A Proposal for

MICROELECTRONICS TRAINING & DEVELOPMENT CENTRE

Infrastructure Establishment and World-Class Training

at

(ANY SCHOOL, AGENCY, ETC IN NIGERIA)

by

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THIS GENERIC PROPOSAL WAS ADAPTED FROM ONE TO A NIGERIAN STATE GOVERNMENT. CONTACT US FOR ONE FOR YOUR SCHOOL, AGENCY, ETC. WE HAVE REMOVED THE PRICES SINCE THIS IS GENERIC

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Executive Summary

This proposal articulates a two way strategy for the government of Your state to fund and develop a microelectronics centre in the state. Microelectronics has been recognized as the most pervasive industry in the world that has impacts in all areas of human endeavors. It drives medicine, energy, entertainment and indeed all key industrial areas of the 21st century. Researchers have observed that appropriate diffusion of microelectronics enhances economic activity, and helps transition ICT industry in developing economies from consuming to creating. (The emergence of Brazil, India and Turkey were preceded by massive investments in microelectronics). As your state drives its vision to become a global leader in technology creation, microelectronics must necessarily be the anchor for that development.

There are many opportunities developing microelectronics provide to the state, and they are:

- Lead the nation in developing core knowledge manpower for the 21st century
- Quality manpower improves the odds of attracting location of knowledge firms
- Facilitate international collaborations with available in-state tools
- Expands the state economy by infusion of new ideas and knowledge capital
- Drives the emergence of technology clusters and hubs
- Helps create new companies and reduce unemployment
- Transitions the ICT sector to become creative with value creation capability
- Makes the state #1 in Nigeria to have a fully world class microelectronics centre
- Opens a new opportunity for the SMEs
- Brings the world's engine of wealth to Nigeria and modernize education

The proposal is divided into two sections: **INFRASTRUCTURE DEVELOPMENT AND ESTABLISHMENT** and **ACADEMIC, BUSINESS AND ENTERPRISE.** The former presents all the necessary steps and activities with cost implications to establish a **Microelectronics Training and Development Center**. The latter presents all the required trainings needed to develop a deep core knowledge base to a spectrum of the citizens.

The cost is broken down as follows:
Section I – (call us)
Section II– (call us)

Our Company

First Atlantic Semiconductors and Microelectronics Ltd (Fasmicro) is a fully incorporated knowledge company with Nigeria's Corporate Affairs Commission (RC908703).

SECTION 1: INFRASTRUCTURE DEVELOPMENT AND ESTABLISHMENT

1. **Purpose of this Proposal**

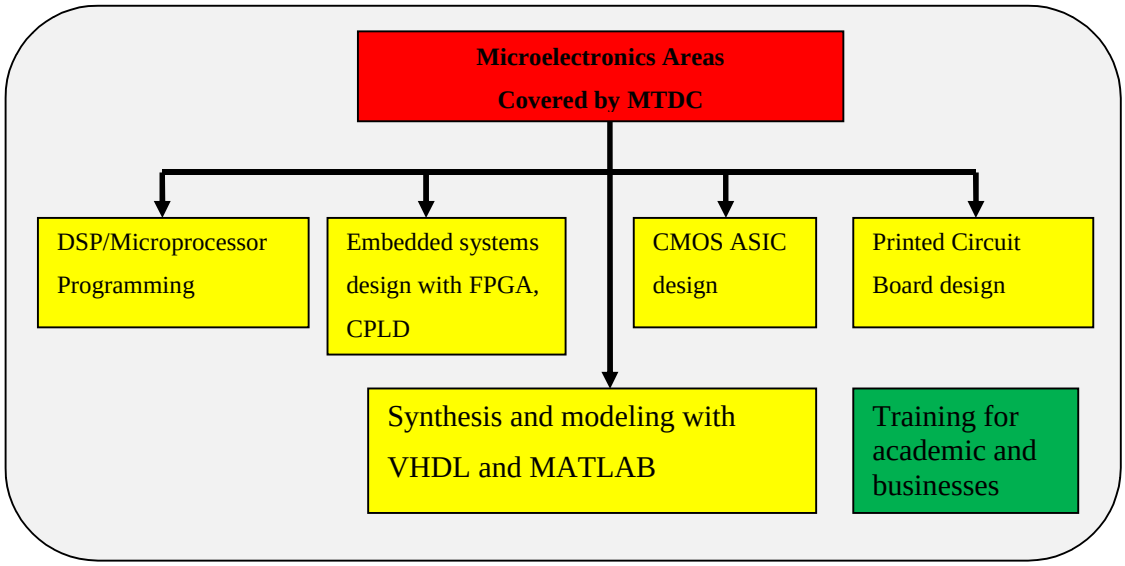

Figure 1: What this proposal –MTDC-covers.

(NB: Definition and explanation of acronyms in Appendix of this proposal)

The purpose of this proposal is to facilitate the development of the most vital industry of the 21st century, microelectronics, in your state. This will be accomplished through improvement in the quality and relevance, efficiency and equity, in microelectronics business and learning opportunities in the state. We propose a new Centre, **Microelectronics Training & Development Centre (MTDC)**, towards realizing these objectives and meeting the skills requirements in the state's evolving and dynamic information and communication technology (ICT) sector. It will become a center of entrepreneurship and technology creation for Nigeria. Areas of focus in this proposal are presented in Figure 1, above.

MTDC will educate and train businesses and schools in the exciting field of microelectronics, and its applications to agriculture, energy, manufacturing, telecommunications, information

systems and foster opportunities not only for the acquisition of new knowledge, but also the production and application of new knowledge. It will open new vistas of opportunities for small and medium scale enterprise (SMEs) to differentiate their services and create new values in their product offerings. The centre will provide broad-based innovative trainings, which would enhance the quality of their business processes and systems.

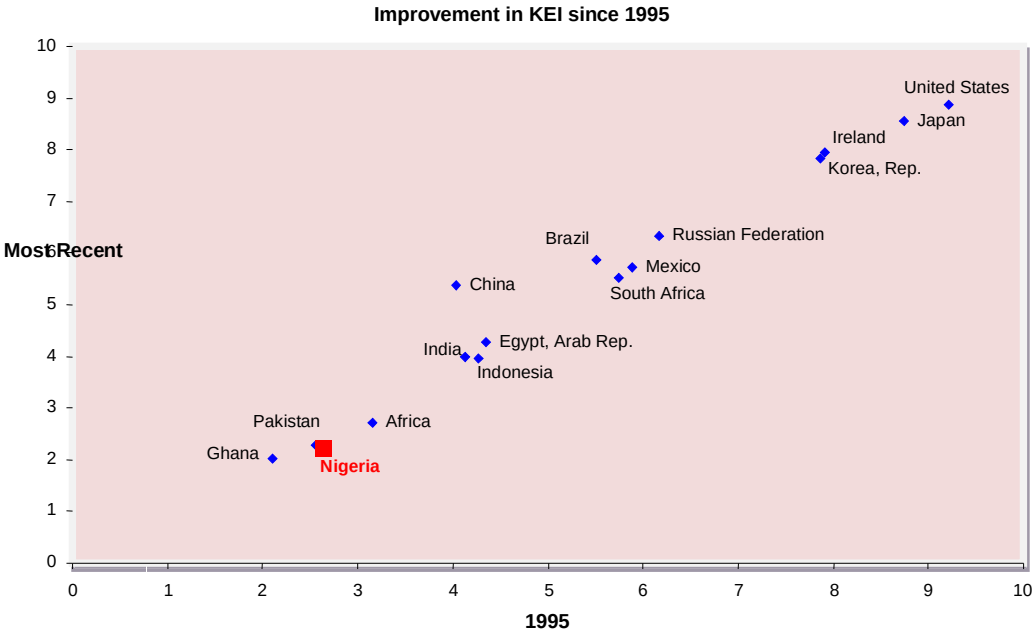

Figure 2: Nigeria KEI (Knowledge Economy Indicators) slips with low diffusion of microelectronics and creative ICT. Data Source: World Bank

From our studies, a 10% diffusion of microelectronics will produce a compounded tripling of the state economy, over five years. It will create a new source of knowledge workers that can establish companies and provide jobs to the citizens. Microelectronics diffusion will also facilitate broad impacts across all segments of the economy and position the state for foreign direct investment from multinational and outsourcing companies. MTDC will play a major role in the government's efforts to develop an industrial and technology districts. It will also help to move Nigeria's KEI (Knowledge Economy Indicators) as shown in Figure 2, above.

MTDC programs will provide educational opportunities for schools and businesses in the emerging and interdisciplinary areas of neuromorphics, MEMS, telecommunication circuits

and systems, information systems, controls, etc. There would be cross-disciplinary efforts and partnerships between the state academic institutions and international academic partners.

MTDC is consistent with both the state vision of developing capacity in science and technology. In the next decade, courtesy of many visioning projects across Africa and the explosive growth of telecommunications sector, there would be needs for microelectronics engineers to help the continent move up the ladder in the technology pyramid. These engineers will be creating in leading the design and development of some of the electronics systems and tools that would be used in Africa.

The proposed program will help the state's technical schools that already have the missions of providing technical education and training in technical and scientific areas, critical to the state economy. This program will promote the acquisition of new knowledge and the production and application of new knowledge in classrooms and laboratories, and produce highly trained and skilled graduates well qualified to move into academic, industrial or federal and state research positions. It will also drive a new focus on the SMEs in the state.

This proposal mirrors similar initiatives which have been used by MOSIS (USA), CMC Microsystems (Canada), Europractice (Europe), TSMC (Taiwan) - all programs supported by their respective governments towards practical oriented training and learning on microelectronics. Over the years, these initiatives have enabled the different nations to train and develop more relevant practically oriented professionals for the industries.

2. MTDC Justification

ICT is facilitating the process of socio-economic development in Nigeria. It has offered new ways of exchanging information, and transacting businesses, efficiently and cheaply. It has also changed the dynamic natures of financial, entertainment and communication industries and provided better means of using the human and institutional capabilities of the continent in both the public and private sectors. Increasingly, ICT is rapidly moving Nigeria towards knowledge-based economic structures and information societies, comprising networks of individuals, firms and nations that are linked electronically and in interdependent global relationships. This remarkable success of ICT in Nigeria and indeed globally since the dawn of the 20^{th} century has been enabled by the phenomenal growth of the microelectronics technology. Microelectronics is the engine that drives the information age and without its

constant evolution, ICT cannot advance. Unfortunately, the microelectronics industry does not have presence in Nigeria despite a hugely expanding ICT sector.

Over the years, many Nigeria schools have developed and taught courses on microelectronics. However, lack of institutional capabilities, like excellent facilities, teaching and learning environments have stalled its capacity to offer practical and relevant skills needed by its students and industry to facilitate the diffusion of microelectronics technology from bottom-up approach in the nation. At present, no sub-Sahara African university or institution has a world-class microelectronics teaching and training environment. We understand the challenge which has affected Africa's capacity to develop world-class programs on microelectronics- the lack of adequate funding which partly affected the abilities to have the right mix of people, processes and tools.

Further, because of the rapidly-growing Nigeria's telecommunication sector and the identification of microelectronics as a major research thrust area to help develop Made-in-Nigeria's infrastructure, the stage is set to establish a microelectronic centre in the nation. Your State has an opportunity to lead the nation. And build the foundations for Made-in-Nigeria's products which will cover the full spectrum of products, such as cell phones, microprocessors, cameras, etc. The justifications for establishing such a program are listed below:

- MTDC program will promote Your's stature as a leader in creating and disseminating new knowledge, and in the application of new knowledge
- MTDC program will fulfill the need for cross-disciplinary training of students and Your state businesses in a new area of advanced technology.
- MTDC program will drive a vibrant collaboration between Your state schools and their foreign partners, with available tools and facilities. Obtaining grants from international firms and sponsors will be a lot easier also.
- The MTDC program will offer new field of research and application which will create increased opportunities for employment and economic growth in the state.
- We are optimistic that having MTDC will make Your state the natural location for companies like HP, Intel, AMD, Motorola and other semiconductor firms presently selling their products in Nigeria to build plants, when the time comes.

3. Execution Steps for establishing MTDC

We will follow these steps to execute this proposal, if approved and funded by the government.

Activity 1: Physical Structure for MTDC

We assume that the state has a physical structure where MTDC will be established. The room should accommodate about 30 people at a time. These people include SMEs, students, professionals that would be trained. We will equip 25 computers with Computer Aided Design (CAD) tools for training and research. Also, this room will house oscilloscopes, function generator, spectrum analyzers, test chips, programming kits, FPGA hardware, etc. They will also have the usual test-benches associated with electrical labs for soldering and bread-boarding.

Activity 2: Equipment and Computer Systems Purchase & Installation

The equipment and computer systems will be installed in the room. This will involve some computer networking since all the systems must be networked. These computers will be high-end to run the CADs.

Fabrication Services: This proposal does not cover fabrication. Rather, MTDC will be assisted to use fabless contracting with our US partners to fabricate microchips made in MTDC. This cost for fabricating PCB and microchip is not included in this proposal. It will depend on the frequency of the design and its complexity. Fabless contracting is used by most developing nations since building and maintaining a modern cleanroom costs excess of $6 billion.

Workstations: Twenty five high-end Linux/Windows computers will be purchased, as stated above. These computers will have high speed and memory to enable usage of the CAD tools. They will be divided for server and CAD applications design and development. There will be additional Tape Back-Up Systems and HP storage system to backup all works on real time. Two servers will be bought.

Test Systems: Tests systems will be purchased for the 25 nodes. Details of the systems and associated costs will be presented in the finance and budget section of this proposal.

Design Tools: We will install and acquire licenses for the CAD tool.

High Level Synthesis (FPGA/CPLD):	Xilinx ISE
High level simulation (VHDL, Verilog, HDL)	Hamster, Xilinx III
PCB (Printed circuit board)	PCB Express/Altium
DSP Platforms	(PIC, SX-48 microcontrollers)

Activity 3: Trainings & Equipment Trainings (plus safety training)

As a matter of priority, we will train MTDC staff on the safety issues on any equipment we will install. Also, we will provide overview trainings on the CAD, tools, and equipment. For advanced trainings, see Section II of this proposal.

Progress Indicators

Table 1 presents the indicators of this proposal, for Section I.

Table 1: Progress Indicators for Section I

Activity 1: Physical Structure for MTDC			
Progress Indicators	Phase One	Phase Two	Final Phase (Milestone 1)
	Provided by state (M1)	Provided by state (M1)	Room or building ready (M1)
Activity 2: Equipment and Computer Systems Purchase & Installation			
Progress Indicators	Phase One	Phase Two	Final Phase (Milestone 1)
	Send tools, CAD and systems from USA/Nigeria (M3)	Send tools, CAD and systems from US A/Nigeria (M4)	Complete equipment and computer systems purchase and installation (M4)
Activity 3: Trainings & Equipment Trainings (plus safety training)			
Progress Indicators	Phase One	Phase Two	Final Phase (Milestone 1)
	Organize training on tools and CADs (M5)	Safety trainings (M5)	Complete trainings for Section I (M5)

*Phase is used here to describe a stage/segment of an activity with a time dimension.

** M is month; M1 is Month 1 after award and upon signing grant agreement and funding

** *This assumes immediate and on-time payment by the state

4. **Sustainability and Management**

Businesses and students that will use MTDC are likely to come from a broad range of disciplines, such as engineering, computer science, physics and mathematics. We expect that a significant number of students will come initially from Your state. We believe that the centre will help progress the reputation of the state. As the ICT sector improves and expands, we see markets for creating the infrastructure from bottom-up. This will involve supporting emerging technology applications in digital signal processing (DSP), printed circuit board (PCB) technology, microcontroller programming, developing hardware drivers, etc. Even the government research institutes across Nigeria will likely send their employees while many small and medium enterprises (SME) will patronize the programs to learn cutting edge skills to become competitive. Thus, the program is strategically oriented to serve the needs of current and future industrial and government sectors of Nigeria. Accordingly, MTDC can be a profit centre to the government as it can be self sustainable through revenue generation. The following will help to ensure more applicants attend MTDC programs:

- Maintaining a frequently updated web page that informs the public on the organization, opportunities, accomplishments, and excitement of the program.
- Faculty presentations about the program at technical meetings (and trade associations) that are devoted to S&T education.
- Faculty visits to other institutions with potential sources of businesses and students.
- Mass mailings and e-mailings of flyers and other publicity materials about the program.
- Organize workshops, seminars and conferences as revenue sources
- Introduce products in the market within the first 4 years
- Seek more sources of funding, such as grants, endowments, etc, internationally
- Generate income from patents and spin-offs
- Contact with alumni and other potential benefactors via mail and open houses.
- Governments selecting some entrepreneurs and encouraging them to devote interests in emerging new technologies. That will create more opportunities for MTDC to nurture and develop future technical leaders.

5. **Assessments and Impacts**

Here are how to access impacts and indicators for improvements and quality control in MTDC. Table 2 presents the impacts and assessments for Section I of this proposal.

Table 2: Assessment and Impacts for Section I

Activity:	**Expected Outcome (Result)**	**Indicators of Outcome (Result)**	**Means of measurement/Verification**
International collaboration	This will expose schools and businesses to new areas of technology and partners	*publications * patents * exchange students * more investments	We expect 10% increase in SME tech creation, patents and publications in 2nd year; 20% in 4th year.
Entrepreneurship and start-up firms (products and success rates)	We want participants to be technology creators and innovators	* start-up firms	Before our 5th year, at least 2 participants should be managing a big firm with networks across Nigeria
Support services	We will support chip fabrication through our relationship with external foundries	* chips fabricated	We will fabricate 10 working chips in our 1st year; 20 in our 2nd year.
Expanded research base	The Centre will expand as it matures and get better	* 100% capacity utilization	We expect after 3 months for the center to be fully utilized in research and learning. We expect it to open doors to energy research
Enhanced skills and equipment/tools usage proficiency	Participants will be the best microelectronics experts in Africa	* jobs * Hub for talents	Leads the industry in Africa in developing and nurturing future talents.
Collaboration/training of SMEs	We will train many state SMEs to new technical skills to make them better	*competency * products in market * industry diffusion	We will elevate the level of skills of SME-measurable by better products; MTDC will stimulate microelectronics industry diffusion from 1st year
Overall Project:	**Expected Outcome (Result)**	**Indicators of Outcome (Results)/Impact**	**Means of measurement/Verification of outcome(results)/Impact**
MTDC (this proposal)	Project will stimulate state's ICT. It will create diffusion and produce better ICT	* new products * industry growth * new firms * manpower	At least 10 products will come from this center within 4 years; microelectronics industry will emerge in Africa; at least 4

	managers and tech creators. Will be both technical and management success	capacity	firms from MTDC will redesign Africa; 200 skilled microelectronics engineers will be ready for Africa's economy from MTDC within 2 years.

6. Section I Finance and Budgets

Total budget for Section I of MTDC is provided below. Please refer to section 2 for all the activities. Table 3 presents the Finance and Budgets for section I of this proposal.

Table 3: Finance and Budgets for section I of this proposal

Activity	**Item**	**Unit (number, hour or license)**	**Unit Cost (USD)**	**Total (USD)**
Equipment and Computer Systems Purchase & Installation	Computers	25		
	Servers	1		
	Backup storage	1		
	Major CAD software: Tanner	25		
	FPGA/DSP Development Boards	10		
	Microchip PIC and UBICOM Dev Boards and programming interface	10		
	Supporting **Hardware:** GPIB interface card, switches, NIDAQ Acquisition system	lots		
	Supporting CAD software: PCB Altium, FPGA VHDL, Hamster, Matlab **Measurement software** - Labview	lots		
	Test equipment: Osciloscope, Function/logic generator, spectrum analyzer, microscope, air station, signal generators, power meters, soldering stations, power supplies, multimeter	3 each at average cost of 3, 000 USD for ten nodes		
	MOSIS: chip fabrication/foundry services with US fabless vendors	10		

	Lab consumables: wires, tyrapps, solder, PCB cleaners, hardware, wafers, soldering machine, selected chips, test boards, breadboards	lot		
	Shipping costs			
Trainings & Equipment Trainings (plus safety training): CAD usage training; equipment usage training; labware usage	40 hours of training on tools, safety and CAD overview	40		
Professional fees (local and expatriates)	Fees for setting up MTDC and get it running			
3 months support services				
Total				
Grand Total				

* The state can provide the Computers, Servers, UPS, Printer, and Data Storage if we provide the specs ** Quotes are valid for six months from date of this proposal ***50% Mobilization payment and balance 50% at completion of 50% of the assignment.

SECTION II: TRAINING – ACADEMIC AND BUSINESS

This section covers the business and enterprise trainings we will develop for the academic and business communities, with special focus on the SMEs and lesser on academics. These trainings will be practically-oriented to enable your state businesses to incorporate some values microelectronics help create to advance their firms. They will master introductory and advanced areas of FPGA, PCB, DSP, etc. The following trainings are developed for both the academic and business communities, and they cover all the microelectronics areas in Section I.

1. Practical-Oriented Courses

EMBEDDED SYSTEMS & FPGA SYNTHESIS DESIGN

This focuses on introductory and advanced laboratory-based training on the application of FPGA technology to information processing, using VHDL synthesis methods, for hardware development. The participants will use commercial CAD software for VHDL simulation and

synthesis, and implement their systems in programmable XILINX 20,000 gate FPGA devices. The lab will consist of a series of digital projects demonstrating VHDL design and synthesis methodology, building up to final projects at least the size of an 8-bit RISC computer. Projects will encompass such things as system clocking, flip-flop registers, state-machine control, and arithmetic. Participants will learn VHDL methods as they proceed through the lab projects, and prior experience with VHDL is not a pre-requisite.

MICROPROCESSOR PROGRAMMING

This course introduces the participants to the programming of computers or microprocessors at the machine level. General concepts relevant to microcontrollers are presented, including memory access, numerical representations, programming models, and coding techniques. A CAD will be used along with development platform like PIC, and SX-48 chips.

CAD DESIGN OF DIGITAL VLSI SYSTEMS AND PCB

This course will get participants to manually and through computer simulations design digital CMOS integrated circuits and systems at the level of transistors. The design flow covers transistor, physical, and behavioral level descriptions, using SPICE, Layout, and VerilogHD1 VLSI CAD tools. After design computer verification, participants will fabricate their devices. PCB (printed circuit design) will also be designed using CAD

ADVANCED ANALOG INTEGRATED CIRCUITS

This covers analysis and optimized design of monolithic operational amplifiers and wide-band amplifiers; methods of achieving wide-band amplification, gain-bandwidth considerations; analysis of noise in integrated circuits and low noise design. Precision passive elements, analog switches, amplifiers and comparators, voltage reference in NMOS and CMOS circuits, Serial, successive-approximation, and parallel analog-to-digital converter, switched-capacitor and CCD filters, applications to codecs, modems, will be covered.

SEMINARS & WORKSHOPS

Research seminar devoted to current research in the engineering of large-scale integrated analog systems and project management. Topics include opamps, comparators, vision and auditory processing systems, RF circuits, etc. A business focused semiconductor workshop will be carried out to introduce the semiconductor business, markets and strategies.

2. Progress Indicators

Please notice that the indicators are in hours (H). The hours indicate how long it will take to complete each module of the courses. For instance H10 means ten hours will be required in that module. Table 4 presents the progress indicators for section II of this proposal.

Table 4: Progress Indicators for Section II of this proposal

Embedded systems and FPGA synthesis Design			
Progress Indicators	Phase One	Phase Two	Final Phase (Milestone 1)
	Introductory (H20)	Advanced (H20)	Labs and practicals(H40)
Microprocessor programming			
Progress Indicators	Phase One	Phase Two	Final Phase (Milestone 1)
	Introductory (H20)	Advanced (H20)	Labs and practicals(H40)
CAD Design of Digital VLSI systems and PCB			
Progress Indicators	Phase One	Phase Two	Final Phase (Milestone 1)
	Introductory (H20)	Advanced (H20)	Labs and practicals(H40)
Advanced Analog Integrated Circuits			
Progress Indicators	Phase One	Phase Two	Final Phase (Milestone 1)
	Introductory (H25)	Advanced (H25)	Labs and practicals(H50)
Seminars and Workshops			
Progress Indicators	Phase One	Phase Two	Final Phase (Milestone 1)
	Seminars (H8)	Workshop (H16)	Workshop (H16)

*Phase is used here to describe a stage/segment of an activity with a time dimension.

** H is hour; H1 means it takes one hour to complete that module of the course.

Expectation: Participants after this training can open a company and provide similar services. Working on systems as in Figure 3 will become simple.

Figure 3: A microchip. Training will help state technology SMEs create products from chips like this.

3. Section II Finance and Budgets

Table 5 presents the Finance and Budgets for section II of this proposal.

Table 5: Finance and Budgets for section I of this proposal

Activity	**Number of Hours (see Table 4)**	**Cost/Hour (USD)**	**Total (USD)**
Embedded systems and FPGA synthesis Design	80		
Microprocessor programming	80		
CAD Design of Digital VLSI systems and PCB	80		
Advanced Analog Integrated Circuits	100		
Seminars and Workshops	40		
Total (USD)			
Grand Total (USD)			

* Quotes are valid for six months from date of this proposal **50% Mobilization payment and balance 50% at completion of 50% of the assignment.

NB: Fasmicro assumes funding of Section I of this proposal. In a case the government wants to execute Section II without the first section, we will the rent/license the necessary tools and charge for them. We estimate a cost of (call)

APPENDIX AND DEFINITION OF TERMS

What is microelectronics? The term microelectronics describes a group of technologies that integrate multiple devices into a small physical area. Often these devices are made from semiconductors with a process called photolithography. Several components are available in microelectronic scale such as transistors, capacitors, inductors, resistors, diodes, insulators and conductors. The microelectronics can be divided to its subfields which in turn are connected to other micro related fields. These subfields are micro electromechanical systems (MEMS), nanoelectronics, optoelectronics and single electron devices (SED). Integrated circuits and microchips are typical microelectronic devices, which can be found in computers and mobile phones. Microelectronics can be also found for example in medical devices, toys and automobiles. Its industry, the semiconductor industry, is considered one of the most pervasive in modern history and continues to shape global commerce and industry.

Integrated circuit: an integrated circuit (also known as IC, chip, or microchip) is a miniaturized electronic circuit

CMOS: Complementary metal-oxide-semiconductor (CMOS) is a technology for constructing integrated circuits.

ASIC: is an integrated circuit (IC) customized for a particular use, rather than intended for general-purpose use.

FPGA: is an integrated circuit designed to be configured by the customer or designer after manufacturing—hence "field-programmable".

CPLD: is a programmable logic device with complexity between that of PALs and FPGAs, and architectural features of both. The term Programmable Array Logic (PAL) is used to describe a family of programmable logic device semiconductors used to implement logic functions in digital circuits.

PCB: board used in electronics

MATLAB: is a numerical computing environment and fourth-generation programming language

VHDL: (VHSIC hardware description language; VHSIC: very-high-speed integrated circuit) is a hardware description language used in electronic design automation to describe digital and mixed-signal systems such as field-programmable gate arrays and integrated circuits.

DSP: the study of signals in digital computing and their processing methods.