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Abstract: ICT community cornerstones (`IoT` in particular) gain competitive advantage from using physical resources. This paper adopts Time Petri-Nets (`TPN`s) to model and analyze the consumption cycles of composite resources. These resources consist of primitive, and even other composite, resources that are associated with consumption properties and could be subject to disruptions. These properties are specialized into unlimited, shareable, limited, limited-but-renewable, and non-shareable, and could impact the availability of resources. This impact becomes a concern when disruptions suspend ongoing consumption cycles to make room for the unplanned consumptions. Resuming the suspended consumption cycles depends on the resources' consumption properties. To ensure correct modeling and analysis of consumption cycles, whether disrupted or not, `TPN`s are adopted to verify that composite resources are reachable, bound, fair, and live.



## 1 INTRODUCTION

There is a consensus in the Information and Communication Technology (`ICT`) community that the Internet of Things (`IoT`) is helping achieve Mark Weiser's vision about ubiquitous computing that is "*...The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it*" (Weiser, 1991). Whether visible or invisible, today's things like ambient sensors and smart watches are used anytime, anywhere producing massive amount of data about people and other "things" like vegetable freshness in a transit facility, and patients' vitals in an ICU. It is predicted that the total economic impact of `IoT` will reach between $3.9 trillion and $11.1 trillion per year by the year 2025 (DZone, 2021).

To sustain the `IoT` economic impact mentioned above, particular measures should be taken to address things' processing, storage, and communication limitations. Indeed, not all things (e.g., ambient sensors) are embedded with powerful processing capabilities and not all things (e.g., smart watches) can store large amount of data nor communicate data quickly. In the literature, some measures consist of coupling `IoT` applications to cloud computing so, that, appropriate processing, storage, and communication resources are made available based on these applications' functional and non-functional requirements (Li et al., 2020; Ren et al., 2017). In a previous work (Maamar et al., 2021), we associated cloud resources with `consumption properties` specialized into `unlimited`, `limited`, `limited-but-renewable`, `shareable`, and `non-shareable`, allowing a better control over these resources in terms of availability, consistency, and accountability. Each property is modeled, with Finite State Machine (`FSM`), as cycle that tracks the progress of consuming a resource by an application.

While `IoT` application/cloud coupling seems the way to move forward, many critical concerns are barely touched upon like first, guaranteeing the continuous availability of cloud resources following the occurrence of disruptive events (e.g., urgent upgrades to counter cyber-attacks and urgent demands to execute last-minute requests) and second, composing re-



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