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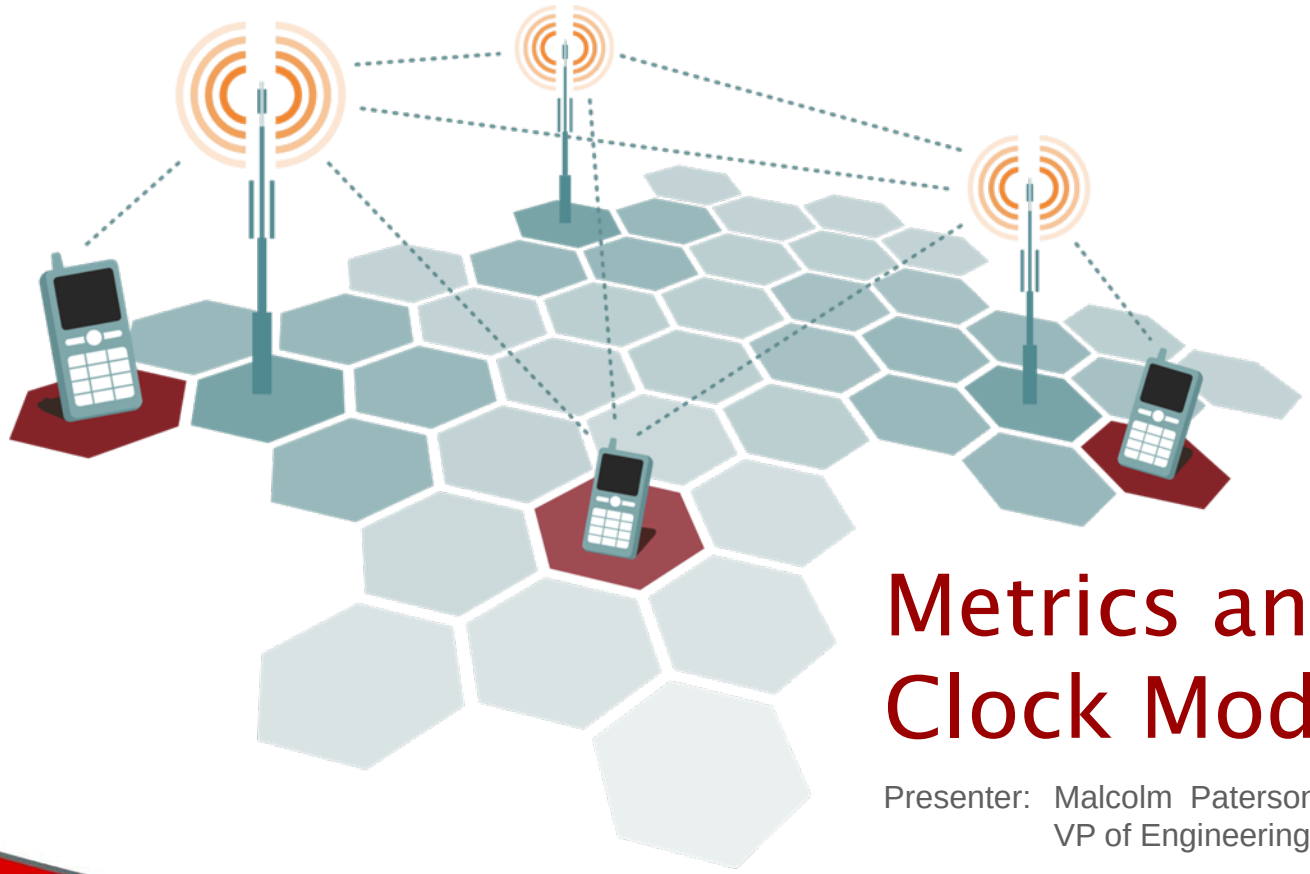

Metrics and Slave Clock Models

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Overview

- **Desire -** to be able to characterise a network and on the basis of standardised measurements and guarantee PTP operation – Go/No-Go
- **How -** Create a model for a slave clock with parameters and minimum values or a range of values for these parameters to support the measurements
- **What –** should the model be?
- The approach outlined is consistent with the current measurement approaches
- Not the answer but a means to the answer

The Shared Objective

- Deployment of timing elements into a network with a guarantee of performance.
- This presentation outlines an approach which will allow the use of a model with adjustable parameters to converge on a method for measuring performance of networks and for assessing PTP slaves to address this shared Objective

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The Search

- Industry looking for pass/fail testing based on required performance masks.
    1. Available on the output side of devices – E1/T1 mask and 1pps Time of Day error
    2. Nothing agreed for the packet side to give the knife edge pass-fail
- Item 1 above allows the performance of a system to be measured after deployment or to allow the performance to be measured against the “standard” G.8261 defined profiles.
- If a method of addressing item 2 were delivered then a network could be assessed for support of timing elements before and during deployment.

The Search

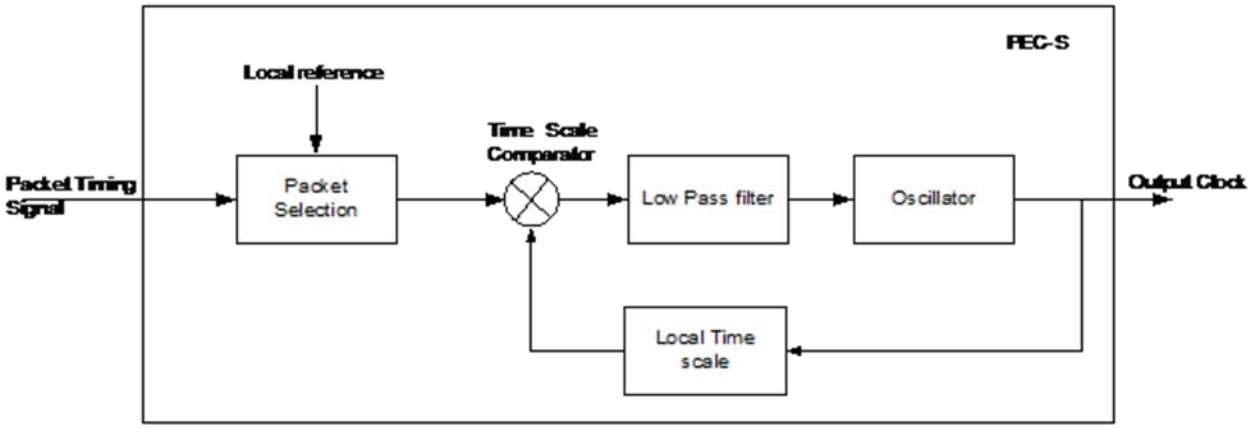
- G.8261 Appendix VI defines a method of generating representative timing profiles to test network elements.
  - It is not binding – normative
  - Is seems to be the only agreed method of testing
  - It does not meet the needs of assessing an existing network for future development
- The search goes on – measurement of packet behaviour
- 2 main constituencies who need packet metrics
  - Service providers – can my network support the required phase and timing accuracy?
  - Network Equipment Manufacturers – will my equipment meet the requirements in a real network?

Current Work

- Much work is being done on metrics.
- Actual and experimental data is being sliced and diced and tested to arrive at a set of consistent measures.
- Several techniques are being used to try to achieve the necessary insights
  - TIE Data
  - Banded data
  - % data
  - MAFE, MATIE……

The Approach

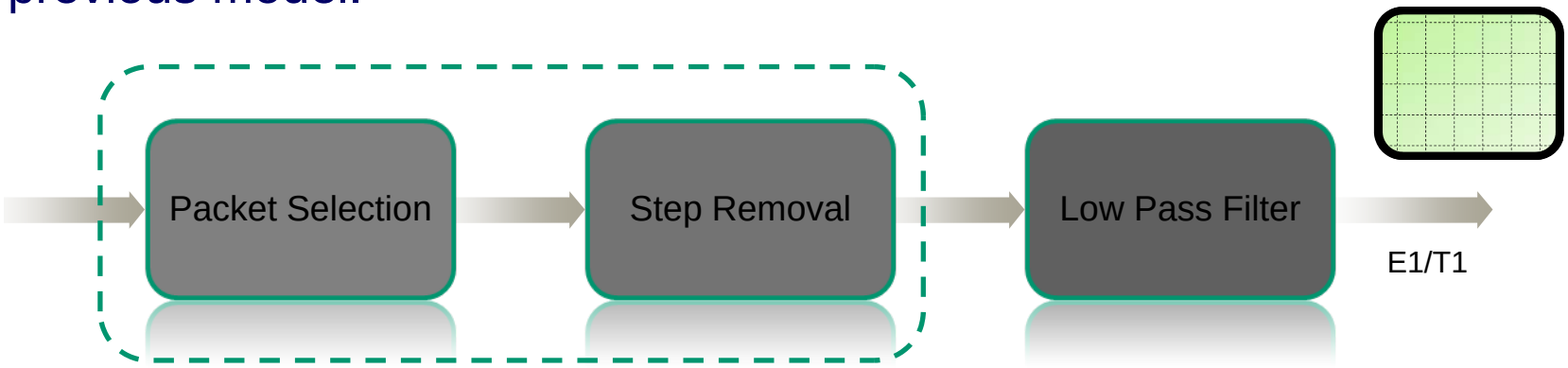
- The Functional model of a PEC-S packet based clock as shown in G.8263 Appendix A is the basis of the proposed approach.



- The details of how the model refers to individual implementations is not standardised and is the subject of IP.

The Approach

- One change proposed is to separate out the step removal stage of the previous model.



- At each stage analysis and results are presented to show “performance” at this stage or the effect of altering the parameters.
- The aim is to correlate the output’s final results with the results of the model steps.

Packet Selection

- The selection parameters for this are:
  - A tiled **Window Width**. The packet selection is applied for each of the windows.
  - Within the window the packets may be selected in a number of ways
    - **Floor Packets** – the “luckiest” x% or packets below a specified delay Y nanoseconds (X and Y user selectable)
    - **Banded Packets** - the packets with a delay within a specified or calculated band
- The output is the analysis based on the population of selected window values
  - MTIE, TDEV, MAFE, MATE

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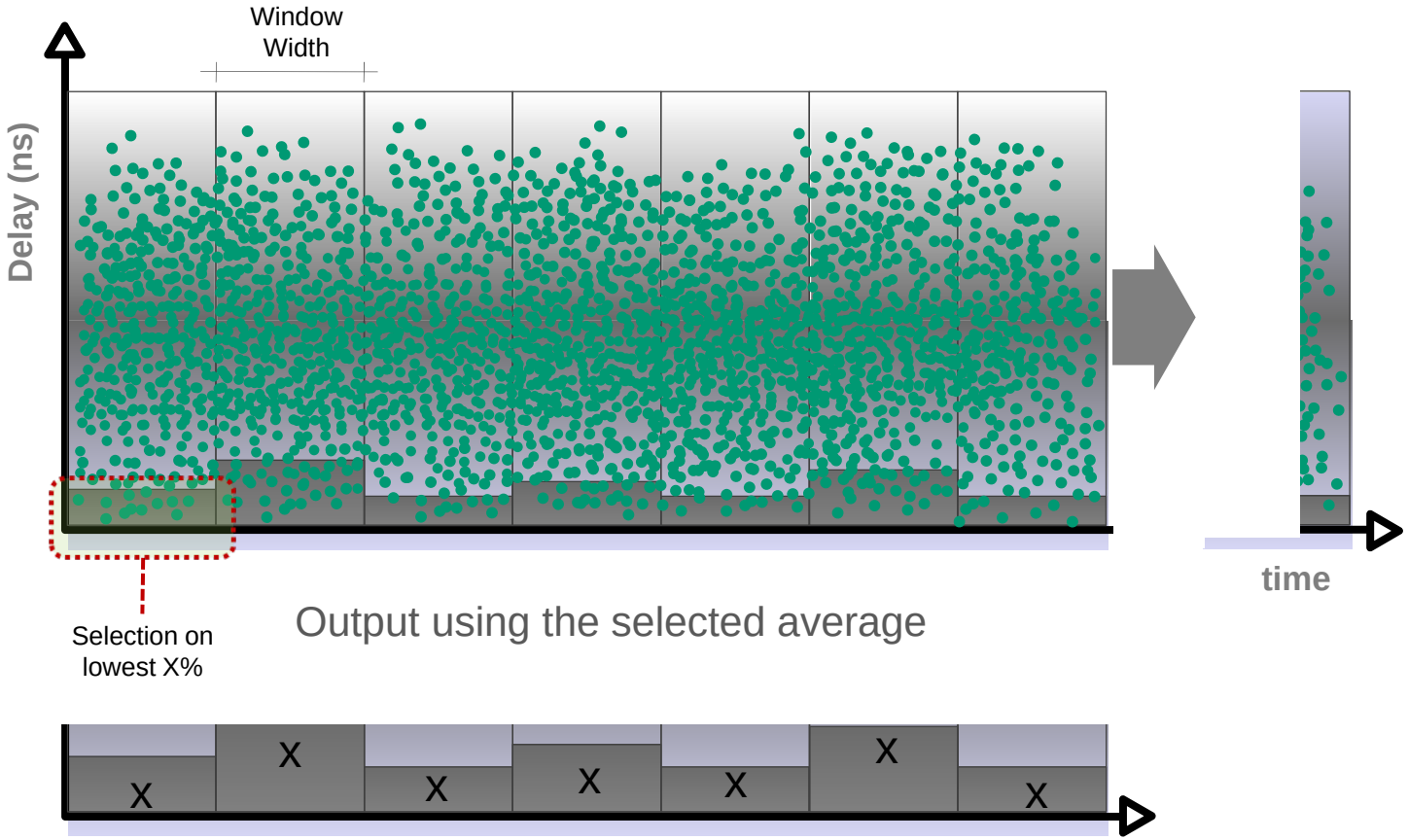
Packet Selection



Step Removal

- Remove the steps in the output of the Packet Selection section
- To differentiate between long term step due to a change in network topology and short term step due to traffic changes.
  - Burst of traffic, temporary not to be removed
  - Switching of the path, should not respond to this so remove
- Definition of a step
  - Change of over a preset value for a specified duration – these are the selectable parameters
- The output of this stage can be analysed in the same way to show the impact of the process for differing parameters and correlation with the clock output.

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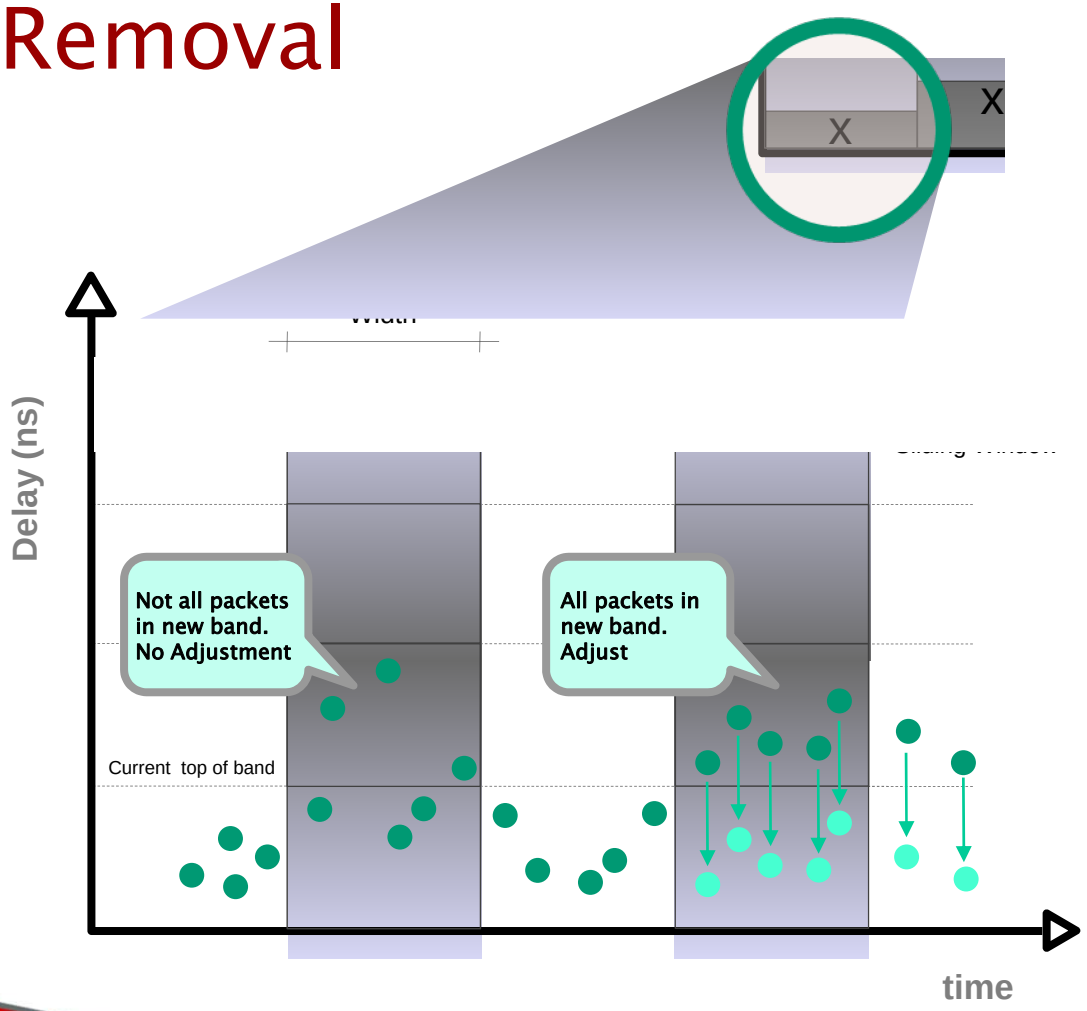
Step Removal



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Step Removal – illustration

time

Low Pass Filter

- This is the transfer function of the oscillator section of the clock
  - The order of the filter and the corner frequency are the settable parameters
- Again the analysis tools will be applied to the output of this section of the model and should reflect the performance measured at the E1/T1 and 1pps or equivalent outputs

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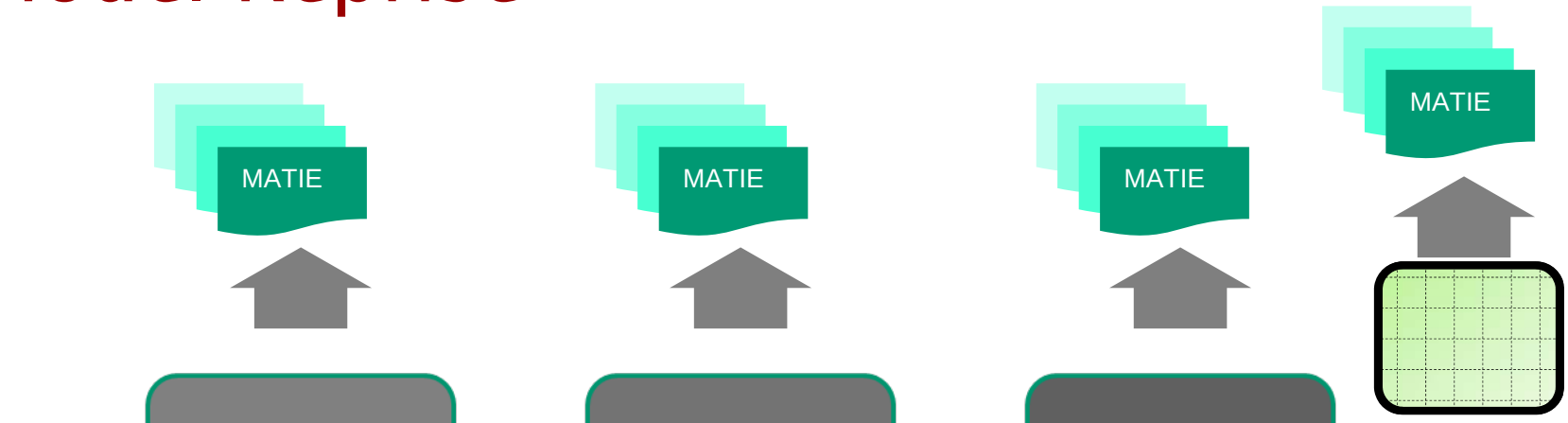
Model Reprise



Selectable Parameters

- Window Width
- Floor(%)
- Floor (delay value)
- Band (%)
- Band (Delay Value)

- Step Height
- Step Duration

- Corner Frequency
- Filter Order

Conclusion

- Proposed is a model for assessing correlation of packet performance with slave clock performance
- Allow experimentation through variable parameters so that the same data can be analysed multiple times with a view to achieving agreement on what the “minimum” parameter values should be for real life clocks
- Determining where the greatest sensitivities are in the model

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Calnex Paragon Sync

- IEEE 1588v2
- CES
- Sync-E
- OAM