Preemption Versus Priority

Why Interrupt a Signalized Intersection

There are several reasons to interrupt a signalized intersection from the normal operation of assigning right-of-way. Some examples include:

- At grade Heavy Rail crossing
- Emergency Vehicles
- Transit Signal Priority
- Oversize Pedestrian Movements

What are some of the effects of interrupting a signalized intersection?

Since one of the goals of a signalized intersection is to safely and efficiently maximizing capacity for each intersection approach. This is accomplished by coordinating the intersection with the adjacent intersection.

If the interruptions are not managed correctly, the resulting effects on the intersection can be felt long after the interruption has ended.

How can the effects of interrupting the signal be minimized?

The Siemens m50 series traffic controller using SEPAC software has several different options for effectively and efficiently interrupting a signalized intersection.

- Preemption Routines

- Priority Routines
  - Full Priority
  - Partial Priority
  - Minimal Priorty

Preemption Routines

How to ensure the intersection is safe before preempting the signal?

How does heavy rail differ from emergency vehicle preemption?

Can yellow trap conditions be prevented before servicing the preempt?

What is the difference between a track phase and a dwell phase?

Can the intersection still cycle on a limited bases during preemption?

Are flashing yellow arrows available during preemption?

Preemption Routines

Can the preemption routine be terminated for an emergency vehicle parked in front of the signal?

Exit phases, are they needed?

How to ensure the intersection is safe before preempting the signal?

- Setting the minimum green and walk (**MIN GRN/WLK**) defines the amount of time a conflicting phase must be serviced before servicing the preemption input.

```
EPAC ALL PREEMPTS DATA

RING TIMERS      1      2      3      4
 MIN GRN/WLK    10     10     10     10
PRIORITY    FL   1/2  2/3  3/4  4/5  5/6
 STATUS      1    1    1    1    1    1
CODES          0-NO    1-YES
A-UP B-DN C-LT D-RT E-ENTER F-PRIOR MENU
```

- Setting the **STATUS** defines the hierarchy of each of the preemption inputs.

```
EPAC ALL PREEMPTS DATA

RING TIMERS      1      2      3      4
 MIN GRN/WLK     5      5      5      5
PRIORITY    FL   1/2  2/3  3/4  4/5  5/6
 STATUS      1    1    1    0    0    0
CODES          0-NO    1-YES
A-UP B-DN C-LT D-RT E-ENTER F-PRIOR MENU
```

Rail versus Emergency Vehicle Preemption

Heavy Rail

- Typically the highest preemption level within the controller.
- Uses both track and dwell phasing
- Needs the fast reaction time to service the approaching train.
- Pedestrian times may need to be truncated to allow enough time to clear the tracks.

Emergency Vehicle

- Typically serviced in a first come first service order
- Only uses a dwell phasing
- Pedestrian times usually are not truncated.

```
EPAC ALL PREEMPTS DATA

RING TIMERS       1      2      3      4
 MIN GRN/WLK      5      5      5      5
PRIORITY    FL   1/2  2/3  3/4  4/5  5/6
 STATUS      1    1    1    0    0     0
CODES         0-NO    1-YES
A-UP B-DN C-LT D-RT E-ENTER F-PRIOR MENU
```

Prevent Yellow Trap Before Servicing Preempt

- If protect/permissive lefts turns are allowed, caution must be used to prevent a yellow trap condition. The SR Mode (**SRMOD**) field can be used to force an all red condition before servicing the preempt to eliminate the yellow trap condition

  - **SRMOD** values:
- 0 Disable **SRMOD**

1 Apply All Red on Entry Only

2 Apply All Red on Exit Only

3 Applies All Red on Entry and Exit

```
EPAC PREEMPT 1 MISC DATA    (0-NO/1-YES)
TEST..: 0  DELAY: 0  MXCAL:  0  DB/10: 0
N-LOCK: 0  EXTND: 0  L OUT:  0  SRMOD: 0
LINK #: 0  DURAT: 0  GATE :  0
PHASE....1.2.3.4.5.6.7.8.9.0.1.2.3.4.5.6
 EXIT    0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
 CALLS   1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0
A-UP B-DN C-LT D-RT E-ENTER F-PRIOR MENU
```

Difference Between a Track Phase & Dwell Phase

- The **Track Phases** are defined as the phase or phases that the train tracks cross. Before the train can be serviced, these phases must be give right-of-way to clear any vehicles that may have stop on the tracks.

- The **Dwell Phases** are defines as the phase or phases that the controller will dwell in while the train has right-of-way and the track phases are blocked.

```
EPAC PREEMPT 1 INTERVAL TIMES
 SEL PED CLR:   8      TRK YEL/10 :  40
 SEL YEL/10 :  40      TRK RED/10 :  20
 SEL RED/10 :  20      DWELL GREEN:  10
 TRACK GREEN:  10      RET PED CLR:   8
 TRK PED CLR:   8      RET YEL/10 :  40
                       RET RED/10 :  20
A-UP B-DN C-LT D-RT E-ENTER F-PRIOR MENU
```

```
EPAC PREEMPT 1 VEHICLE STATUS
PHASE    1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6
 TRK GRN 0 0 1 0 0 0 0 1 0 0 0 0 0 0 0 0
 DWELL   0 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0
 (0-RED.1-GRN 2-FLR 3-FLY 4-DARK 5-FLG)
 CYCLE   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
    (0-NO..1-ACT..2-MN REC..3-MX REC)
A-UP B-DN C-LT D-RT E-ENTER F-PRIOR MENU
```

Cycling to Limited Phases during Preemption

- If the intersection geometry allows for multiple phases to be serviced during the preempt, the phases that are compatible with the train may be assigned as cycle phases instead of dwell phases.

- While operating in limited cycle, the intersection will be run as a free intersection.

```
EPAC PREEMPT 1 VEHICLE STATUS
PHASE     1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6
 TRK GRN  0 0 1 0 0 0 0 1 0 0 0 0 0 0 0 0
 DWELL    0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
 (0-RED.1-GRN 2-FLR 3-FLY 4-DARK 5-FLG)
 CYCLE    1 1 0 0 0 1 1 0 0 0 0 0 0 0 0 0
    (0-NO..1-ACT..2-MN REC..3-MX REC)
A-UP B-DN C-LT D-RT E-ENTER F-PRIOR MENU
```

Flashing Yellow Arrows During Preemption

- The key to using flashing yellow arrows during preemption is to remember that the flashing yellow arrow is usually assigned to the green output of the load switch.

- If the FYA overlap is to be active during the dwell interval, it will need to be assigned a code 5.

- If the overlap is to be active during the limited cycle, a code of 1 is still used.

```
EPAC PREEMPT 1 OVERLAP STATUS
OVERLAP..A.B.C.D.E.F.G.H.I.J.K.L.M.N.O.P
 TRK GRN 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
 DWELL   5 0 5 0 0 0 0 0 0 0 0 0 0 0 0 0
 CYCLE   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
(0-R.1-G.2-FR.3-FY.4-DK.5-FG|0-NO.1-ACT)
 TRAIL   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
A-UP B-DN C-LT D-RT E-ENTER F-PRIOR MENU
```

Terminating a Preempt Routine for Parked Vehicle

- In the case where the emergency vehicle stops on the near side of the intersection and is still putting in a preemption call to the controller, the **MXCAL** value can be used to set the maximum length of time that the signal will be seen as valid.

- Once the **MXCAL** timer expires, the preemption signal will need to be removed before the preempt can be re-serviced.

```
EPAC PREEMPT 1 MISC DATA    (0-NO/1-YES)
TEST..: 0  DELAY: 0  MXCAL:  0  DB/10: 0
N-LOCK: 0  EXTND: 0  L OUT:  0  SRMOD: 0
LINK #: 0  DURAT: 0  GATE :  0
PHASE....1.2.3.4.5.6.7.8.9.0.1.2.3.4.5.6
 EXIT    0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
 CALLS   1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0
A-UP B-DN C-LT D-RT E-ENTER F-PRIOR MENU
```

Are Exit Phases Needed?

- Exit phases define which phase or phases the controller will service first after the preemption routine as normal operations begins.

- Typically set to the track phases since they have been waiting the longest time while the train had the right-of-way.

```
EPAC PREEMPT 1 MISC DATA    (0-NO/1-YES)
TEST..: 0  DELAY: 0  MXCAL:  0  DB/10: 0
N-LOCK: 0  EXTND: 0  L OUT:  0  SRMOD: 0
LINK #: 0  DURAT: 0  GATE :  0
PHASE....1.2.3.4.5.6.7.8.9.0.1.2.3.4.5.6
 EXIT    0 0 1 0 0 0 0 1 0 0 0 0 0 0 0 0
 CALLS   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
A-UP B-DN C-LT D-RT E-ENTER F-PRIOR MENU
```

Priority Routines

How are priority routines different from the Preempt routines?

What effects do the priority routines have on coordination?

How are exit phases assigned within the priority routines?

How does the full priority routine get back instep with the coordination timer?

How many advance detectors are needed to implement the priority routines?

How are travel time distances assigned within the priority routines?

Use Cases:

Emergency Vehicle

Transit Vehicle

Priority Routines Differ From Preempt Routines

The biggest difference between preemption and priority is that the priority routines work in conjunction with the coordination timer.

Preempt vs. Priority

- Coordination
- Dwell
- Pedestrians
- Transit Signal

Priority Routines and Coordination

Each of the different types of priority routines operate within coordination differently.

- **Full Priority**
  - Skip to the assigned phase
  - Jump back to the coordination timer
  - Offset correction
- **Partial Priority**

By applying phase reductions and extensions, always in step with the coordination timer

- **Minimal Priority**

Can only apply phase extensions and the reductions are applied after the priority terminates

Assigning Exit Phases in Priority Routines

Once the full priority request has been serviced, the next phase to be serviced is assigned to one of three user assigned options:

- Normal – the phase that is normally the next phase in the ring.
- Wait – the phase that has the longest queue length based on assigned queue detectors
- Recovery – the assigned recovery phases for the priority routine

φ1	φ2	φ3	φ4
φ5	φ6	φ7	φ8

How Does Full Priority Get Back in Step With Coordination Timer

The last stage of the full priority routine is returning to coordination.

- Cycle – SEPAC will determine how much of an adjustment is required and then apply an offset correction.

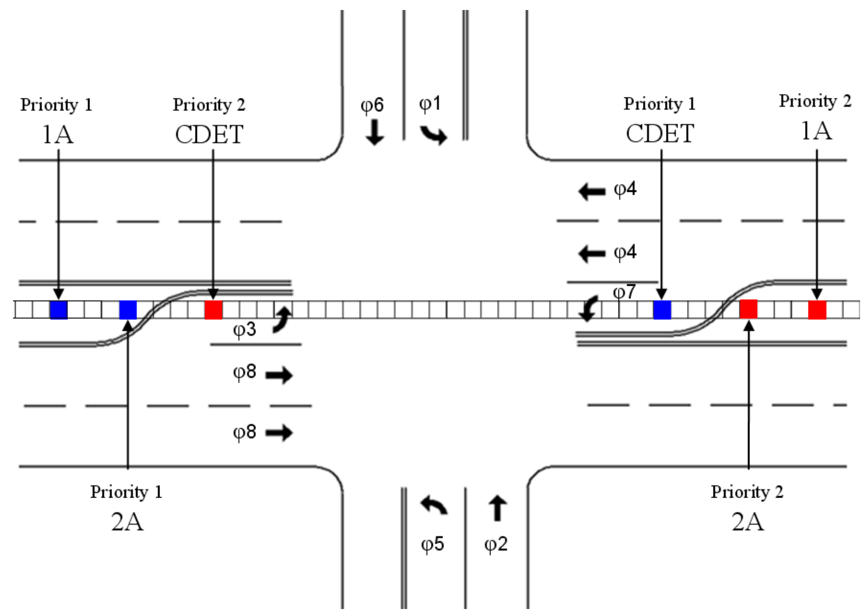
- Jump – SEPAC will jump back into coordination assuming minimum split times can be meet.

Advance Detectors and Priority Routines

Each of the priority routines can use up to 6 advance detectors, a check out detector, a cancel detector, and a backup detector.

Additionally, SEPAC can operate with any of the detectors that are available with in the cabinet.

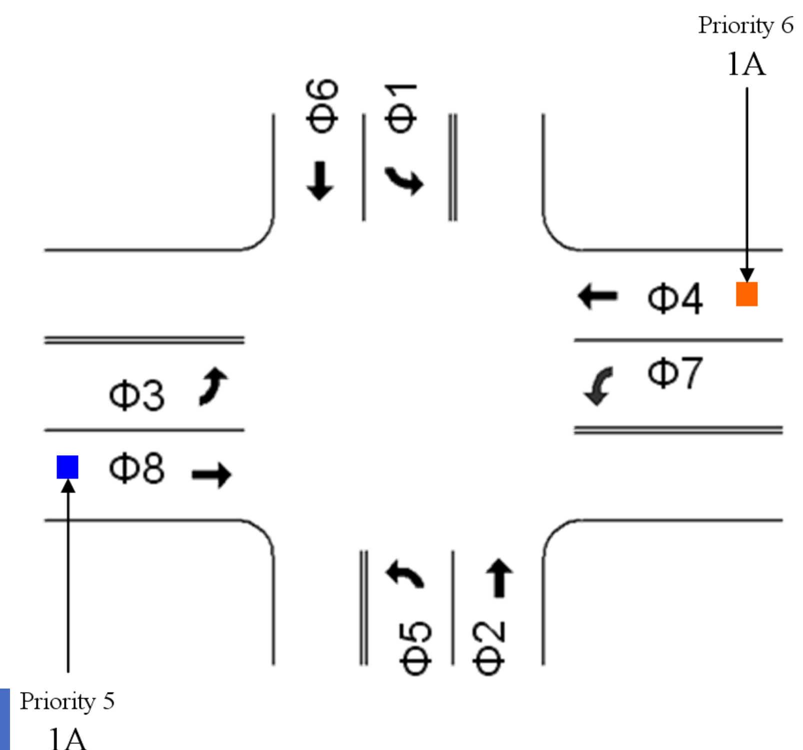
- 64 Vehicle Detectors
- 8 Special Detectors
- 8 Pedestrian Detectors
- 6 Preemption Detectors



Assign Travel Time Distances Within Priority Routines

SEPAC uses three different time parameters to determine when the priority routine should be active.

- TSD – Time to Service Desired
- TED – Time to Expected Departure
- TTL – Time to Live



Using Full Priority for Emergency Preemption

How does the priority routine differ from the preempt routine for emergency vehicles?

- The full priority will skip any phases need to service the approaching emergency vehicle.
- Co-phases are assigned instead of dwell phases.
- Minimum and maximum green times are assigned instead of dwell time.

Priority Routine for Transit Vehicles

How does the priority routine provide for transit vehicles?

- Time to Service Desired (TSD) times are assigned for each advance detector.

- Phase reductions and extension times are entered into each of the coordination plans.

Addition Uses for Priority Routines

With a little outside the box thinking, there are several additional uses of the priority routines.

- Dynamic offset adjustments for prioritizing main street platoons.
- Extending side street green times to accommodate oversize pedestrian times.