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Topic Title: NewOS: RebootlessOS
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Definition
Today’s operating systems were originally designed to support hardware and applications from more than 40 years ago. Linux currently dominates both high end and mobile space, but new technology trends, such as non-volatile memory, rack-scale heterogeneous computing, and photonic interconnects are stretching the boundaries of the OS requirements. This is not even accounting for the next generation hardware based on rebooting computing which will fundamentally change the landscape. In addition, new application domains, enabled by technologies such as IoT, SmartCities, Cyber Physical Systems, Big Data Streaming Analytics, NFV, and 5G pose new requirements in terms of scale, power, reliability, security, manageability, real-time, etc. It is the time to rethink the OS, and deeply integrate it in the DevOps and broader software ecosystem.

Description. Operating systems experienced flurry of innovation in late seventies through nineties, riding on the wave of UNIX variants ported to mini computers, through workstations and eventually microcomputers. In nineties, consolidation started happening through Unix International and OSF. Eventually the Open source approach, in particular Linux, took over and started dominance in the past decade. Today, Linux is a dominant OS both in data centers and on mobile phones (Android), covering majority of computers.

However, there are many disruptive trends in core computation and communication technologies that are taking place today that are affecting Linux configurations optimized for 2 socket machines. Operating memories are becoming huge (tens of terabytes today, approaching petabytes in the next year or two), non-volatile (with a few competing technologies STT RAM, PCRAM, Memristor, etc.) and more global (hyper radix switches make it possible for CPUs to access remote memory even across racks). Advances in photonics, make rackscale computing much more manageable, scalable, and power efficient, while longer-term silicon photonics extends these benefits end-to-end. Heterogeneity of computing components (GPGPUs, accelerators, FPGAs, ASICs, etc.) further optimize computation but require non-trivial systems software support. Capabilities (e.g. CHERI) and formal verification (e.g. seL4) are promising solutions to security of these large scale systems, but its adoption is far from desired.

At the same time application requirements driven by Big Data (Streaming) analytics, IoT, 5G, etc., pose much more stringent non-functional requirements which are hard to meet if not impossible with an operating system developed for hardware architectures of four decades ago. Virtualization and Cloud Computing are making up for some of the shortcomings of operating systems by scaling them beyond a single node boundaries and by providing some security and safety guarantees. But requirements are becoming stronger and stronger.
In the long term, approaches such as Rebooting computing threaten to completely replace Von Neumann's architecture and revisit analog computing opportunities. How do we manage these new resources and at the same time continue to support legacy applications and systems? We believe that it is the time to take a fresh look at the operating systems and design them from scratch for the near-term domains where Linux struggles to meet the requirements (e.g. the size and power of very small IoT device or noise-free, ultra-scale OS for exascale systems) and ultimately for longer-term systems, such as those based on rebooting computing.

IEEE has lost some leadership ground in the area of operating systems to USENIX and ACM. Its premier workshop (small event by design) on Hot Topics in Operating Systems, went to ACM (via USENIX) and this is an opportunity to rebuild our product portfolio and community in OSe. Furthermore, OS is tightly weaved into many other computing, communications, storage, etc. topics where IEEE exercises strong leadership and therefore this activity will highly complement many other efforts (events, publications, communities, etc.) in IoT, NFV, 5G, Cyber Physical Systems, Edge Computing, and many others across many IEEE societies.


Our goal is to create an OS community within IEEE, attracting top researchers, engage industry, academia, and government towards an open source implementation, with elements of modern standardization, and living experimental code. The NewOS will focus on one or two critical area for the next generation vertical applications (e.g. cyber-physical systems, 5G, NFV, etc.).

FDC support will enable us to experiment with new models of publications (short surveys of the critical fields, letter-size technical reports linked to the code base); new models for living, incremental standardization closely tied to open source; hackathon/maker-like events for design and code development, etc. not only that we will advance the technical field of operating systems, but we shall also advance the knowledge creation, and delivery through advanced, experimental tools that span a number of societies: Computer, Communications, Control, Power, Photonics, Materials, Aer