

4. Estimating the voltage at adjacent substations using the line parameters and local measurements of current and voltage.
5. Comparing adjacent substation estimates of local voltage against direct measurement of local voltage.

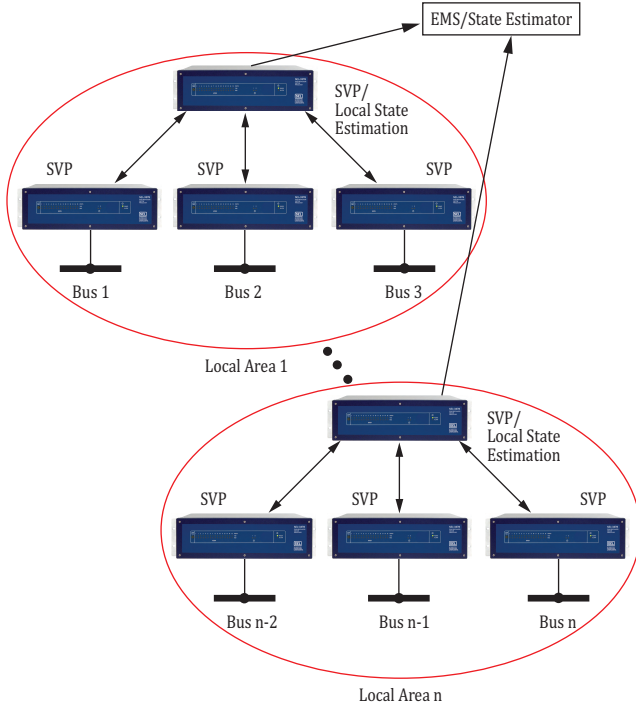


Figure 8.4 SVPs detect errors, refine measurements, and send the local estimates to the wide-area state estimator.

A distributed, local-area state estimation approach detects topology errors earlier in the estimation process, shortening the actual process. The SVP provides local logic to make intelligent topology estimations. For example, if the branch status monitor detects an error, the SVP assumes that the branch is closed. This local activity directly reduces the work required to estimate the entire wide-area state and reduces the risks of nonconvergence.

Consider the simple three-bus network in Figure 8.5, with an SVP at each bus. The first function of the SVPs is to collect voltage, current, associated phase angles, and bus topologies for the state estimator. Further, each SVP exchanges synchrophasor information with adjacent SVPs. This redundancy provides backup communications paths to the state estimator if the primary communications link becomes disabled. This configuration has multiple benefits. Should the communications channel between an SVP and the state estimator fail, an adjacent SVP could forward the data, thus keeping the state estimator running.

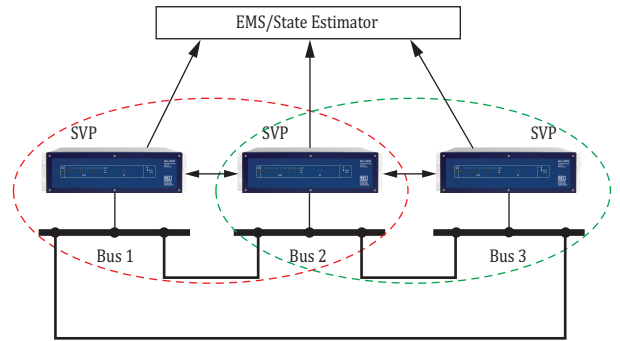


Figure 8.5 SVP peer-to-peer communication provides redundancy.

### 8.3.3 Remote measurement supervision

The SVP can gather and process data from different substations, so it can supervise local and remote redundant measurements. The SVP uses the local bus voltage, the impedance of the transmission line between the local and remote buses, and the transmission line current to supervise the remote voltage measurement. Figure 8.6 shows the major components of this voltage supervision scheme. We use the model shown in Figure 8.7 to represent the transmission line. Relay 1 and Relay 2 gather data from the local and remote substations. Relay 1 sends the measured local voltage  $\bar{V}_{L MEAS}$  and the measured local current  $\bar{I}_{L MEAS}$  to the SVP. Relay 2 sends the measured remote voltage  $\bar{V}_{R MEAS}$  to the SVP. The SVP also requires transmission line parameters to calculate the remote voltage.

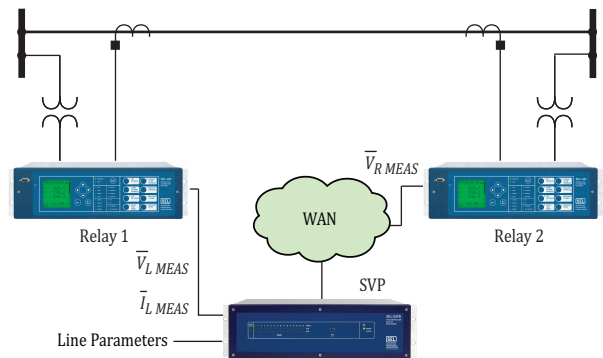


Figure 8.6 Scheme to supervise remote voltage measurements.

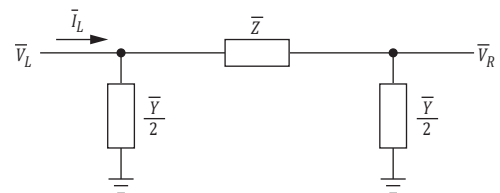


Figure 8.7 Transmission line model.