Proposal for the Establishment of CSC: Compute Services Club

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Preface

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https://csc.sujal.dev/

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Chapter 1

Introduction: The What and Why

1.1 Abstract

This proposal requests the establishment of a Computer Science & Systems Administration Club (CSSAC), an exceptionally unique and innovative endeavor, as the existence of such clubs in Indian universities is rare, if not non-existent. Such a club offers unparalleled learning experiences to members, has practical usefulness to virtually all other clubs and has the potential to offer facilities typically only found in the Indian Institutes of Technology and various leading universities abroad such as MIT, Stanford, University of California and The University of Waterloo.
All details necessary for the creation of CSSAC are outlined in this proposal, including requirements from the university, and it also demonstrates that the author is capable of leading the technical aspects of this initiative.

1.2 Vision

"What I cannot create, I do not understand."
—Richard Feynman

At the very heart of this club is the goal to learn by doing, to obtain in-depth knowledge, to cultivate a community of technically competent members who possess a strong theoretical foundation in computer science but also have the ability to practically apply that knowledge to real-world problems. After all, we're soon to be engineers. CSSAC places no emphasis on tasks aimed solely at securing better job prospects, but only on the goal of utilizing our time at the university to become better engineers, and yet it'll allow members to distinguish themselves from others in a pool of equally talented candidates. CSSAC also strives to promote hacker culture (not to be confused with cracker) throughout the university.

In practical terms, this translates into having two subteams (not necessarily mutually exclusive), as implied by the name of the club. These subteams will undertake two different sets of problems described in their respective sections, a computer science team dealing with mostly abstract problems and the systems administration team applying the learnings from the aforementioned team to practical purposes with fruitful outcomes.

1.3 Systems Administration Team

The systems administration team focuses on addressing practical problems. It's primary objectives are as follows:

1. **On-premise Cloud:** The systems administration team will design, establish and maintain an on-premise private cloud offering available as a service to members, other clubs, faculty and individual students. This also lays a foundation for significantly more ambitious projects in the future such as providing high-performance computing (HPC) to research projects in the university.

2. **Services:** CSSAC will reserve a portion of the resources to deploy services for the entire[1] university. This will include services like providing cloud storage, source code hosting, mail services and mailing lists, static web hosting, etc. Initially, we might reserve all resources to deploy services that are available to everyone in the university.

The exact implementation details are not discussed in this proposal since this will mostly be dictated by the hardware provided to the club.

[1] Limited to those who register for an account and available capacity.

1.3.1 Symbiotic Relationship with Other Clubs

This club has the potential to offer significant utility to other clubs and offer them the opportunity to develop various innovative projects in collaboration such that these projects are mutually beneficial to all parties involved. Several such scenarios are described in the following sections:

IoSC, GDSC, SDC, ACM and IEEE

Many clubs in our university have various web development and AI teams, all of which stand to gain immense benefits from the compute services offered by CSSAC. We could also offer GPU compute services in the future to be able to train machine learning models and other applications which heavily benefit from GPU compute.
CSSAC also stands to benefit from these clubs; for example, instead of creating our own web development team we could offload such tasks to the web development teams of these clubs.

Karuyantra Club

The Karuyantra club could offer us 3D printing services to be able to produce various makeshift solutions in an example scenario such as when a network card's bracket will not fit the chassis of the server. They can also work on a project to develop a robot which can remotely perform tasks in a data center that would normally require a human's physical presence such as replacing faulty hard drives or periodic reapplication of thermal paste on CPUs.

1.3.2 Proof of Concept

While the idea for the club appears novel, it heavily draws inspiration from entities that have existed at various institutes worldwide since the early days of the Internet. This is not a drawback; rather, it proves the need for the existence of this club exists, and it's implementation is achievable in an academic setting.
Here follow some examples of existing entities which perform operations akin to those of the systems administration team of CSSAC:

1. **Computer Science Club, University of Waterloo**
   This is an entirely student-run operation that has been able to accumulate 4 racks full of servers over the years and has a cloud offering for members at just $2 per term. Moreover, they've also deployed many services both for their members and some for the public good such as a Linux mirror. HPC is handled by other bodies at this institute. Read more at: https://wiki.csclub.uwaterloo.ca/

2. **Computer Services Centre, IIT Delhi**
   IIT Delhi has developed their very own cloud offering named "Baadal", which allows users to spawn resources via a web interface also developed at IITD. They plan to put to use the underutilized computers in most computer labs and still maintain reliability by running redundant copies of virtual machines on different physical nodes, which is something we should also experiment with. They also have HPC facilities available, read more at: https://csc.iitd.ac.in/

Additionally, I am also in the process of deploying several servers at home, which has provided me with innumerable learning opportunities.

1.3.3 Outcomes

This section makes an attempt at answering the question *"What does this accomplish?"* to fairly non-technical readers, because technical readers might already be familiar with the potential outcomes of such an undertaking.

Examples

The easiest explanation here would be to just enumerate some examples, and so, here follow some tasks that the systems administration team will be concerned with:

- Faculty XYZ needs to deploy a static homepage. For example, IIT Delhi allows faculty and students to deploy a homepage under the following URL pattern: https://web.iitd.ac.in/~name.

- Imagine as a student the university grants you certain services, for example, a certain amount of storage accessible from all university computers upon login with your credentials (this also hints towards a central authentication server) or even accessible through the

Internet, such services would be operated by the systems administration team.

- In cooperation with the team currently administering the university network, we could implement various methods to isolate parts of the network from one another, deploy VPN services, implement security best practices, etc. I've also noticed an issue with the current network wherein I speculate that the server responsible for issuing addresses to devices runs out of said addresses in the allowed range, a student bypassing this server by manually filling in their address is granted access to the network while other students are not, we might be able to fix such problems.
- Many premier institutes often host a mirror for various Linux distributions, such a service often causes global appreciation for the university and also benefits students by offering high speed downloads. Such a service can be maintained by this club given additional storage is provided.

The list could go on, but the fundamental point of all of these outcomes is that having such facilities on-campus, removes the *"magic"* from data centers and allows members of the club to have hands-on experience with the processes that happen behind-the-scenes to the run the modern world.

1.4 Computer Science Team

The computer science team will deal with problems in the software realm, but exceptions can be made. The proposal intentionally avoids restricting the domain of problems that the computer science team will tackle, as long as the project is related to computer science, they're free to choose whatever project interests them.
This team also aims to bring focus to the often neglected aspects of computer science in the Indian academic context such as compiler design, operating systems, computer graphics, computer networking, etc. To achieve such goals, we aim to do the following:

- initiate projects that are open to contributions from the entire university which implement various technologies from scratch that we today take for granted.
- arrange accompanying workshops for these projects which allow students to learn and discuss the concepts behind such projects.

1.4.1 Outcomes

While it is hard to describe an exact criterion for what could qualify as a project for the computer science team, it is possible to enumerate example projects that I wish to execute under this team:

- Implementing an 8-bit computer from scratch using TTL chips.
- Building a toy assembler and/or compiler.
- Building a toy operating system.
- Designing a network protocol.

Chapter 2

Execution: The How

The execution plan deliberately refrains from specifying exact implementation details, instead it tries to explore possibilities rather than fixed pathways. This flexibility is essential because the implementation details will vary depending on the allocated budget.
The computer science team does not require much funding, if any. All the funding is for the systems administration team which will acquire various hardware required to set up the operations detailed in the preceding chapter.

2.1 Considerations & Assumptions

This section describes a few critical considerations that the university should carefully contemplate to avoid developing unrealistic expectations from the club, the proposal also bases some assumptions upon these considerations to reduce initial costs. These are as follows:

- CSSAC is not a one-time investment, it has running costs and so an annual budget is to be expected.

- Servers consume considerable amounts of electrical power, the proposed servers assume that university receives subsidized electricity at cheap rates and also produces a portion of its electrical power through solar energy.
  Another assumption has been made about the power reliability on the campus, a runtime of not more than 2–4 minutes is to be expected from the proposed UPS solutions. If the university is equipped with generators, they should start delivering power within this time-frame.

2.2 Server Recommendations

I would highly recommend starting with a minimum of 2 physical nodes, or a server paired with a dedicated firewall device, but a secondary server would be my preferred choice. This is to ensure that the network is physically isolated from the server hosting services and events such as reboots do not take down the network, and in this case, the path offering convenience also enhances security. HP servers are to be avoided due to them requiring an active subscription to receive firmware updates, this is highly unethical and incentivizes running potentially insecure software. And so, several Dell servers have been shortlisted:

2.2.1 Dell Poweredge R820

This is a 12th generation server from the poweredge series, offering 4 CPU sockets which could support upto 48 cores and 96 threads, and it supports upto 1.5TB of DDR3 RAM.

2.2.2 Dell Poweredge R730

This is a 13th generation server, offering 2 CPU sockets which could support upto 44 cores and 88 threads, but it supports newer generation processors as compared to the R820. It also supports faster and more efficient DDR4 memory. The R730 while marginally more expensive than the R820, it is a sweet spot between expensive newer generation servers and cheaper older generation servers.

2.2.3 Dell Poweredge R620

This is a 12th generation server which could be used as a secondary server to virtualize the firewall.

Table 2.1: Price List

Component	Price (INR)
Dell Poweredge R820 (32GB DDR3, 4xE5-4620 v2)	88,499
Dell Poweredge R730 (64GB DDR4, 2xE5-2680 v3)	100,499
Dell Poweredge R710 (32GB DDR3, 2xX5650)	39,435
Dell Poweredge R320 (32GB DDR3, 1xE5-2470 v2)	37,380
Dell Poweredge R620 (64GB DDR3, 2xE5-2670 v2)	64,499
Intel Xeon E5-4650 V2 Processor	4,999
Intel Xeon E5-2696 V4 Processor	25,960
Any 24–48 port managed network switch	20,000
Any 42u Server Rack	50,000
Any >3000VA UPS	60,000

2.3 Requirements

If the proposal is accepted, the club has the following requirements from the university:

2.3.1 Room Allotment

Server Room

When selecting a server room, several critical factors must be accounted for. The chosen room shall have proper equipment to control temperature and humidity, too much humidity will cause condensation and too little will promote electrostatic discharge. Ideally, the room shall not have any windows (or the windows should be covered) or be located nearby any potential sources of water which might leak. Considering the weight of the servers and racks will increase over time as more equipment is added over the upcoming years, it will be essential to assess the load-bearing capacity of the floor to ensure it can safely accommodate the anticipated growth.

Operations Room

This room will be home to the entire club. It will be the place to keep inventory of random parts such as raid cards, hard drives, warranty documents, hardware projects by the CS team, etc. As suggested by the name of the room, it will also be the place where the sysadmins will administer the servers and thus this room will require around 2–4 computers. The reason to have two separate rooms instead of sharing a common room is due to the fact that servers are loud and long term exposure to such noise can cause hearing loss.

2.3.2 Budget

With reference to the price list in table 2.1, a budget of about **3–4 Lakh INR** is to be expected for the following items:

- Dell Poweredge R730 (128GB DDR4, 2xE5-2696 v4)
- Dell Poweredge R620 (64GB DDR3, 2xE5-2670 v2)
- 2x8TB SATA HDD budget upto 36,000 INR
- 24/48 port network switch budget upto 20,000 INR
- 42u server rack budget upto 50,000 INR
- UPS budget upto 60,000 INR

This is by no means the final budget, instead it offers a ballpark estimation to allow the reader to make an informed decision about whether to accept this proposal or not. If the proposal is accepted, I can start requesting quotes from various vendors on behalf of the university both online and offline (Nehru Place market) and prepare a proper budget.

2.3.3 Public Static IP Address & Domain

The club will also require at minimum one public static IP address and one domain. I'm unfamiliar

with the procedure, but I'd assume to obtain such an address, someone at the National Knowledge Network (NKN) will have to approve this request. For the domain, if the university would prefer (and it should) a domain like `ipuedc.ac.in` then ERNET is the responsible authority for `ac.in` domains, if not, domains such as `ipuedc.com` can be obtained with relative ease.

2.3.4 Offsite Backup

A Backblaze personal account seems to be the cheapest solution, offering unlimited backup for $99 per year. Another approach could be to pay a one-time upfront cost for a server and hard disks and install the server in the main campus.

2.4 Sponsorship Program

A sponsorship program may also be created to partially fund this venture. As a reference, hackCBS hackathon held annually at Shaheed Sukhdev College of Business Studies was able to raise an estimated amount of $7,900 USD as per their sponsorship brochure and the sponsor list. Our sponsorship programme could be open to both monetary and hardware donations.