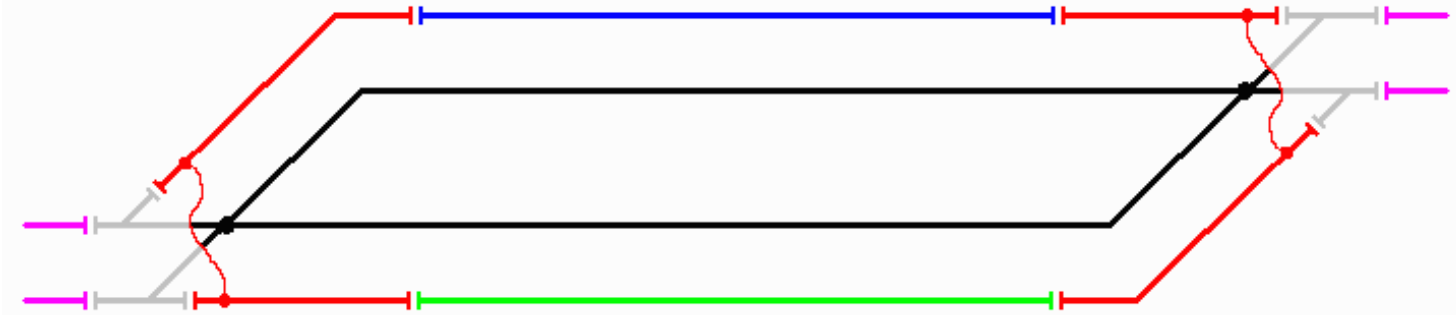


Track Segments

- Bi-Directional track starts with a Queuing Track



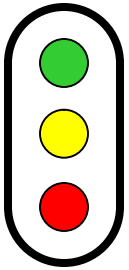
- Every 3000’ there is a Mainline Meet Track



- And there is an End.

Blocks

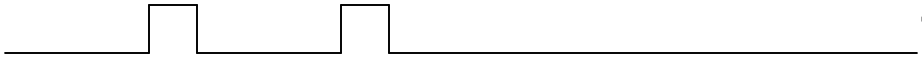
- Track Segments are broken into up to 6 Blocks of about 600’ each
  - Farmersville to Witcombe Mainline Meet Track - 2500’ - 4 Blocks
  - Witcombe Mainline Meet Track to Cougar Mainline Meet - 1500’ - 3 Blocks
  - Cougar to Cooper Junction - 1900’ - 3 Blocks



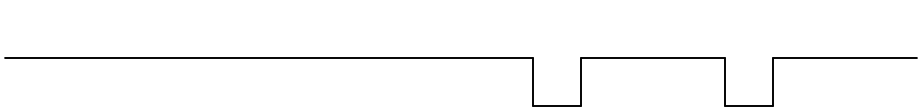
ABS Signals at Block Boundaries

- Communicate using pulses through the rails
- Requires Bonded Track
- 255 Second Rule

Pulses Through the Rails

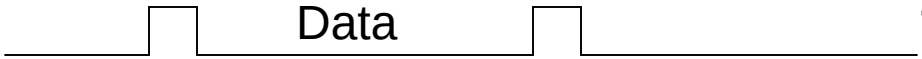


Transmit are positive



Received are negative

1 Second = 512 clock pulses

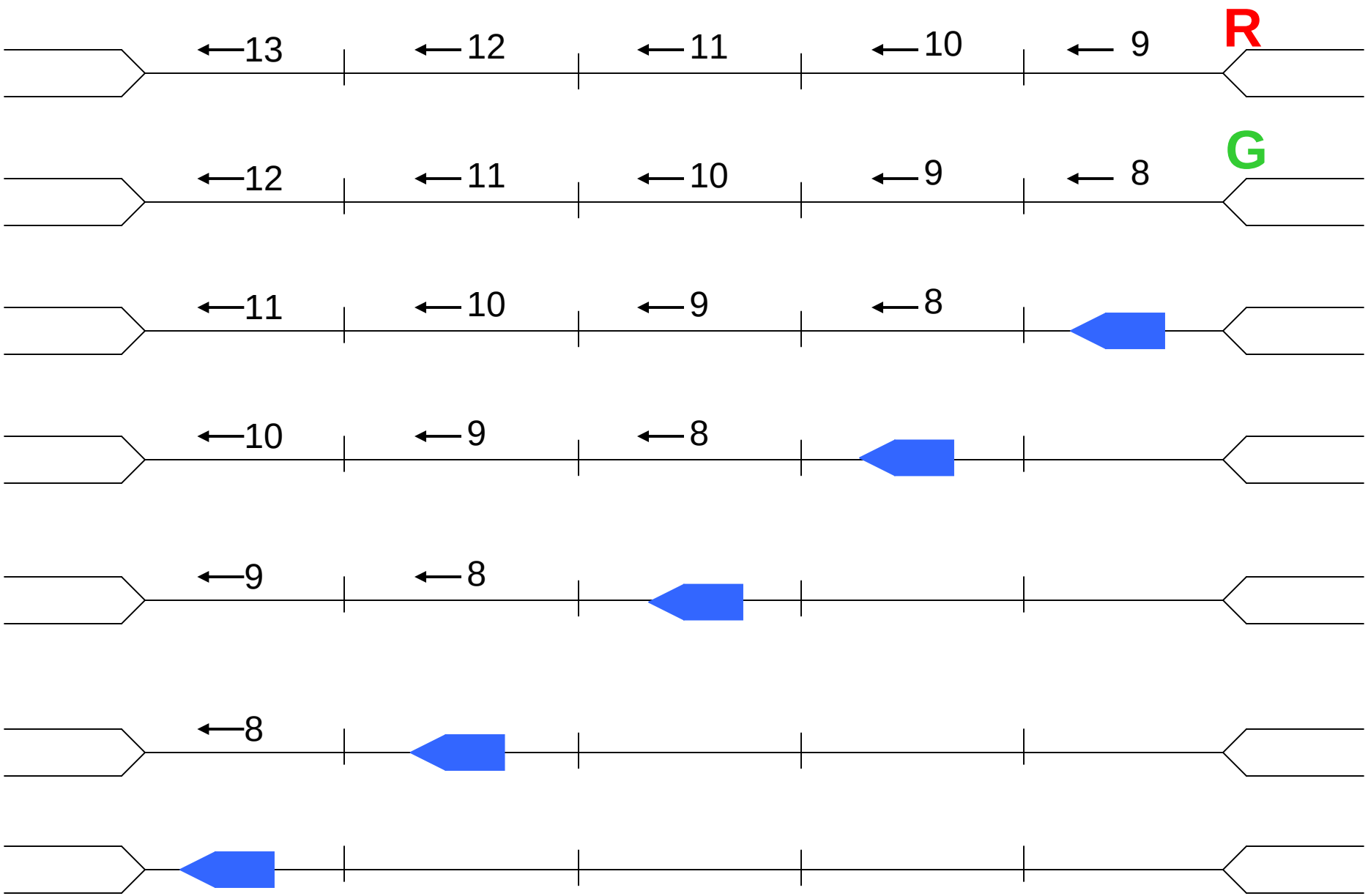


Time between Pulses is Data

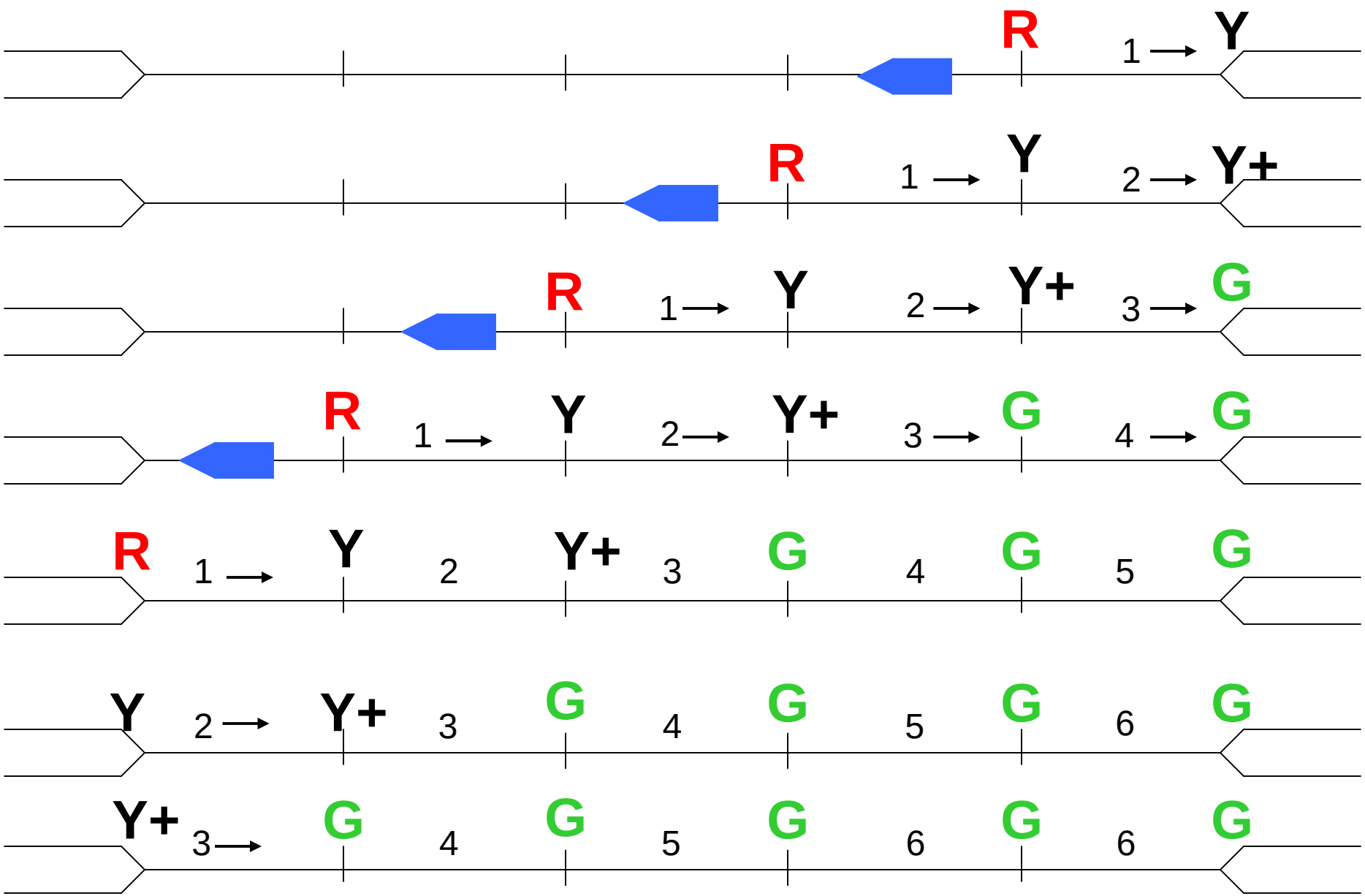
Clock Pulses between leading edges = (Code x 16) + 8

Code = 2, Clock Pulses = 40
Code = 6, Clock Pulses = 104

Forward Codes

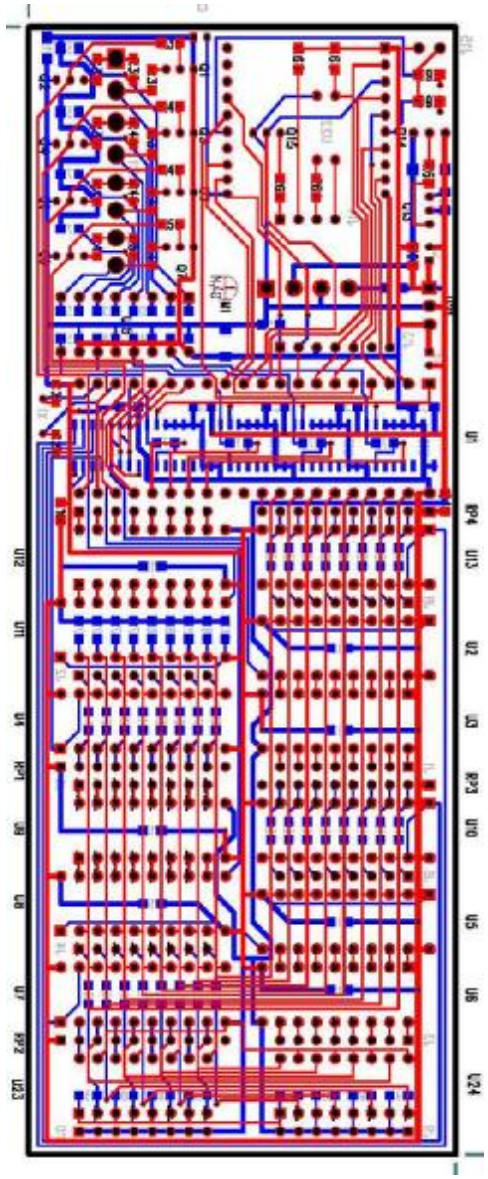


Rearward Codes

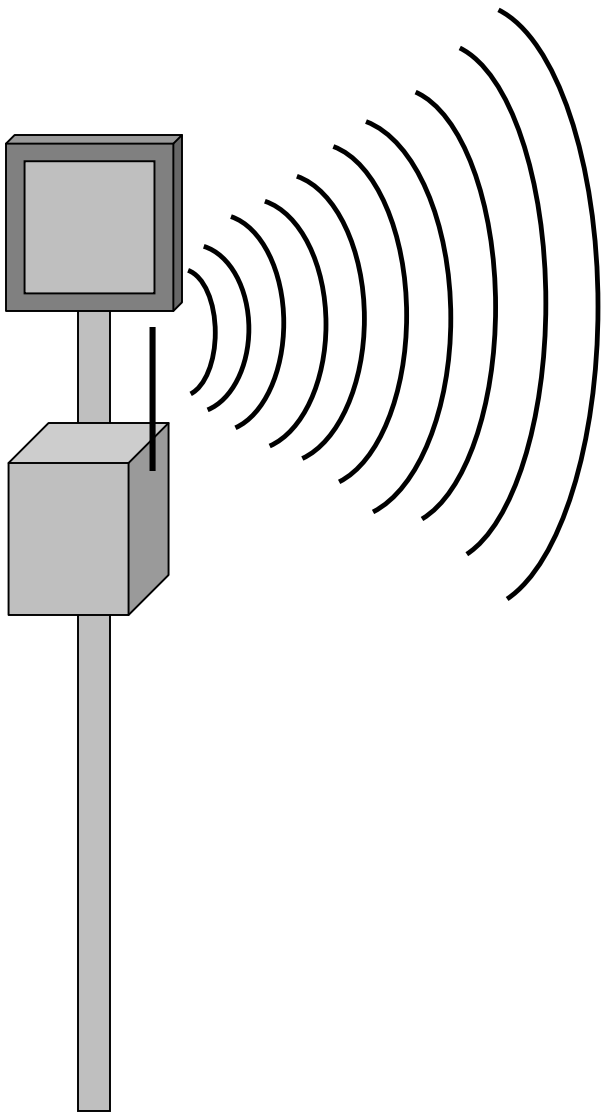


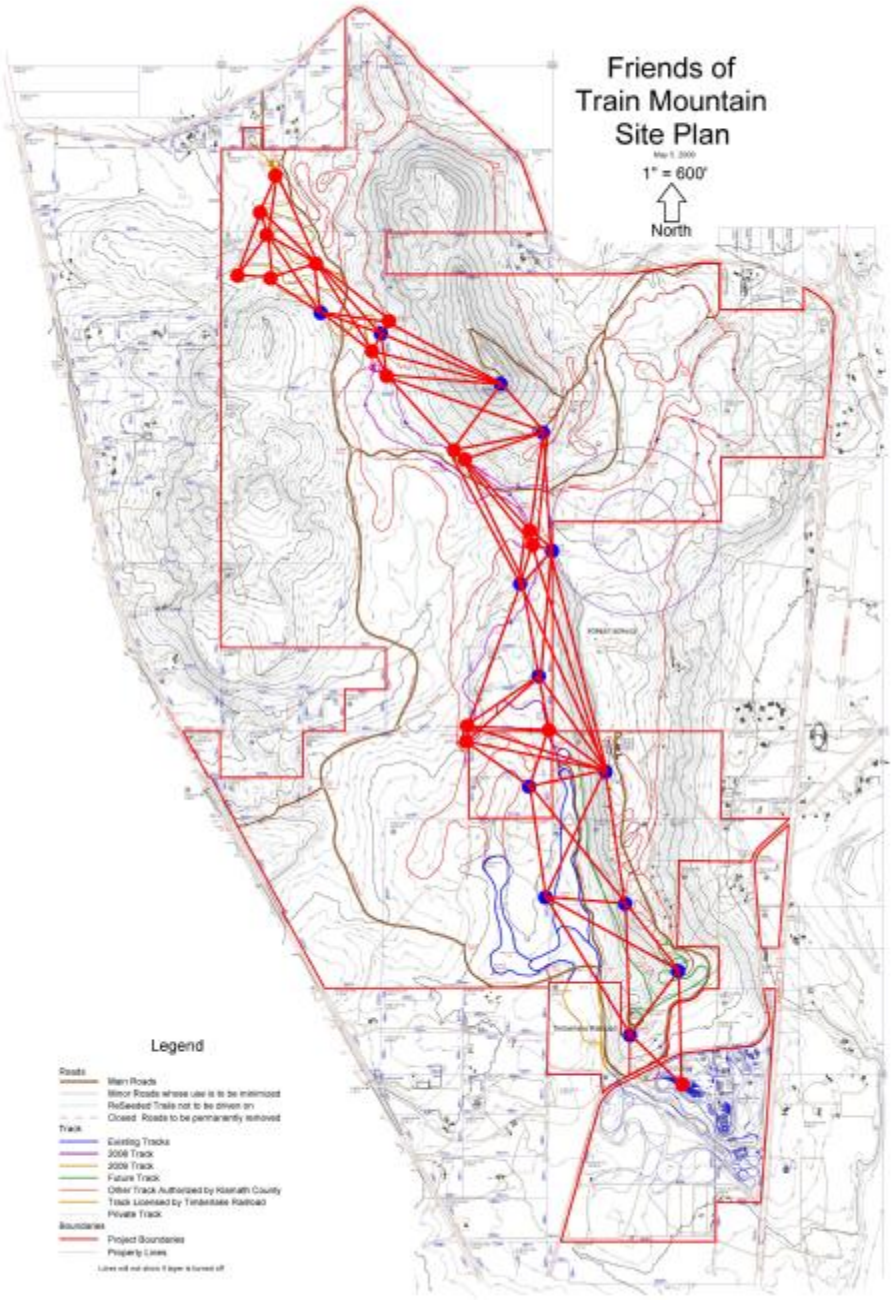
Control Point Boards - CP Boards

- One at each
  - Queuing Track
  - Wye
  - Siding
  - Mainline Meet Track
- Controls Track Authority and Current
- Communicates
  - to nearest CP Boards and ABS Boards with Track Pulses
  - to Computer by Radio



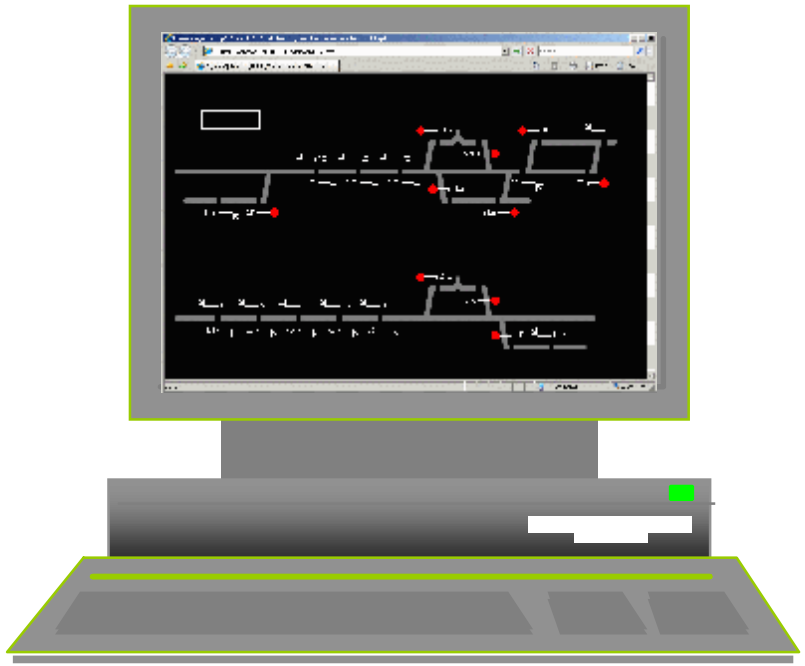
Radio Network

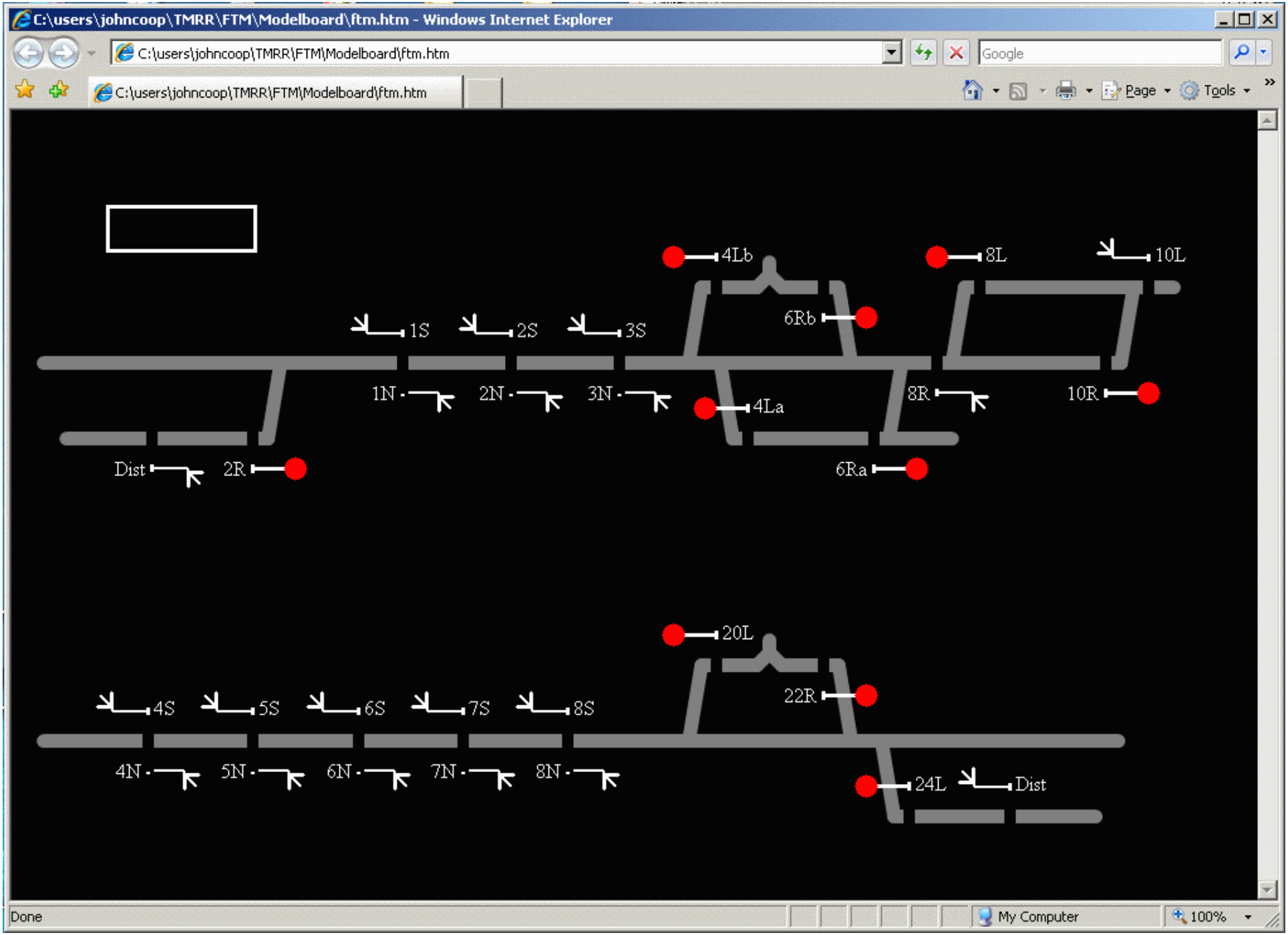




Computer

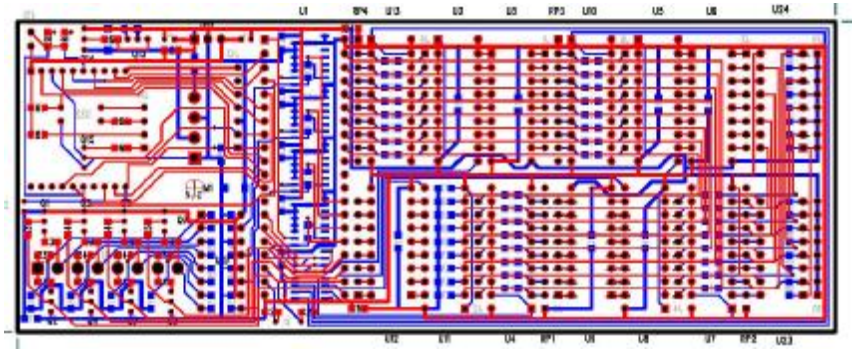
- Displays Modelboard
  - Signal Status
  - Current
  - Authority
- Allows Manual Control
- Optimizes Throughput
  - Farmersville Queue -- Witcombe Meet -- Cooper Junction
- Isolates Technical Difficulties



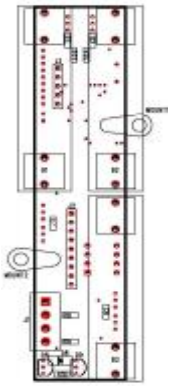

C:\users\johncoop\TMRR\FTM\Modelboard\ftm.htm - Windows Internet Explorer
C:\users\johncoop\TMRR\FTM\Modelboard\ftm.htm
Google
C:\users\johncoop\TMRR\FTM\Modelboard\ftm.htm
Page
Tools
4Lb
8L
10L
6Rb
1S
2S
3S
1N
2N
3N
4La
8R
10R
Dist
2R
6Ra
20L
22R
4S
5S
6S
7S
8S
4N
5N
6N
7N
8N
24L
Dist
Done
My Computer
100%

Components

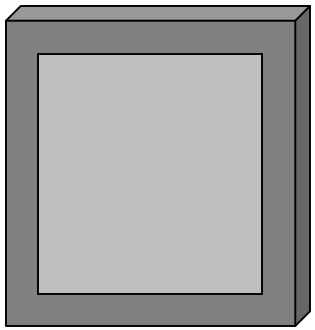
- 1 CP Board --- 3 software flavors
  - Queuing Track
  - Siding/Wye
  - Mainline Meet Track

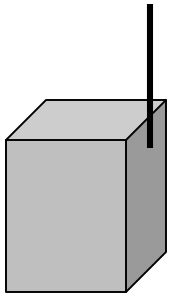


- 3 ABS Boards
  - Master
  - Slave
  - Passive (used with CP Boards)



- Solar Panels
- Radios
- Computer



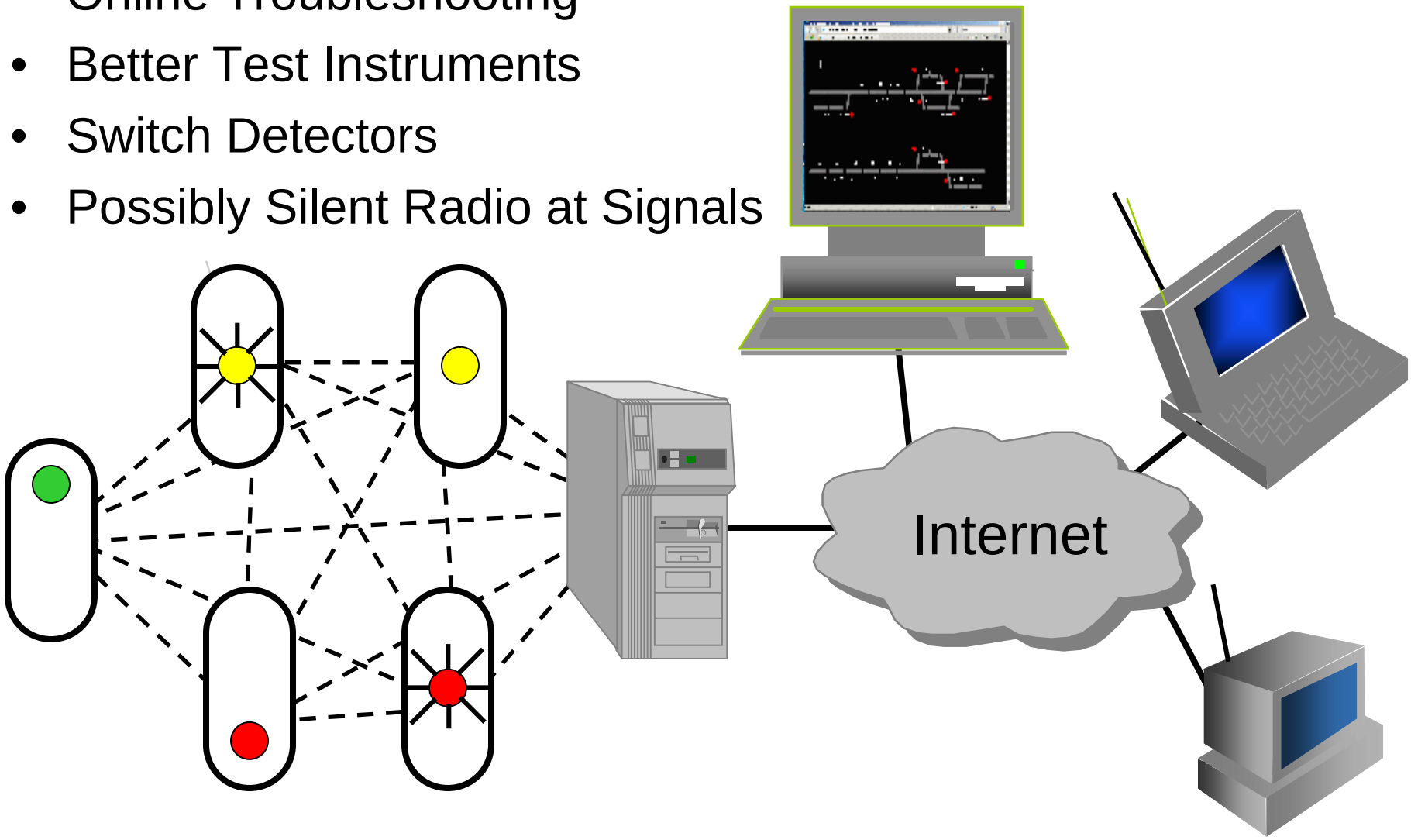


Technology Failures

- **Lightning**
- **Bonding Fails in a Siding or Wye**
  - Line on Computer Screen does not turn red
- **Bonding Fails on a Queuing Track or Mainline Meet Track**
  - Will only detect trains on the Signal side of the bonding failure
- **Bonding Fails or An ABS Intermediate Master Board Fails**
  - In the Segment with the Failure, Traffic can flow in the direction it was going at Failure, Not in the other direction.
  - Line on Computer Screen does not turn red
  - Nearby ABS signals will timeout, go dark
  - Catastrophic in terms of Function
  - No loss of protection
- **A CP Board Fails**
  - Catastrophic at the individual Siding/Queue/Wye/Meet
  - Cannot negotiate traffic in either direction
  - Rest of Railroad works fine.
- **Computer Fails or Radio Fails**
  - Everything works
  - No loss of Protection
  - Lost ability to throttle traffic when there are lots of 140’ trains

Future Releases

- Web Interface
- Online Troubleshooting
- Better Test Instruments
- Switch Detectors
- Possibly Silent Radio at Signals



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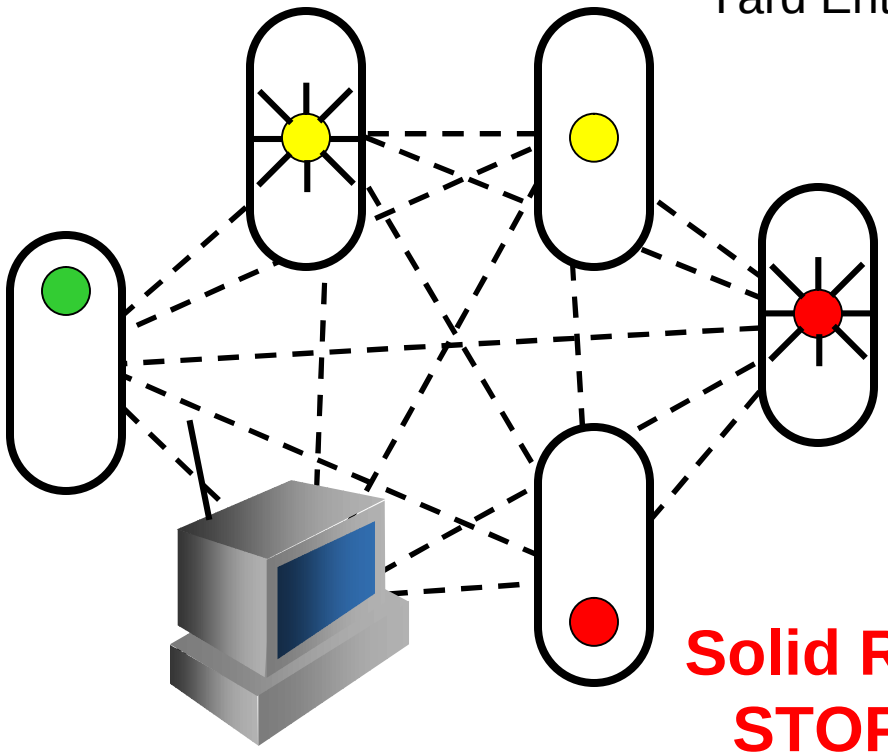

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Be Prepared to Stop.

Solid Red
STOP !!
Do Not Pass
This Signal