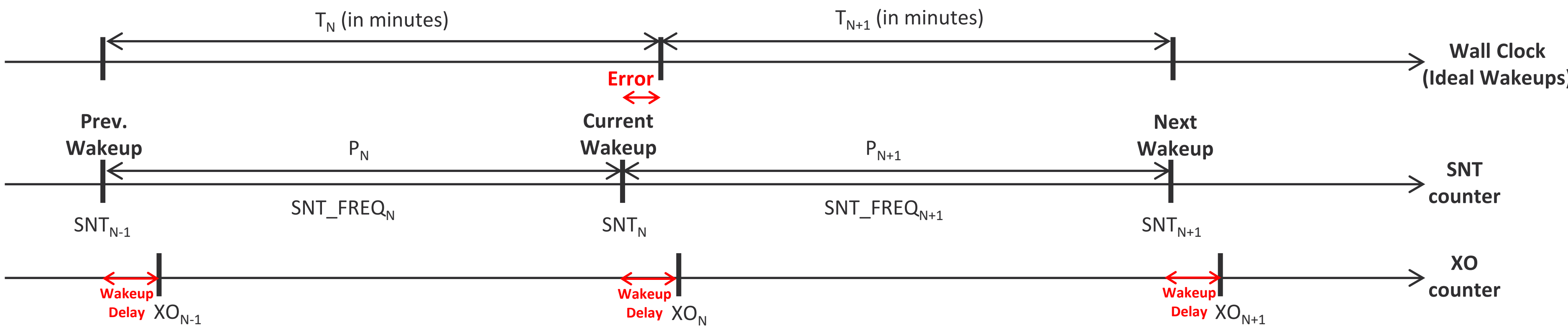
# SNT Calibration – v1p09




- Current SNT Threshold
  - $SNT_N = SNT_{N-1} + P_N$
- Frequency Adjustment
  - $SNT\_FREQ_{N+1} = \frac{P_N}{Actual\ Elapsed\ Time} = \frac{P_N \times XO\_FREQ}{XO_N - XO_{N-1}} = SNT\_FREQ_N \times \frac{P_N \times XO\_FREQ}{SNT\_FREQ_N (XO_N - XO_{N-1})}$
- Interval Adjustment
  - $Error(in\ sec) = Expected\ Elapsed\ Time\ - Actual\ Elapsed\ Time = \frac{P_N}{SNT\_FREQ_N} - \frac{XO_N - XO_{N-1}}{XO\_FREQ}$
- Calculate $P_{N+1}$
  - $$\begin{aligned} P_{N+1} &= 60 \times T_{N+1} \times SNT\_FREQ_{N+1} + Error(in\ sec) \times SNT\_FREQ_{N+1} \\ &= 60 \times T_{N+1} \times SNT\_FREQ_{N+1} + \left(\frac{P_N}{SNT\_FREQ_N} - \frac{XO_N - XO_{N-1}}{XO\_FREQ}\right) \times \frac{XO\_FREQ \times P_N}{XO_N - XO_{N-1}} \\ &= 60 \times T_{N+1} \times SNT\_FREQ_{N+1} + P_N \left(\frac{P_N \times XO\_FREQ}{SNT\_FREQ_N (XO_N - XO_{N-1})} - 1\right) \end{aligned}$$
- Next SNT Threshold
  - $SNT_{N+1} = SNT_N + P_{N+1}$

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- Equations (All terms are positive integers)
  - $SNT\_FREQ_{N+1} = SNT\_FREQ_N \times \frac{P_N \times XO\_FREQ}{SNT\_FREQ_N(XO_N - XO_{N-1})}$
  - $P_{N+1} = 60 \times T_{N+1} \times SNT\_FREQ_{N+1} + P_N \left(\frac{P_N \times XO\_FREQ}{SNT\_FREQ_N(XO_N - XO_{N-1})} - 1\right)$
  - $SNT_{N+1} = SNT_N + P_{N+1}$

- How to calculate
  - $\frac{P_N \times XO\_FREQ}{SNT\_FREQ_N(XO_N - XO_{N-1})}$: Needs to be represented as a decimal number. Its value is very close to 1.
    - Use N=28 fixed-point number representation
  - $P_N(A-1)$, where $\mathrm{A} = \frac{P_N \times XO\_FREQ}{SNT\_FREQ_N(XO_N - XO_{N-1})}$ using the N=28 fixed-point number representation
    - If $\mathrm{A} \geq 1$
      - $P_N(A-1) = P_N \times (A \,\&\, 0xEFFFFFFF)$
    - If $\mathrm{A} < 1$ (i.e., $\mathrm{A}[31{:}28] = 4'\mathrm{b}0000$)
      - Calculate $P_N(1-A)$ and subtract this from $(60 \times T_{N+1} \times SNT\_FREQ_{N+1})$ when calculating $P_{N+1}$
      - $P_N(1-A) = P_N\left(1 - \sum_{i=0}^{27} \frac{n_i}{2^{i+1}}\right)$, where $n_i$ is the $i$-th bit in $\mathrm{A}$

$$= P_N\left(\sum_{i=0}^{27} \frac{1}{2^{i+1}} + \frac{1}{2^{28}} - \sum_{i=0}^{27} \frac{n_i}{2^{i+1}}\right) = P_N\left(\sum_{i=0}^{27} \frac{1-n_i}{2^{i+1}} + \frac{1}{2^{28}}\right)$$

$$= P_N \times [(\sim A) \,\&\, 0x0FFFFFFF] + (P_N \gg 28)$$

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- Final Equations, where $A = \frac{P_N \times XO\_FREQ}{SNT\_FREQ_N(XO_N - XO_{N-1})}$ (using the decimal number representation)
  - $SNT\_FREQ_{N+1} = SNT\_FREQ_N \times A$
  - If $A \geq 1$: $P_{N+1} = 60 \times T_{N+1} \times SNT\_FREQ_{N+1} + P_N \times (A \;\&\; 0xEFFFFFFF)$
    If $A < 1$: $P_{N+1} = 60 \times T_{N+1} \times SNT\_FREQ_{N+1} - P_N \times [(\sim A) \;\&\; 0x0FFFFFFF] - (P_N \gg 28)$
  - $SNT_{N+1} = SNT_N + P_{N+1}$

- NOTE:
  - Except $A$, all terms are positive integers
  - $A$ is very close to 1.
  - '$P_N \times (A \;\&\; 0xEFFFFFFF)$' is a positive integer.
  - '$P_N \times [(\sim A) \;\&\; 0x0FFFFFFF]$' is a positive integer.