The 18th IERE General Meeting and Japan Forum
May 21-24, 2018, Kyoto, Japan

A Decentralized and Cooperative Voltage Control Scheme for Increasing Hosting Capacity

Won Nam Koong
Senior Researcher, KEPCO, KEPCO Research Institute
Daejeon, Korea

Keywords: *Cooperative Voltage Control, DER, AMI*

Abstract

The increased deployment of DER connected to the distribution networks influences the feeder voltage profiles. Thus conventional voltage management system need to be changed for reliable operation.

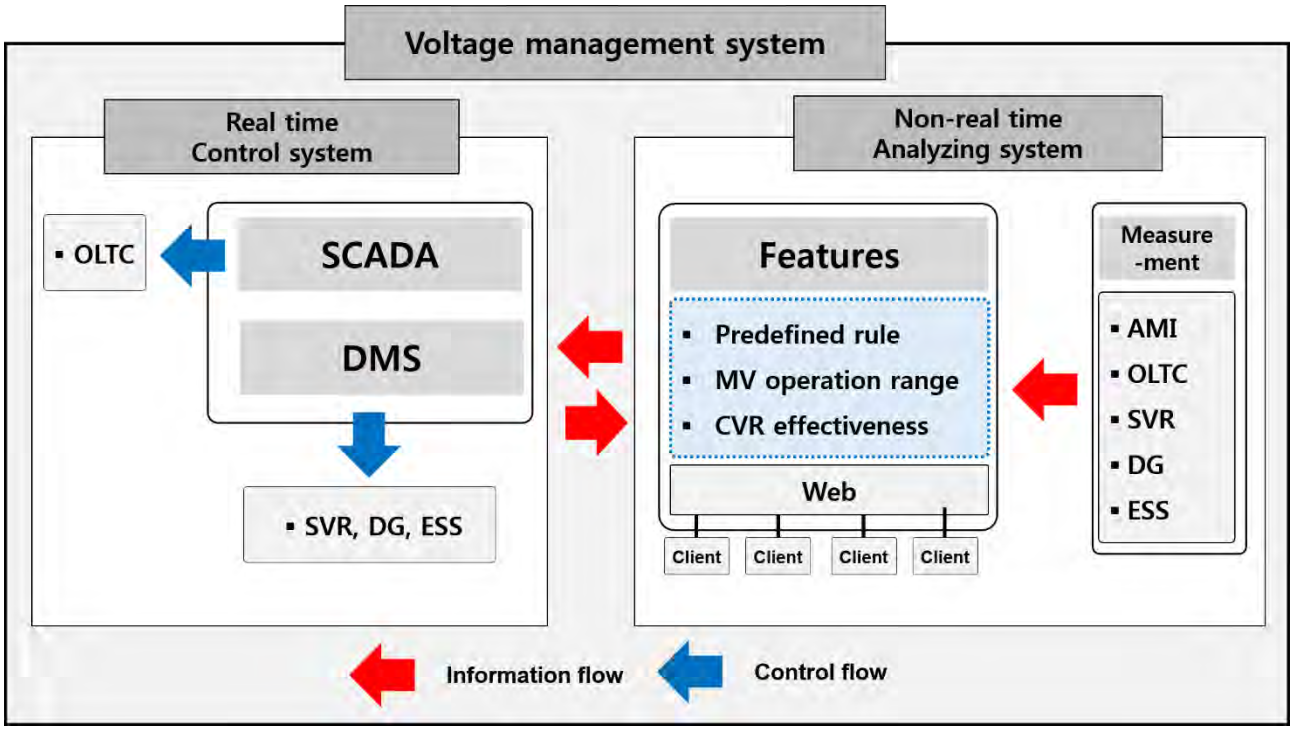

Fig. 1: Voltage management system based on history data analyzing

In transmission networks, the voltage problem handled by optimal power flow methods (OPF). OPF needs an extensive and robust communication infrastructure and a correct network model to be executed in real time.

In distribution networks due to far more nodes with a limited communication infrastructure, decentralized methods are more practical for proper voltage management.

In this paper, advanced voltage management system based on history data will be addressed.

The voltage management systems consist of real time control system and non-real time system.

The real time control system controls OLTC, SVR and DER in real time. The non-real time analyzing system makes coordinated voltage control scheme of OLTC, SVR, and DER by analyzing the history data from AMI, OLTC, DER, etc.

The non-real time system uses simulation based on history data to makes predefined rule for Voltage Control devices. Theses operate based on the predefined rule without centralized control.

The main objective of the system is increasing DER hosting capacity of distribution network without additional investments and voltage problem.

The approach consists of three steps.

1) History data from AMI, OLTC, etc. for making N different cases.
2) For N cases, predefined rule for Voltage Control devices is selected with objectives and constraints
3) The predefined rule is applied on a test network and verified.

An example of the approach is introduced as follows.

For N cases, a predefined rule for DER is selected to maintain voltage at nodes within specific limits. Voltage at customers and OLTC and SVR is calculated based on application of DER with the predefined rule. Over and under voltage margin are calculated at nodes by analyzing voltage profiles and limit. New sending voltages at OLTC, SVR are calculated based on the over and under voltage margin for N cases.

A LDC parameter of OLTC, SVR is selected according to the objective function and the constraints. However, it is difficult to employ predefined rules in real distribution networks since variety cases and impractical constraints results in the unpractical solutions.

There are some considerations for practical solutions.

1) Parameters like R/X ratio is defined by user
2) Constraints like MV voltage limit is produced by analyzing voltage log at MV and LV level at same time.

The proposed method is verified on a real network with three SVRs, 70 DERs (four controllable, two ESS), 30 measurement points. By application of the method, it is possible to increase DER hosting capacity without voltage problem and additional investment.

In future work, the proposed system and method will be demonstrated under a variety network and improved to apply it for cost effective voltage management in local energy communities.