ON THE QUANTITY, QUALITY AND MEANING OF WIND CAPACITY

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Overview

Renewable resources such as wind and solar have been concerned for their characteristics of intermittency. As a consequence, the capacity contribution of these renewable sources to the grids becomes a subject of debate that requires proper methodology to resolve. The existing capacity evaluation metrics such as installed capacity, capacity factor and capacity credit are not adequately to serve this purpose, which further prevents one from effectively managing and fairly rewarding all involved resources.

Methods

In this work, we propose a network calculus (NetCal) approach to model the capacity metric with respect to given quality-of-service (QoS) requirements. The NetCal approach emerged from the field of telecommunication engineering to analyze QoS guarantee issues. Essentially, deterministic queuing systems are defined and analyzed under a (min, +)-algebra, for which performance bounds for virtual delay and backlogs are elegantly characterized. As an application, the generating resource is interpreted as a queuing server, and its capacity is arisen as the derivatives of the service curve, a fundamental construction in NetCal.

Results

First, a new capacity modeling framework and evaluation methodology is developed.

Second, the methodology is applied to real wind data to gain insights on wind's Quality-of-Service characteristics.

Third, under this modeling framework, optimization for the operation and configuration of storage devices are readily derived.

Conclusions

A new capacity modeling framework and evaluation methodolgy is developed and proposed here to assist renewable integration.

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