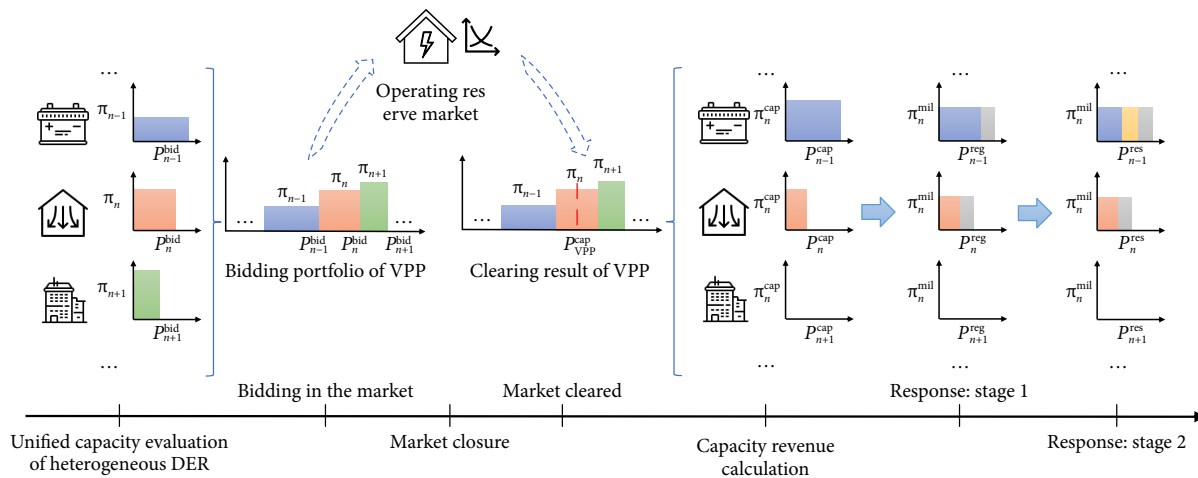


Trusted operation framework for virtual power plants

Original reference: *iEnergy*, 2(2): 133–142, 2023

The prevalence of intermittent renewable energy sources further stimulates the need for operating reserve to maintain the supply-demand balance of the power system. DERs can form a VPP to provide both upward and downward operating reserve to the power system. The process of providing operating reserve as a VPP includes evaluating of reserve capacity of DERs, bidding in the operating reserve market, responding to the regulation signal,

assessing the response performance of DERs and allocating the profit (see the Figure, which is reprinted with permission from *iEnergy*, 2(2): 133–142, 2023 © 2023 The Author(s)). The operation characteristics of various DERs are modeled for the evaluation of their available operating reserve capacity. However, due to the uncertainty of the DER status, there might exist a mismatch between the estimated capacity at the bidding stage and the available capacity at the response stage, which could result in an inaccurate tracking of the regulation signal. Thus, a timely update of the operating reserve capacity evaluation result is introduced to the operation of VPP, which enables the proactive compensation for capacity mismatch during the stage of assigning of regulating power.



However, since DERs usually belongs to different entities, the trusted operation of VPP is still a challenging problem. Blockchain is a distributed ledger, in which only the information agreed by the majority of the nodes in the network is recorded. These records are recognized as transparent, traceable and trustworthy, thereby blockchain is widely applied to promote the trust relationship in power system operation without central authority. In this work (*iEnergy*, 2(2): 133–142, 2023), a blockchain-based operation framework is proposed to provide a trusted environment for the VPP in coordinating DERs to provide operating reserve. In the blockchain network, each DER in the VPP serves as a peer node and contributes to the trusted recording of VPP operation. To further promote the timely operation of VPP, the process of

operating reserve provision is embedded in the smart contract, which can be executed automatically within the blockchain environment. With the assistance of blockchain and smart contract, the trusted operation of VPP in providing operating reserve can be promoted without requiring the existence of a central authority.

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