

Conceptual Design at the box level

Here we will look at how conceptual design is different, but still fairly similar at the box or product level. This process would be useful if ever you are called upon to design a “one-of,” or project special set of products.

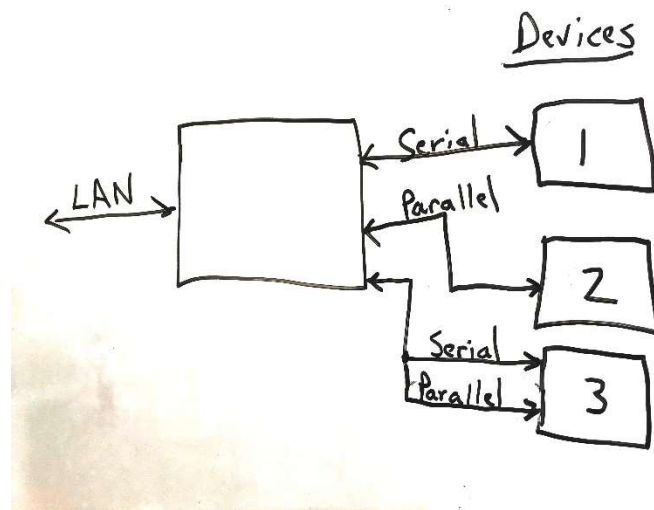
Specs – What to Build

Conceptual Design is just what it says, an idea is fleshed out enough to determine what it will take to produce and deliver it. How it will work, what it will look like, what features it will have, as mentioned earlier its external specs.

The story is told of a few engineers at a local pub years ago sketching the design of the National Semiconductor Corporation product that eventually became the IMP16 family of processors based on the GPC/P chipset on a napkin. GPC/P is the General-Purpose Controller/Processor a MOS LSI set of five PMOS integrated circuits. One Control Read Only Memory (CROM) and four Register and Arithmetic Logic Units (RALU) function as a single sixteen-bit microprocessor. Of course, you don't have to go anywhere to use this approach, just grab your pencil and paper and start designing. One of our mentors told one of us to not use a ruler, do it freehand as it's much quicker. He was right.

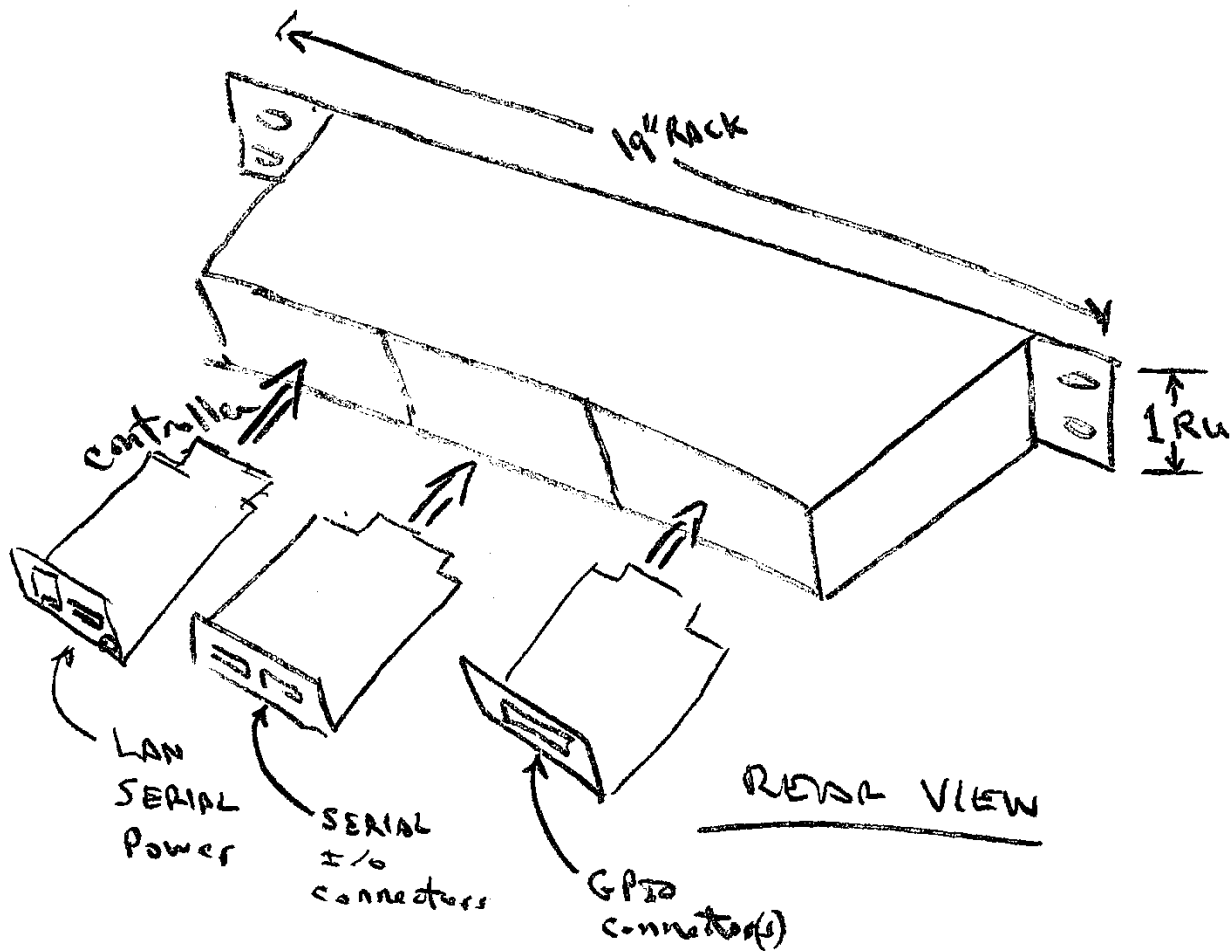
So, let's start our example design by giving a description of what it is we're going to solve.

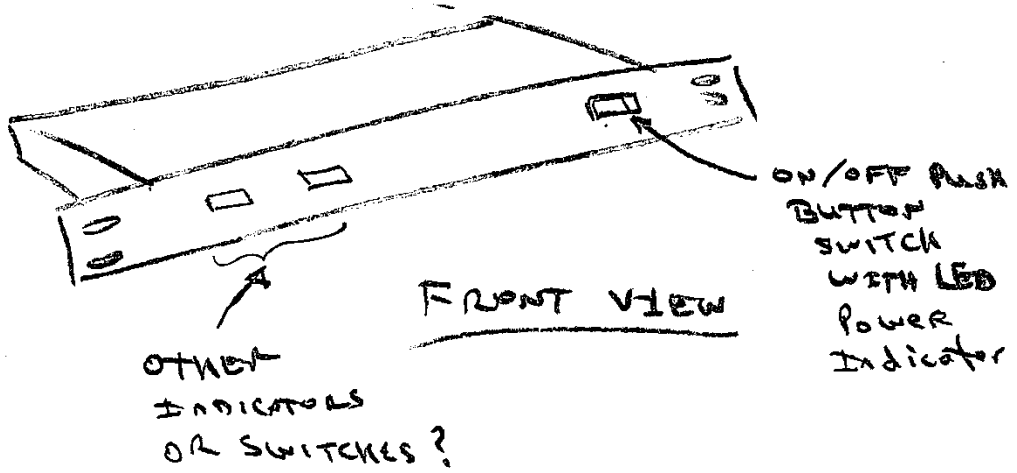
The company decides that you are to design and build a device that can control a cluster of devices on an assembly line it is setting up. The control is to be via a network connection, but none of the devices have network interfaces. What those devices do have is parallel and serial interface ports. Your box is going to have to be able to take commands sent over the network and convert those commands into the required parallel and serial commands and distribute those commands to the correct device. In addition, the devices provide status or telemetry back about their status via the same parallel and serial ports.



After a few discussions it is decided to also have an audio output feature with two channels of quality audio which will allow connection of a public address system, alarm system or radio to make announcements selected by the user program. In addition, the company wants your box to be one rack unit high and fit in a nineteen-inch rack. One rack unit is 1.75" in height, two rack units is 3.50" in height. Rack units are just multiples of the 1.75" height. The power and all connectors are to be on the rear of the enclosure and the unit is to be modular with a common interface for each module. Let's give the enclosure with backplane, front panel, external power supply and ready to plug in modules a name, CENTRI Frame.

Here is a napkin sketch of what the product could look like. Don't be afraid of drawing several versions and discarding the ones you don't like. Changes at this point are free! Later they will get much more expensive.





Now that you have a concept, a few other items that need to be addressed and conditionally solved, let's continue down the list.

Other Internal and external specs

Features

User interface

Inputs and Outputs

Connectivity/Remote Control

Size

Shape & Enclosure

Rack Mount

Table top

Hand held

Wearable

Technology used – processing required

Embedded Controllers

Microprocessors verses Microcontrollers

Microprocessor (MPU) = CPU

Microcontroller (MCU) = CPU + Memory + Peripherals

Bluetooth = MCU

WiFi = MCU / MPU

Cellular = MCU

Sensors = MCU

GPS = MCU

Motor/solenoid control = MCU

HD 720p camera = MCU / MPU

HD 1080p camera = MPU

USB 3.0 = MPU

Real-time processing = MCU

Long battery life = MCU

Advanced data processing = MPU

Graphical User Interfaces = MCU / MPU

^{3rd}-party network connectivity = MPU

Conduct Vendor Survey and feasibility studies of Possible solutions

Decision – Tradeoffs between HW/SW/Logic

Architecture – Block (Conceptual) Diagrams

Power

Assembly

Certifications

Prototype Cost

PCB Production costs

PCB Assembly costs

Electronic components

Enclosure

Planning the documentation list

Conceptual Design Review