# Tech Note 1105 – Flashing Yellow Arrows using Overlaps

Agencies may choose the optional use of flashing yellow arrow method for permissive left turns (see diagram below). This is the implementation discussed in NCHRP Report 493. It was issued an MUTCD interim approval by the FHWA on March 20, 2006. A full explanation can be found at http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_493.pdf.
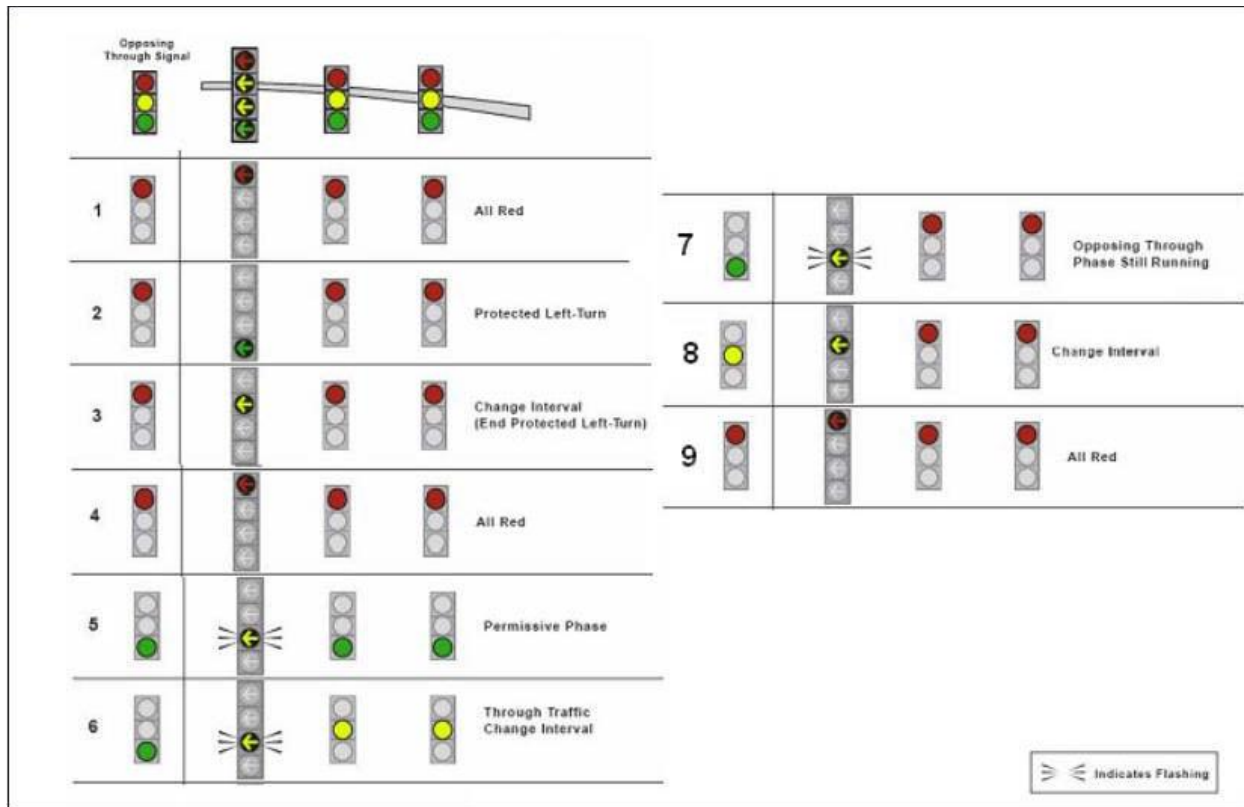
THE FLASHING YELLOW ARROW MOVEMENT IS BEING DEVELOPED BASED UPON RESEARCH PERFORMED IN NCHRP PROJECT 3-54. THIS PROGRAM IS AUTHORIZED BY THE FEDERAL HIGHWAY ADMINISTRATION AND IS CURRENTLY IN AN EXPERIMENTAL PHASE.

Trafficware does not provide any guidelines, warrants, or recommendations for the use of protected/permissive left-turn phasing. The underlying assumption is that the traffic engineer has decided that flashing yellow arrow protected/permissive control is the most appropriate left-turn treatment. It is also assumed that the deploying agency has made all necessary considerations regarding this control method and has determined that it is consistent with relevant traffic engineering standards and practices. Please note that the operation of this feature is subject to change pending actions by the regulating standards organizations.

Version 61.x Flashing Yellow Overlap Programming

Version 61 accomplishes this by using existing pedestrian yellow outputs that are not normally used by the Walk and Don't Walk intervals. This feature allows the Flashing Yellow Arrow (FYA) output from an overlap to be mapped to the yellow output of a pedestrian channel. The yellow output is typically not used and therefore available for FYA use. In other words, the overlap, during the modified phase period of that overlap, drives the pedestrian channel that is mapped to it, to flash the yellow arrow. This feature allows an FYA signal to be implemented without using a second full load switch position or cumbersome cabinet re-wiring. For example, we will change a protected only Phase 1 Left-turn to a Protect-Permissive using a 4-head signal with Flashing Yellow. We will program Overlap B (Overlap 2) that will utilize the Yellow Flash output from Phase 2 Ped Yellow.

Please note the user should assign only even-numbered overlaps for the Flashing Yellow Arrow (FYA). **Odd-numbered overlaps that are one less than FYA must remain unassigned because the yellow is used as an alternate way to get the FYA output.**

Channels are set up via MM->1->3->1. In this example we will use the default channel setup for a typical TS2 Cabinet.

```
     Chan.1...2...3...4...5...6...7...8    <     Chan.9..10..11..12..13..14..15..16
P/Olp#     2   2   4   4   6   6   8   8   P/Olp#     0    0    0    0    2    4    6    8
   Type  OLP VEH OLP VEH OLP VEH OLP VEH      Type   OLP  OLP  OLP  OLP  PED  PED  PED  PED
  Flash  RED RED RED RED RED RED RED RED     Flash   RED  RED  RED  RED  DRK  DRK  DRK  DRK
```

First, set up overlap #2 via MM->1->5->2->(olp)2->1. Make sure you program the type as R-T/OTH and set up the included phase as the protected/permitted phase and the modifier phase as the conflicting through movement.

```
    Ovrlp B     Ps....................
Included Ps    1   0   0   0   0   0   0   0
Modifier PS    2   0   0   0   0   0   0   0
Type:R-T/OTH Grn: 0 Yel: 3.5 Red: 1.5
```

Next, go to the MM->1->5->2->(olp)2->2 screen and make sure that you program the Type+ as F1Yel-4 for a 4 section head. Note if you have a 3-section head, you can program Type+ as T1Yel-3.

```
    Ovrlp B     Ps....................
Confl Ps       0   0   0   0   0   0   0   0
Confl Ovrlps   0   0   0   0   0   0   0   0
Confl Peds     0   0   0   0   0   0   0   0
Lead Grn OFF    Delay 0   Type+   FlYel-4
```

Use the FYA mapping screen (MM->1->5->4) to map FYA outputs of overlaps to Pedestrian Clearance outputs of channels. Assume that Phase 2 Ped is programmed as the default Ped 2 channel, Channel 13.

```
Fl Yel Arw    # Olp Chan    # Olp Chan
              1   2   13     2   0   0
              3   0   0      4   0   0
```

The # columns show which of 4 FYA signals is being programmed. The Olp column shows the overlaps that are programmed as type FlYel-4. Up to four 4-output FYA overlaps may be mapped to Ped Clearance outputs. The first four overlaps that are programmed as type FlYel-4 will be shown in order. The user may enter the number of an output channel that is assigned as type "PED" to use its Ped clearance output. A zero entry means that no mapping takes place and the FYA output will appear as it usually does on the yellow overlap output of the overlap that is one number less than the main FYA overlap.

For example, if overlap 6 is configured as type FlYel-4, its flashing yellow output will appear on the yellow output of overlap 5. If Ped Clearance mapping is set up, it will also appear on the ped clearance output of the channel programmed on this screen.

Note that if a channel assignment is made to a channel that is not assigned as Ped, the FYA mapping does not occur.

Note, too, that the overlap associated with the FYA mapping entry (#) is dependent upon whether it is first, second, etc. of the overlaps configured as FlYel-4. If overlap types are changed such that this order is changed, the Fl Yel Arrow mapping should be reviewed to ensure that the FYA outputs are mapped to the desired Ped Clearance outputs.

Running special operations such as preemption, may affect the output of this arrow such that you may have to "hard code" the clearance times to insure proper hardware monitoring of this channel.

Channels 13-16 Pedestrian Movements Assignment Example

The following is a reprint from the MMU manual, which lays out the Ver 61 channel and left-turn arrow channel assignments for a standard 16 channel TS2 controller using four (4) left-turn arrows.

FYA Programming
8/30/2007

4 Left Turns, Peds on 13-16

CONTROLLER

Channel	Controller Channel Assignments															
Channel	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Type	OLP	VEH	OLP	VEH	OLP	VEH	OLP	VEH	OLP	OLP	OLP	OLP	PED	PED	PED	PED
#	2	2	4	4	6	6	8	8	0	0	0	0	2	4	6	8

Overlap	Controller FYA Overlap Setup			
Overlap	2	4	6	8
Olp Included	1	3	5	7
Olp Modifier	2	4	6	8
FYA out on Chan	13	14	15	16
OLP Type	R-T/OTH	R-T/OTH	R-T/OTH	R-T/OTH
OLP Type+	FLYel-4	FLYel-4	FLYel-4	FLYel-4

Notes

1 Assign only Even-numbered overlaps as FYA. Odd-numbered overlaps one less than FYA must remain unassigned b/c the yellow is used as an alternate way to get the FYA output.

MMU-516L

FYA #	MMU FYA Setup			
FYA #	1	2	3	4
Type	FYA	FYA	FYA	FYA
FYA Channel	1	3	5	7
Yel Input Chan	13	14	15	16
Permissive 1	2	4	6	8
Permissive 2	13	14	15	16

Please note that the Channel numbers in parentheses are not programmed on the Program Card. Their FYA functionality is entered on the FYA Setup Screen as indicated above.

MMU Prog Card

Version 65.x/Version 76.x Flashing Yellow Overlap Programming

Version 65.x and V76.x is much like version 61.x. The difference is that the user can utilize pedestrian yellow outputs as discussed above or the user has the option to only use the existing overlap yellow outputs. Programming the same example above, using Version 65/Version 76, we will change a protected only Phase 1 Left-turn to a Protect-Permissive using a 4-head signal with Flashing Yellow. We will program Overlap B (Overlap 2) that will utilize the Yellow Flash output from Phase 2 Ped Yellow. First set up the overlap via MM->1->5->2->(olp)2->1. Make sure you program the type as FYA-4 and set up the included phase as the protected/permitted phase and the modifier phase as the conflicting through movement.

```
  Ovrlp B-2    Ps....................
Included Ps    1  0  0  0  0  0  0  0
Modifier PS    2  0  0  0  0  0  0  0
Type:FYA-4   Grn: 0 Yel: 3.5 Red: 1.5
```

Use the Output Channels+ screen (MM->1->8->4) to tell channel 13 that it is having an overlap override applied, whose source is via Overlap B(Overlap 2) and that it is to flash the yellow output. Assume that Phase 2 Ped is programmed as the default Ped 2 channel, Channel 13.

```
<     Chan.9..10..11..12..13..14..15..16
Flash Red .    .    .    .    .    .    .    .
Flash Yel .    .    .    .    X    .    .    .
Flash Grn .    .    .    .    .    .    .    .
Inhibit Red Flash in
   Preempt .    .    .    .    .    .    .    .
Olap Ovrd 0    0    0    0    2    0    0    0
```

Flashing Yellow Arrow works a little different in Version 65/Version 76, it's a little more flexible. In these versions overlaps have 4 outputs. They have RED, YELLOW, GREEN, and AUX. In the channel+ screen, you tell which channel's yellow output is going to be overridden by the overlap AUX output. Keep in mind that you do not have to use a ped channel, but can use any channel. For ver 65, you can elect to utilize a whole channel for the FYA output, or an existing pedestrian channel.

Four approach example using V65/V76

The next example will show how to set up Flashing Yellow Arrows in all 4 directions. In this example, we will change protected only Left-turns for Phases 1, 3, 5, and 7 to a Protect-Permissive using a 4-head signal with Flashing Yellow.

For our example, our cabinet has been set up as a typical TS2 cabinet that will utilize the MMU using Channels 1,3,5 and 7 to output green for phases 1,3,5, and 7 and will flash the Ped yellows outputs 2, 4, 6 and 8. The channel programming accessed via MM->1->8->1 is shown below.

```
      Chan.1...2...3...4...5...6...7...8        <      Chan.9..10..11..12..13..14..15..16
P/Olp#    2   2   4   4   6   6   8   8         P/Olp#    0   0   0   0   2   4   6   8
  Type  OLP VEH OLP VEH OLP VEH OLP VEH           Type  OLP OLP OLP OLP PED PED PED PED
 Flash  RED RED RED RED RED RED RED RED          Flash  RED RED RED RED DRK DRK DRK DRK
```

First set up the 4 overlaps via MM->1->5->2. Make sure you program the type as FYA-4 and set up the included phase as the protected/permitted phase and the modifier phase as the conflicting through movement. This is shown below:

OLP B-2   OLP D-4

```
  Ovrlp B-2     Ps....................        Ovrlp D-4     Ps....................
Included Ps    1  0  0  0  0  0  0  0        Included Ps    3  0  0  0  0  0  0  0
Modifier PS    2  0  0  0  0  0  0  0        Modifier PS    4  0  0  0  0  0  0  0
Type:FYA-4   Grn: 0 Yel: 3.5 Red: 1.5       Type:FYA-4   Grn: 0 Yel: 3.5 Red: 1.5
```

OLP F-6   OLP H-8

```
  Ovrlp F-6     Ps....................        Ovrlp H-8     Ps....................
Included Ps    5  0  0  0  0  0  0  0        Included Ps    7  0  0  0  0  0  0  0
Modifier PS    6  0  0  0  0  0  0  0        Modifier PS    8  0  0  0  0  0  0  0
Type:FYA-4   Grn: 0 Yel: 3.5 Red: 1.5       Type:FYA-4   Grn: 0 Yel: 3.5 Red: 1.5
```

The overlaps are used for driving the flashing yellow arrows whenever the modifier phase is running. The overlaps are **not required** to be programmed as channel outputs or wired in the cabinet for the flashing yellow arrows to run properly. To flash yellow, you must then choose 4 available yellow outputs that will drive the Flashing yellow arrow for each approach and are wired in the cabinet. In this case we will use Ped 2 (Channel 13) Yellow to drive the phase 1 permissive yellow arrow during phase 2, Ped 4 (Channel 14) Yellow to drive the phase 3 permissive yellow arrow during phase 4, Ped 6 (Channel 15) Yellow to drive the phase 5 permissive yellow arrow during phase 6, and Ped 8 (Channel 16) Yellow to drive to drive the phase 7 permissive yellow arrow during phase 8.

Now we must set up the yellow indications to flash whenever the FYA overlap is being run. This is done by programming the MM->1->8->4 Channels+ screen.

```
<    Chan.1...2...3...4...5...6...7...8 │ <    Chan.9..10..11..12..13..14..15..16
Flash Red .   .   .   .   .   .   .   . │ Flash Red .   .   .   .   .   .   .   .
Flash Yel .   .   .   .   .   .   .   . │ Flash Yel .   .   .   .   X   .   .   .
Flash Grn .   .   .   .   .   .   .   . │ Flash Grn .   .   .   .   .   .   .   .
Inhibit Red Flash in                   │ Inhibit Red Flash in
  Preempt .   .   .   .   .   .   .   . │   Preempt .   .   .   .   .   .   .   .
Olap Ovrd 0   0   0   0   0   0   0   0 │ Olap Ovrd 0   0   0   0   2   4   6   8
```

The programming will flash the Ped 2 (Channel 13) yellow during phase 2 by utilizing OLP 2, flash the Ped 4 (Channel 14) yellow during phase 4 by utilizing OLP 4, flash the Ped 6 (Channel 15) yellow during phase 6 by utilizing OLP 6, flash the Ped 8 (Channel 16) yellow during phase 8 by utilizing OLP 8.

Programming Considerations

Please note the following nuances with the FYA software.

1) The yellow arrow will flash for a minimum of 2.0 seconds to ensure proper clearances for the cabinet's conflict monitor.

2) When the time-of-day pattern or preempt disables an overlap that is an FYA overlap, the software will finish out the yellow before dropping the overlap.

3) Upon power, up the controller must cross both barriers before displaying the flashing yellow arrow.

4) If FYA overlaps are inhibited during preemption, when the preemption is completed, the controller must cross the barrier before displaying the flashing yellow arrow.

5) When time-of-day or preempt allows an omitted FYA overlap to be reestablished, it will **not** wait until the overlap is timing green or red.

6) Upon controller startup (i.e. controller power up, NEMA Ext. Startup, startup after Flash, etc.) the FYA outputs will be inhibited until all phases are cycled and serviced once.

Time-of-Day Programming Considerations

Overlaps 1-8 can be turned off on a time of day basis using the scheduler. Thus the user can schedule when the FYA overlaps can be displayed to the motorist. Once you program the FYA overlaps they will remain on until they are turned off by the scheduler. The following is an example on how you would turn off overlaps via the scheduler. For our example we will use the 4 approach FYA overlap example above and turn the FYA's off from 2pm till 8pm daily throughout the year. This controller is running free until 2:00 pm when it runs coordination pattern 1 and stays in pattern 1 until 8:00pm when it reverts back to free operation.

1) Program the FYA overlaps as shown

2) Go to MM->4 Scheduler.

```
            Time  Based Scheduler
1. Set Date/Time    4. Day Plan      7. Status
2. Easy Schedule    5. Action Table  8. Resrvd
3. Adv Schedule     6. Parameters    9. More
```

3) Go to the Easy schedule (MM->4-2) **or** the Advanced Schedule (MM->4->3) menu and program the controller to run Day Plan #1 all year long.

```
 # Day   Mo: From-Thru   DOM: From-Thru   Plan
 1 ALL         01-12              01-31      1
 2 OFF         00-00              00-00      1
 3 OFF         00-00              00-00      1
 4 OFF         00-00              00-00      1
 5 OFF         00-00              00-00      1
 6 OFF         00-00              00-00      1
 7 OFF    +    00-00              00-00      1
```
MM->4->2 Easy Scheduler

```
     Day        Month      more~        Date     1         2         3    Day
 #  SMTWTFS  JFMAMJJASOND         #     12345678901234567890123456789 01  Plan
 1  .......  ............         1     XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX      1
 2  .......  ............         2     .............................       1
 3  .......  ............         3     .............................       1
 4  .......  ............         4     .............................       1
 5  #......  ............         5     ............................#       1
 6+ .......  ............         6+    .............................       1
```
MM->4->3 Advanced Scheduler

4) Set up the Day plan table – Action 99 is free pattern 254 and action 1 is coordination pattern #1.

```
Plan- 1        Evt  Time    Actn    Evt  Time    Actn
Link: 0          1  00:00     99      2  14:00       1
                 3  20:00     99      4  00:00       0
                 5  00:00      0      6  00:00       0
                 7  00:00      0      8  00:00       0
                 9  00:00      0     10  00:00       0
                11  00:00      0     12  00:00       0
             +  13  00:00      0     14  00:00       0
```
MM->4->4 Day plan table # 1

5) Set up the action table for action 1 to run pattern 1 and action 99 to run free.

```
Actn   Patrn   Aux-123   Spec-12345678   Pre.1.2    Actn   Patrn   Aux-123   Spec-12345678   Pre.1.2
 1       1      ...        ........        0 0        94      -      ...        ........        0 0
 2       2      ...        ........        0 0        95      0      ...        ........        0 0
 3       3      ...        ........        0 0        96      0      ...        ........        0 0
 4       4      ...        ........        0 0        97      0      ...        ........        0 0
 5       5      ...        ........        0 0        98      0      ...        ........        0 0
 6       6      ...        ........        0 0        99     254     ...        ........        0 0
 7 +     7      ...        ........        0 0       100     255     ...        ........        0 0
```
MM->4->5 Action Table

6) Now set up pattern #1 to turn off Overlaps 1, 2, 3, and 4, thus turning off the FYA outputs. This is done by accessing Menu item MM->2->6, Alt Tables+

```
Pat#   Alt:   POpt   PTime   DetGrp   Call/Inh    >   <Pat#   Olp.Off: 12345678   CIC    CNA1    Max2    Dia
 1             0      0       0        0               1                .X.X.X.X    0      .       .       DFT
 2             0      0       0        0               2                ........    0      .       .       DFT
 3             0      0       0        0               3                ........    0      .       .       DFT
 4             0      0       0        0               4                ........    0      .       .       DFT
 5             0      0       0        0               5                ........    0      .       .       DFT
 6             0      0       0        0               6                ........    0      .       .       DFT
 7 +           0      0       0        0               7 +              ........    0      .       .       DFT
```

FYA Inhibit Considerations

The FYA is inhibited only when the FYA overlap is not active and is not flashing yellow. This satisfies various state MUTCDs that do not allow Yellow Clearance for flashing yellow to be active while the Modifier phase (which normally conflicts with the left-turn movement) is still green. The controller will begin a FYA inhibit only when the FYA overlap is Red and not flashing in two cases:

1) Inhibit by Time-of-day and

2) Inhibit due to preemption and the "All Red B4 Prmpt" parameter in preemption is set to ON.

This prevents the FYA clearance from occurring asynchronously with the overlap's parent phases. If the FYA is inhibited by time-of-day, the inhibit will take effect the next time the overlap is Red. When the FYA is inhibited by preemption with "**All Red B4 Prmpt**" set,

preemption will cause all rings to clear through All Red if any FYA is flashing yellow. This provides an opportunity for the FYA to clear while the conflicting thru phase (FYA modifier phase) is also timing yellow. If "**All Red B4 Prmpt**" is not set, then the FYA overlap will terminate immediately upon inhibit while the conflicting thru movement may remain green.

Summary

Certain agencies have expressed interest in flashing yellow arrows for permissive left turns. Please note that the Flashing Yellow Arrow movement is being developed and is currently in an experimental phase.