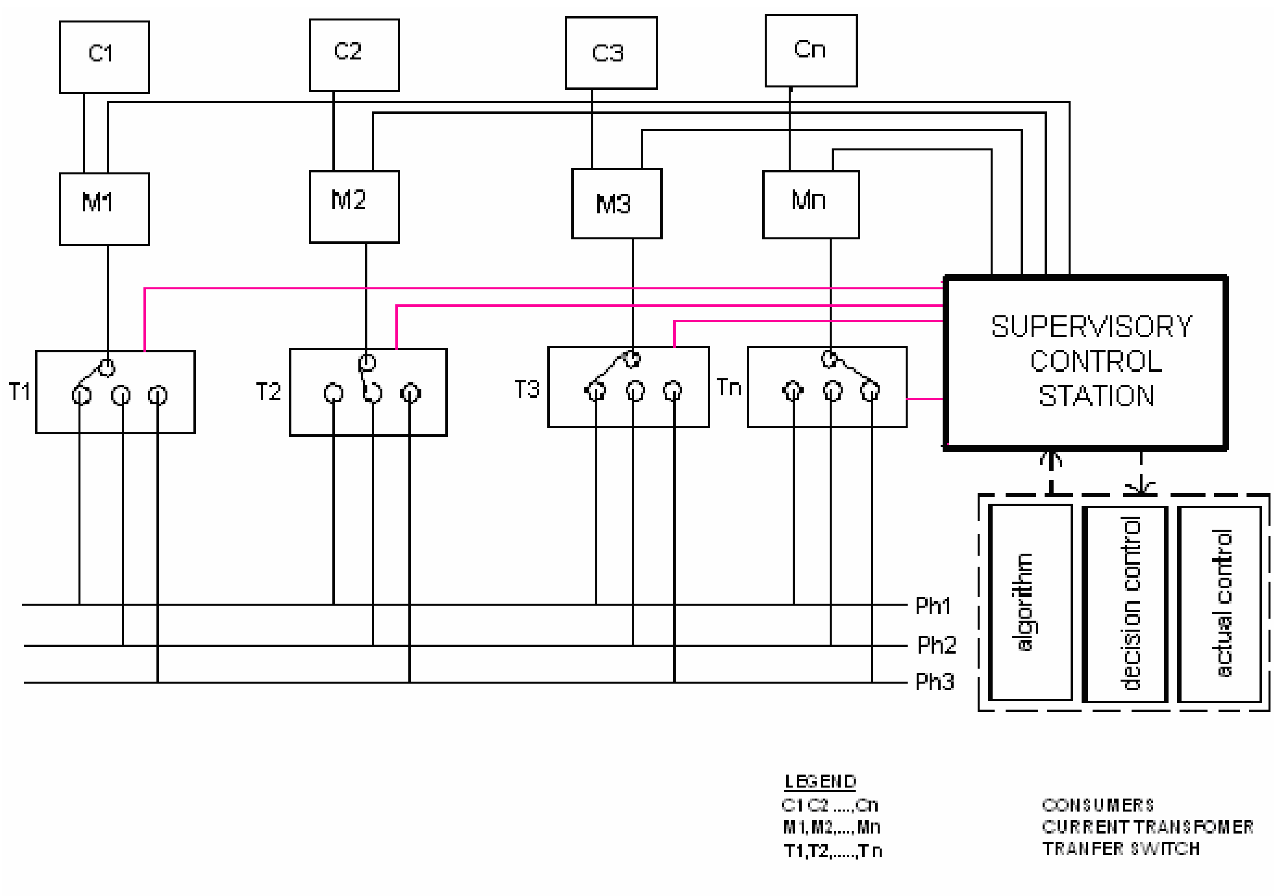

Figure 4:- The Conventional Layout of Consumer Connections to a Feeder System. (Jimoh, Siti and Davidson, 2004).

The three phases in figure 4 above shows the outlet connections to the consumer points, C1, C2, C3 to C_n as well as the respective transformers; T_1, T_2, T_3 to T_n alongside the motors; M_1, M_2, M_3 to M_n.

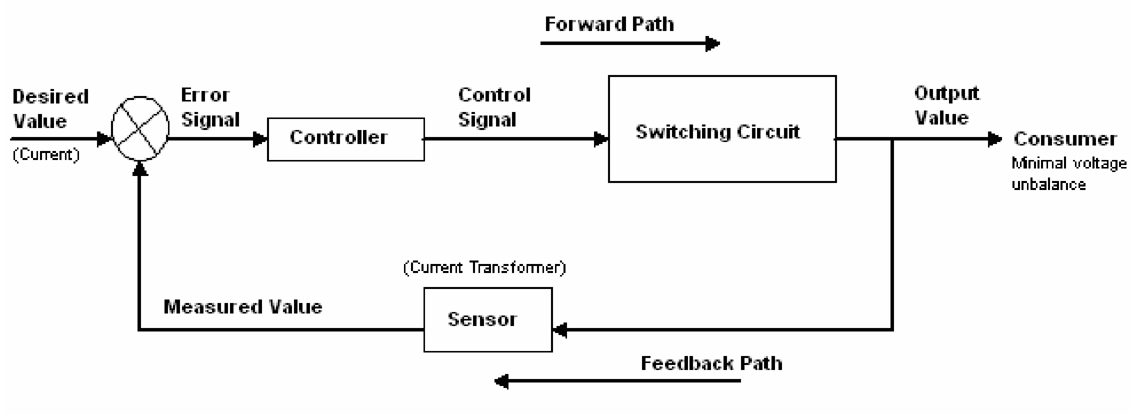

Figure 5: The Closed Loop Operation of the Proposed Network
(Siti, Jimoh and Nicolae, 2005).

The closed loop operation of the proposed network in figure 5 above is explains how the forward signal is sent and a feedback signal passes through the sensor or detector to ascertain the measured value of the signal processed. The controller (actuator) sends the command or control signal to the switching unit for the static transfer switch (S_1) via wireless communication to open, while within a micro second, a signal is sent to S_2 or S_3 to close when the prefer load current on phase 1 deviates from the pre-set upper or lower limit. It occurs during the following conditions:-

1. The phase-angle difference of the phases is within the pre-set value.
2. The voltage of the alternate source is within the limit.
3. The alternate phase or phases can accommodate the required load.

The status of the static transfer switches is also communicated back to the supervisory control station.

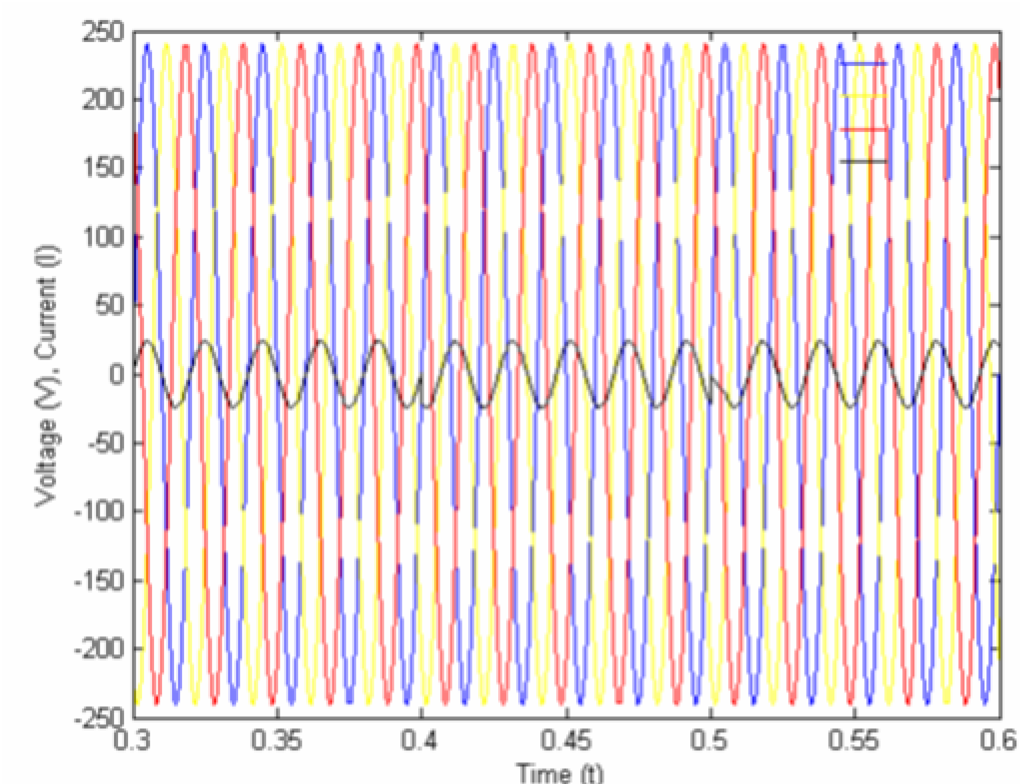

Figure 6: Proposed model for the implementation

The operating characteristic of the proposed model of implementation is between Power (Voltage x Current.) and time measured in seconds. The model actually explains the behaviour of the devices at some certain pre-determined values of power measured in watts and the time frame used to undergo the entire process of implementation.

Table 2: power in watts and time in seconds.

POWER (WATTS)	TIME (SECONDS)
250	0.3
200	0.35
150	0.4
100	0.45
50	0.52
0	0.55
-50	0.6
-100	Nil
-150	Nil
-180	Nil
-200	Nil

At 250 watts, the specific timing falls at 0.3 second. While, at 200 watts, the timing is 0.35 second; at 150 watts, the time for implementation is 0.4 second and so on. But at -50 watts, which is unrealistic in terms of the overall distributed voltage took a larger timing to implement. Finally, the negative powers are zero because the proposed implementation model transfers negligible signals, which will produce unreal voltage at the output end.

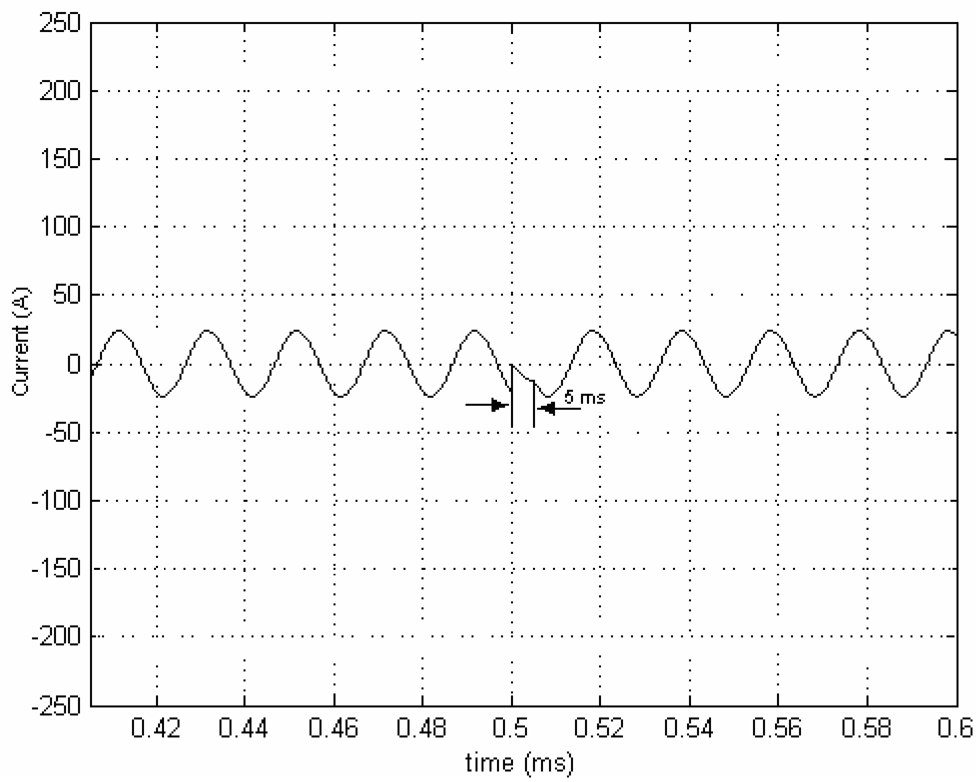

Figure 7: Test Result of transfer operation

Figure 7 shows a comparison between Current measured in amperes (A) and the time in milliseconds. At 250A, the timing for the transfer operation to occur while sending signal is 0.42 ms and it also happens simultaneously at various current values as well as at varying timings.

V. CONCLUSION

The proposed technology for distribution feeders will increasingly need to be based on a trans-sector concept and this digital technological development needs to tap into the economic and social multiplier effects. For this to become economically viable, open infrastructural outlets need to be available to these sectors on a utilities basis. It does not make economic sense for all of these sectors to develop and run their own communications infrastructure using this proposed smart technology. The feasibility of this technology will be realistic only if the government, power and telecommunication companies are collectively involved financially.

Thus, this technology promotes online remoting and automatic switching of consumers to reduce unbalanced loads to a minimal level at the low voltage distribution network. The proposed technology implementation addresses the problems of phase current and voltage imbalances due to irregular distribution of loads in a secondary distribution system feeder. The system utilizes static transfer power electronics switching devices, which has been proven as an effective tool in solving imbalances in the low voltage distribution network.

Finally, the implementation of the automation of the control of these switches using artificial intelligence, telecommunication and power electronic equipment as well as ensuring the prompt implementation of the proposed technology in the Nigerian power distribution network will offer an optimal solution to the power wastage. This will in turn be technically and economically advantageous to the utilities and consumers by boosting power availability. Revenue will be boosted at the utility end and the consumers will enjoy better service delivery at last.

REFERENCES

Baran, M.E and Wu, F.F (1989) "Network Reconfiguration in distribution Systems for Loss Reduction and Load balancing," *IEEE Trans. Power Delivery*, vol. 4, No. 2, pp. 1401–1407.

Jimoh, A.A, Siti, M.W and Davidson, I.E., (2004) "Analysis of Technical Loss Reduction Options in Domestic Feeders Using Engineering and Economic Models", presented at the 9th UIE International Conference, 18-22, January, 2004.

Shirmohammadi, D. and Hong, H.W. (1989) "Reconfiguration of electric distribution networks for resistive Line Losses reduction" *IEEE Transaction on Power Delivery*, Volume 4, PWRD-4, pp 1492-1498.

Siti, M.W, Jimoh, A.A, and Nicolae, D. (2005) "Automatic load balancing in Distribution Feeder"; Paper RF-001504 at IECON conference, 2005, Raleigh North Caroline, USA.

Siti, M.W., Nicolae, D.V., Jimoh, A.A., and Ukil, A. (2007) "Reconfiguration and Load Balancing in the LV and MV Distribution Networks for Optimal Performance"; *IEEE Transactions on Power Delivery*, Paper accepted 12th February, 2007.

United States Office of Electricity Delivery and Energy Reliability, (2015) Electricity System Development: - A Focus on Smart Grids, Overview of Activities and Players in Smart Grids, page 8, retrieved from http://energy.gov/oe/services/technology-development/smart-grid