INDIAN INSTITUTE OF TECHNOLOGY BOMBAY
MATERIALS MANAGEMENT DIVISION
Powai, Mumbai 400076.

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Consultancy Service to Develop Source Code

Service to develop a scalable operating system for application deployment on an edge compute platform based around the AJIT Processor.

IIT Bombay is in the process of developing an edge compute platform system-on-chip (SOC) which incorporates four general purpose processors and four custom accelerators (the 4+4 configuration).
This will be further scaled to a 64-core 64-accelerator SOC (64+64 configuration).

The 64+64 configuration SOC is constructed by assembling 16 bricks, where each brick is a 4-core + 4-accelerator system. Each brick is internally cache coherent. However two distinct bricks are not cache coherent and will exchange messages using non-cacheable memory mapped queues.

The plan is to replace the currently used Cortos2 cooperative operating system developed for the AJIT processor with a more capable operating system which will enhance the scalability of the SOC.

Sr. No	Item Description	Detailed Technical Specification	Technical Compliance (Yes / No)	Additional Information (if any)
1.		The operating system must eventually: ● Provide a means of coordination between processors within the same brick and between processor cores across bricks: ○ Using shared memory within a brick. ○ Using in-memory message queues across bricks. ● Provide a means to communicate between the SOC and a remote host via Ethernet (raw Ethernet is ok) and PCI-express. ● Usable for the development and deployment of the following applications: ○ AI/ML inference engine deployment: ○ Signal processing in radio area networks. ○ GNSS receivers. In order to eventually enable the above must haves, the vendor needs to follow a phased list of deliverables mentioned in the next section. Along with these deliverables the vendor needs to support IITB with maintenance and technical support (mentioned in the next section).		
2.		Payment Terms: 1. First payment of 50% will be made after delivery of Phase-1 deliverables. 2. Payment of remaining 50% will be made in advance for Phase-2 & Phase-3 deliverables against submission of equivalent bank guarantee.		
3.		Phased Deliverables:		

		Phase:1 Single-Core Microkernel 1. Single-core, multithreaded, fully preemptive microkernel operating in Supervisor mode. 2. Support for UART, Interrupt controller, Timer, and MMU. 3. Support for kernel threads, locking primitives (spinlocks, mutexes), and atomics. 4. Dynamic memory allocation and fully unit-tested developer-facing APIs. 5. Single-core AJIT QEMU model with UART, Timer, MMU, & Interrupt controller support. 6. Bringup of single-core AJIT system on silicon/FPGA. Phase:2 Run an application on AJIT SBC 1. A multi-threaded, fully preemptive microkernel with SMP support. 2. SMP boot, real-time scheduling, and basic load balancing. 3. Integrated userspace application support with a limited POSIX syscall interface. 4. Support for application address spaces with VM, TLB, ICache & DCache management. 5. Enable required use case applications on AJIT SBC. 6. Inter-processor interrupts (IPIs), per-CPU timers, and software timer management. 7. Reference counting for in-kernel data structures and SMP support for locking primitives. 8. Multi-core AJIT QEMU model with UART, Timer, MMU, & Interrupt controller support. 9. Bringup of multi-core AJIT system on silicon/FPGA in a single brick configuration. 10. Support shared memory message exchange between cores within a single brick configuration. Phase:3 Peripherals support		

		1. Support for in-memory message queues for coordination b/w cluster bricks. 2. Support for TCP/IP and Ethernet driver integration. 3. Support for enabling PCIe endpoint. 4. Support for scaling the system to 64 cluster bricks without bottlenecks. 5. Support for enabling porting python. 6. Support for enabling use cases like FFT, matrix multiplication, & convolution. a. For AI/ML inferencing, signal processing, GNSS receivers. 7. Further deliverables are subject to mutual discussion and requirement. Maintenance deliverables: 1. Conducting technical training sessions for IITB staff. 2. Provide technical assistance and guidance for use cases enablement. 3. Regular sharing of bug fixes, security updates, software stack improvements. 4. Onsite support for hardware bringup and critical issues. Note: The duration of the consultancy service shall be 1 year from the date of issue of service order.		