Slide 1

Planning for the rest of the semester.

Yesterday evening Dordt announced that we need to add days to the schedule to assure a full semester for accreditation purposes, but EGR 304 does not need them in the sense that we are finishing our planned syllabus on the original schedule.

New Schedule

F	4/03	**Video** Ethernet CSMA/CD animation, typical small business network
M	4/06	**Video** Discussion of test, Def'n of the Internet, Internet is not Ethernet
W	4/08	Test #2
F	4/10	No class--Easter Break
M	4/13	No class--Easter Break
W	4/15	**Video** Ethernet an Internet protocol—higher OSI layers, client-server roles
F	4/17	
M	4/20	
W	4/22	Lab Project II Report Due 11:59 PM
F	4/24	
M	4/27	
W	4/29	
F	5/01	(Last day of class)

M 5/04   New last day of class

W 5/06   10:30 AM to 12:30 PM—Final Exam—Now removed from schedule! Take-home exams recommended.

Spring 2020
DAILY NOTES
Click on a date to download the notes for that day.
M = Monday, W = Wednesday, F = Friday

Original schedule

	DATE	TOPICS
M W F	1/10	Intro, Microprocessor vs. Microcontroller vs SoC, trends (First day of class)
M	1/13	Introduction to Git, Demonstration of a repository
W	1/15	More on Git, HEAD, branch, other commands
F	1/17	Parallel Ports, Configuration of, I/O strategies, Arduino code examples of
M	1/20	|| Ports on Arduino and R-Pi, Pos or neg-true drive, V- vs. I-driven loads
W	1/22	Driving higher powered loads, MOSFETs & BJTs as switches, flyback
F	1/24	More on flyback, debouncing switches, modeling sensors, decibels
M	1/27	Sensors: range, dyn range, precision, accuracy, models, single-ended
W	1/29	Differential sources, diff inputs, connections, variations
F	1/31	A/D conversion: anti-aliasing, sampling, quantizing, audio demo
M	2/03	Sensors: an overview. Matching sensor range to A/D range.
W	2/05	Devotion: "What, me worry?", Intro motors, DC motors, AC motors
F	2/07	3-phase synchronous w/ salient pole or cylindrical motors
M	2/10	Stepper motors, DC motor examples.
W	2/12	Stepper holding torque vs. motor examples.
F	2/14	H-Bridge, relative drive, V-scan, U-scan, Interrupts
M	2/17	Memory, interrupts used for interrupts, sources of interrupts
W	2/19	advantages of interrupts, OOP, risks of OOP
F	2/21	Test #1
M	2/24	Interrupt density, latency, interrupt intervals
W	2/26	Int. intervals example; critical regions; task schdlg via software-hardware
F	2/28	Measuring freq. and period, Memory applications and technologies
M	3/02	Characteristics of memory and data storage
W	3/04	Control of AC loads, SCR devices, Triac devices
F	3/06	No class--Spring Break
M	3/09	No class--Spring Break
W	3/11	No class--Spring Break
F	3/13	No class--Spring Break
M	3/16	No class--Spring Break
W	3/18	Extended Spring Break due to Corona Virus, **Video**: virtual classroom
F	3/20	**Video** Practice virtual live classroom, IEEE Areospace conference report
M	3/23	**Video** Devotion: "Weak"; Async vs sync serial, RS-232 history & voltages
W	3/25	**Video** RS-232 reception, libraries, configuration, power over RS-232
F	3/27	**Video** Baud, synchronous serial interfacing, Ethernet
M	3/30	**Video** 'Scope view of Manchester, PoE+, Wi-Fi, Frames and OSI model
W	4/01	**Video** Definition of Ethernet hub, switch, bridge, router, WAP
F	4/03	**Video** Ethernet CSMA/CD animiation, typical small business network
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1

Slide 2

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New Schedule

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M 5/04   New last day of class

W 5/06   10:30 AM to 12:30 PM—Final Exam—Now removed from schedule! Take-home exams recommended.

How shall we deal with the extra lecture day?

1.) We are headed for finishing the topic of USB on about 4/24. That leaves about four class periods. I propose to add a two topics to the syllabus:

Security of Embedded Systems

Message Broker Services

What about our now unscheduled exam?

Stay with the 2-hour sit-down timed exam in the style of the 2nd test?

Switch to a take-home test with 1 week to finish it? (Dordt's administration is recommending this second option.)

2

Planning for the rest of the semester.

The second lab project is scheduled to be done now, and all of you are actually done with the hardware. The lab report is due on Wednesday, 4/22.

PLAN A

F   4/17 USB
M 4/20 USB
W 4/22 USB   2:00 PM lab demo: transmission lines. LR#2 due
F   4/24 Security of Embedded Systems (SES)
M 4/27 SES
W 4/29 SES   2:00 PM no lab
F   5/01 Message Broker Services (not on final exam)
M 5/04 Message Broker Services (not on final exam)

Th 5/07 Final exam offered in a 2-hour format similar to Test #2.

PLAN B

F   4/17 USB
M 4/20 USB
W 4/22 USB 2:00 PM lab demo: transmission lines. LR due
F   4/24 Security of Embedded System (SES)
M 4/27 SES
W 4/29 SES   2:00 PM no lab, Take-home exam is sent out
F   5/01 Message Broker Services (not on final exam)
M 5/04 Message Broker Services (not on final exam)

W 5/06 Take-home exam is due.

PLAN C
Propose your own plan!

Please e-mail me your thoughts before you go to bed on Saturday.
On Monday I'll report the results and we will make a decision.

3

Another example of a
Synchronous serial interface:

The Universal Serial Bus (USB)

https://pixabay.com/photos/iorange-usb-cable-type-c-gray-1281037/
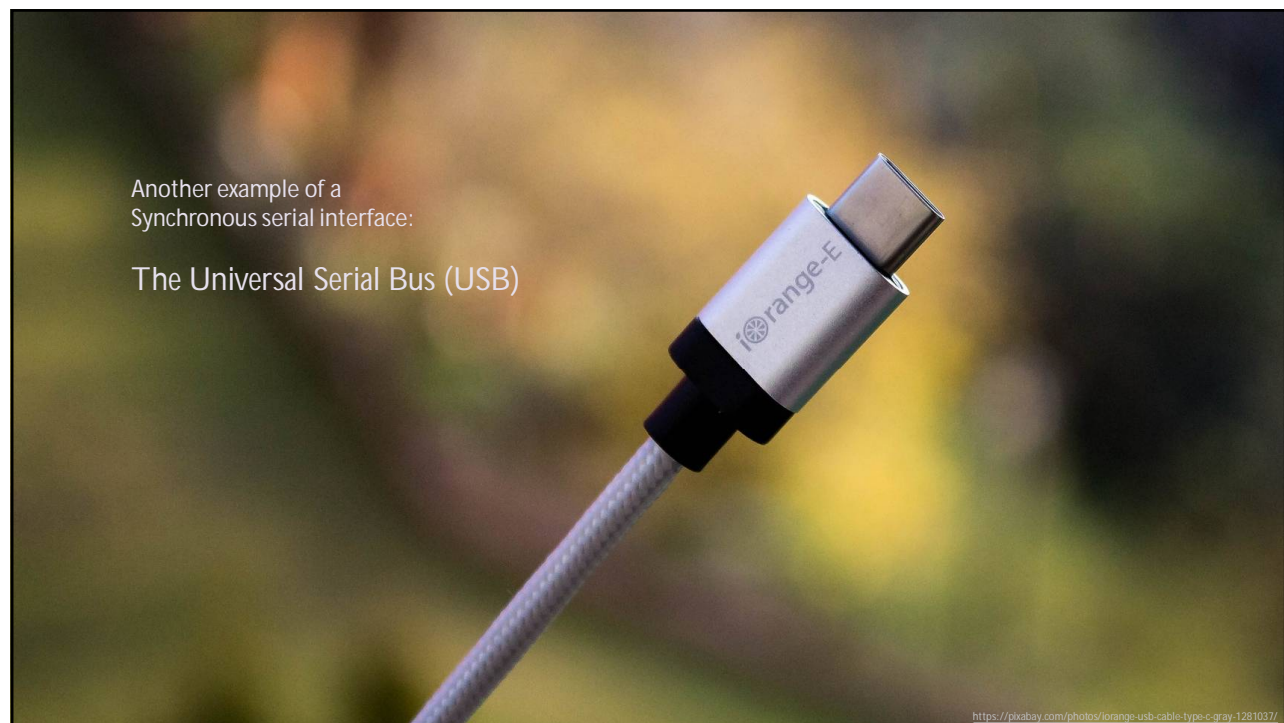
4

USB, Another synchronous LAN

- Bulk of the design work was done in 1990-1995, refinements continue to this day
- Goals of the project
  - Connectors enforce network topology. Easy to use, especially compared to RS-232, Centronics Parallel, PS-2.
  - Low cost in the sense of not much higher cost than other choices but better performance
  - Support for streaming audio in version 1.0, later speed upgrades to support video (2.0) and HD video.
  - Originally envisioned for desktop applications such as
    mouse, keyboard, printer, speaker, microphone, joystick, etc. Later web cam, cell phone charger, etc.
  - 15 foot maximum distance between endpoints.
  - "Class Drivers" provide generic driver software for any hardware—or at least that was the idea.
    Class drivers to be built into the operating system (Windows, Os x, Linux, Unix, etc.)
    The reality is that in the early days many class drivers that came with the OS were very poor quality
    Therefore many manufacturers of USB devices included replacement drivers with their products.
    Also, replacement drivers could give products differentiation by offering special features to only one brand of
      products! But this resulted in installation difficulties that remain to this day.
  - USB was the first LAN to provide power as well as data. The idea had been pioneered with RS-232 and
    Centronics interfaces but these applications were never standardized for them.
  - USB copied twisted-pair Ethernet's "hot-plugging" concept. Making or breaking a USB connection will have no
    effect on other USB devices and most certainly must not crash the OS! (This did routinely happen with RS-232,
    Centronics and PS-2 connections.)

Gold = 4 new ideas pioneered by USB

5

USB, Another synchronous LAN

USB 1.0 supports two speeds—as of 1996 when USB first gained market share.
    Low Speed—"up to 1.5 Mbps." Typical maximum useful throughput is more like 1.0 Mbps
        For various reasons low speed us usually most practical for less than 0.1 Mbps!

    Full Speed—12 Mbps maximum
        Actually used typically for rates between 0.5 and 10 Mbps.
        (Originally in the mid 1990's this was too slow for video then, but HD video is now
        possible at this rate due to improved data compression!

    Truly goof-proof "type A" and "B" connectors—a really distinct advantage of USB. Too bad they were so big!

USB 2.0 adds
    High Speed—"480 Mbps maximum"—to support video applications including video editing.
    Mini connectors. (Too bad they were still too big!)
    Micro connectors added to the 2.0 standard in 2007! (On your many cell phones for example.)

USB 3.0 adds
    Superspeed—"5 Gbps"—about 3 Gbps of practical throughput—to support fast mass storage
    Battery charging mode with "up to 5 A" but in practice about 1.5 A (7.5 watts) available.
        Most modern USB 2.0 hosts and hubs actually meet this 3.0 spec for battery charging.
    New connectors with more contacts for more data wires. (not strictly a serial port anymore)

USB 3.1 adds
    Superspeed+ —"10 Gbps" Speeds of about 7 Gbps have actually been demonstrated!
    Another new connector, "type C." (Actually not part of the 3.1 standard, but came out at the same time.)
        Type C connector has 24 pins! (Hardly a serial data connection!)   Plug it in any which way (active)

USB 3.2 also known as "USB type C" adds
    Superspeed+ now increased to "20 Gbps," type C connectors and cabling required (24 conductors!)

6

USB, Another synchronous LAN

These plugs and sockets relate to various USB 1.0 and 2.0 standards

| Micro-B | (non-standard) "USB 1.1 mini-B" | Mini-B | Standard –A receptacle | Standard-A | Standard-B |

(handwritten, red) BECOMING RARE

(handwritten, red) SOMETIMES PEOPLE TWIST THESE ?

Fairly good-performing and economical connector design has been a hallmark of USB.

7

USB, Another synchronous LAN

USB 1.0 and 2.0

One twisted pair for data,

Two more wires for power

Standard-A plug

Standard-B plug

micro-B plug

Ground | Data+ | Data- | Power (5VDC)

Standard-A receptacle

Data- | Power (5VDC) | Data+ | Ground

Standard-B receptacle

micro-B receptacle

8

USB, Another synchronous LAN
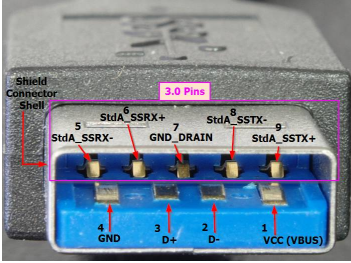
USB 3.0, 3.1
a.k.a.
Superspeed USB

Two more twisted pairs,
Total of 3 twisted pairs.

SS Standard-A plug

SS Standard-B plug

SS micro-B plug
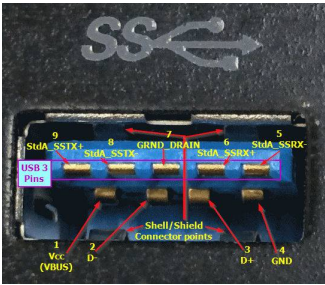
SS Standard-A receptacle
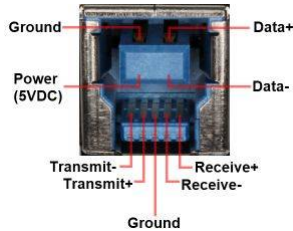
SS Standard-B receptacle
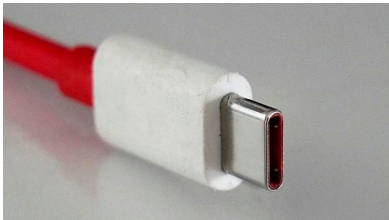

SS micro-B receptacle
(on a Samsung Galaxy 3 phone)

9

USB, Another synchronous LAN

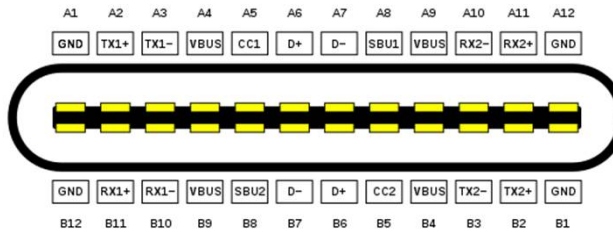USB 3.1, 3.2, a.k.a USB type C

24 pins!
Up to 16 conductors!

USB-C plug

USB-C receptacle

No more type A, type B enforcement.
Loop detection and elimination in software.
USB-C cables have identical plugs.
USB-C sockets are all identical
Plug may be inserted either way.
Adaptors can allow connection of older USB devices.
Supports analog mode for mic, headphone, charging.
Up to 100 W of power-over-USB-C (Up to 20 V at 5 A)
"Alternate modes" allows a USB socket to act as HDMI or other type—special cable.

A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
GND	TX1+	TX1−	VBUS	CC1	D+	D−	SBU1	VBUS	RX2−	RX2+	GND

GND	RX1+	RX1−	VBUS	SBU2	D−	D+	CC2	VBUS	TX2−	TX2+	GND
B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1

USB-C receptacle—looking into the open end.

10

USB, Another synchronous LAN

USB 4.0
Coming this fall. . .
To a smartphone near you!
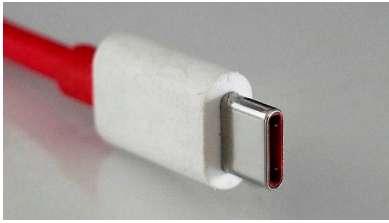
"Up to" **40 Gbps!**

USB-4.0 plug

USB-4.0 receptacle

A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
GND	TX1+	TX1−	VBUS	CC1	D+	D−	SBU1	VBUS	RX2−	RX2+	GND

GND	RX1+	RX1−	VBUS	SBU2	D−	D+	CC2	VBUS	TX2−	TX2+	GND
B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1

USB-4.0 receptacle—looking into the open end.

11

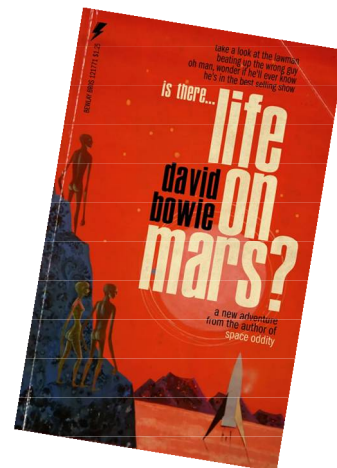
Just how fast is 40 Gbps?

That's 40/8 GBps = 5 GBps.

Consider that a pulp paperback novel is about 100000 words with six ASCII characters (bytes) per word.
Thus a pulp novel has on average about 600 kB of text.

At 40 Gbps that's 1.66667 kpnps (kilo pulp novels per second).
Might that possibly be fast enough for your Kindle?

12

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A You-Tube cat video typically streams in 720p at about 4 Mbps. At 40 Gbps you can simultaneously watch 10 thousand cat videos (or any videos) in 720p.

https://www.youtube.com/watch?v=IUaNo_L7AKU

13

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Dividing by 4 and reducing the SI-prefix by a factor of 10^6 changes the units from "bps" to "cats"

40 Gbps = 10 Kcats. (Watch 10000 cat videos simultaneously on your smartphone.)

NOW you have some perception of what 40 Gbps is.

14

Just how fast is 40 Gbps?

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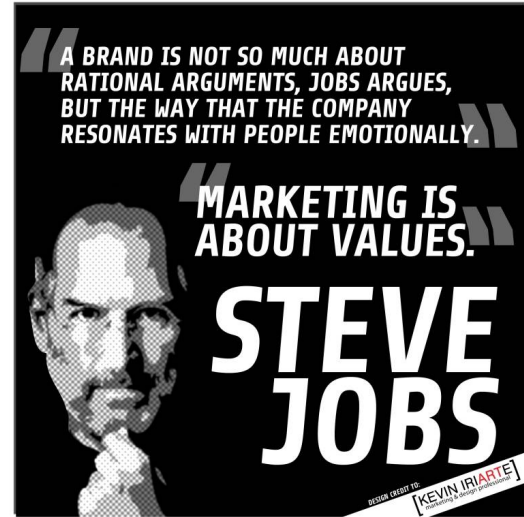"per second concept."

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NOW you have some perception of what 40 Gbps is.

USB 4.0's success will have nothing to do with it's speed.

" A BRAND IS NOT SO MUCH ABOUT RATIONAL ARGUMENTS, JOBS ARGUES, BUT THE WAY THAT THE COMPANY RESONATES WITH PEOPLE EMOTIONALLY. "

" MARKETING IS ABOUT VALUES. "

STEVE JOBS

DESIGN CREDIT TO: KEVIN IRIARTE marketing & design professional

https://suryatalks.wordpress.com/2015/04/25/best-marketing-strategy-ever-steve-jobs-know-it-the-best/

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