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***SYVARI - A Finnish priority strategy implemented in Swarco, Peek and Siemens controllers***

The text of the presentation

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Slide 1 (Title of the presentation):

- ⇒ My presentation is about SYVARI. It is a formula for realizing bus priorities and it has been implemented in Finland in Swarco, Peek and Siemens controllers.
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Slide 2:

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  - ⇒ SYVARI was developed and the first trial junction was programmed in Turku in 2007.
  - ⇒ It has been further developed in a national JENKA project from 2008 to 2010.
  - ⇒ Now it is used in 8 Finnish cities altogether at almost 100 junctions.
  - ⇒ With the exception of Helsinki, new bus priorities in Finland are nowadays programmed using SYVARI
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Slide 3:

- ⇒ The JENKA project was a cooperation project between the 8 largest Finnish cities. It was partly financed by the Finnish Ministry of Transportation and Communications
  - ⇒ The project included four parts:
    - ⇒ First, the principles of SYVARI were finalized
    - ⇒ Then a manual of SYVARI was written
    - ⇒ In the third part, the impacts of SYVARI were evaluated
    - ⇒ In the last part, programming for controllers was standardized according to SYVARI principles
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Slide 4:

- ⇒ Next I'll tell you briefly about the control principles of SYVARI. SYVARI's basic feature is that it is a combination of isolated control without a fixed cycle, and coordinated control with a fixed cycle. SYVARI is based on control functions which normally are used in isolated controlled junctions. The most important of these is that permission to try to start green is given to signal groups by stage sequence programming. The permission to try to start green is never timed via the cycle counter, as is normally the case with fixed cycle control.

Using stage sequence functions to giving green permission, it is easy to program effective and flexible priorities.

Using SYVARI, it is possible to program:

- ⇒ Early greens

- ⇒ Green extensions
- ⇒ Extra stages and stage rotations
  
- ⇒ When priorities are not needed, normal stages are synchronized with the cycle time
- ⇒ This occurs using special synchronizing functions

And then an example of, how SYVARI works:

- ⇒ If the synchronized control has the first stage where eastbound and westbound movements have green indication, and
  - ⇒ We receive a priority call of a bus approaching from west and turning left
  - ⇒ The controller immediately gives up the synchronization
  - ⇒ and realizes a priority treatment for the left turning bus, which in this case is an extra green
  - ⇒ The next normal stage follows after the priority
  - ⇒ and then the controller will return to the synchronized control,
  - ⇒ where the synchronizing functions will synchronize the stage ring again with the fixed cycle.
- The synchronizing functions can slow down or speed up the progress of the stage ring to synchronize the stage ring with the cycle time after priorities. The priorities and synchronizing functions can together result in, the number of cycles of the stage ring differing from the number of fixed cycles.

#### Slide 5:

- ⇒ In a nutshell we can describe SYVARI this way:
- ⇒ When a bus approaches the junction, SYVARI works like an isolated control with priorities, and
- ⇒ When the bus has left the junction, it works like a normal synchronized control with a fixed cycle

#### Slide 6:

- ⇒ One important detail of SYVARI programming is that every signal group has three parallel maximum time counters instead of one as is usually the case. A signal group can maintain green if one of its max time counters hasn't reached its own maximum and an active extension is directed towards this max time.
- ⇒ The first maximum time is guaranteed max time. When a signal group has green demand, it can always maintain its green period as long as the value of guaranteed max time. Synchronization or priority calls of conflicting signal groups can never force the signal group to red during the guaranteed max time.
- ⇒ The second maximum time is synchronization max time
  - Firstly, it is used for synchronizing the ending of green periods with the cycle time, if any priority calls aren't active.
  - This happens by artificial extensions timed by the cycle counter directed towards synchronization max time and by synchronization max time resets given also by the cycle counter.
  - Secondly, synchronization max time is used to realize early green priorities. A priority call for a conflicting group simply resets the synchronization max time and this way the ongoing green is truncated.

- ⇒ The third maximum time is the priority maximum. It's the longest max time and green extensions for buses are directed toward it, and so it realizes priority extensions for buses.

#### Slide 7:

- ⇒ The JENKA project included also writing of a SYVARI manual.
- ⇒ It contains:
  - Explanation of principles of SYVARI
  - Guides for planning
  - Example plans
- Unfortunately, it is only available in Finnish

#### Slide 8:

- ⇒ This is an example of SYVARI plan
- ⇒ In the stage sequence, green arrows are normal greens and blue arrows are extra greens
- ⇒ Timings of synchronization functions are drawn with light blue and red bars. Light blue bars show the artificial extensions, timed by the cycle counter and directed towards synchronizing max time. These maintain the green, although any ongoing real detector extensions aren't directed towards the signal group.
  - The red bars show the periods when synchronization max times are reset if the signal group is running on green.
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#### Slide 9:

- ⇒ A very important part of the JENKA project was standardization of controller programming.
- ⇒ All three suppliers operating on Finnish market created, for their own controllers, a standardized formula for the programming according to SYVARI principles. There are only slight differences between operations of SYVARI in various controllers, though some solutions in programming are completely different. E.g. in Swarcos ITC-2 controller many so called fictional signal groups are used, whereas Peek Traffics EC-2 controller is programmed without fictional signal groups.

Thanks to standardized formulas for programming, SYVARI is:

- Easy and quick to program
- Easy to maintain, and
- Operation is virtually independent of the type of controller

#### Slide 10:

- ⇒ An evaluation of the impacts of SYVARI was made in the JENKA project using simulations
  - The simulated network included three junctions and the simulation program applied was VISSIM. Junctions were controlled using EC-1 controllers.
- ⇒ Two bus routes ran through the network. Simulations were made using 5- and 15-minute headways.

- ⇒ Buses were detected on the main street 200 metres and on the cross street 150 metres before the junction.
  - ⇒ Full bus priorities were used.
  - ⇒ On the left side, we see results, when headways were 15 minutes and on the right side, when headways were 5 minutes.
  - ⇒ The main result was that delays of buses decreased about 50 to 60% and delays of other traffic increased only few seconds.
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Slide 11:

- ⇒ A brief summary
  - ⇒ SYVARI is developed by public authorities, so it can be freely used
  - ⇒ The suppliers have standardized programming for their own controllers
  - ⇒ It has effective priorities, and
  - ⇒ It is easy to use
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Slide 12:

- ⇒ Thank You