Tactile Network Topologies

Inclusive Learning for Visually Impaired Students in Computer Networking Education

Nicholas Caporusso[1], Quentin Roa[1,2], Brad Thomas[1], Mason Tilley[1]

[1]Northern Kentucky University

[2]Clovernook Center for the Blind

Are we prepared to teach students with unmet accessibility challenges? (1/2)

- Approximately 1.3 million legally blind individuals in the U.S.
  - significant disparity in higher education attainment

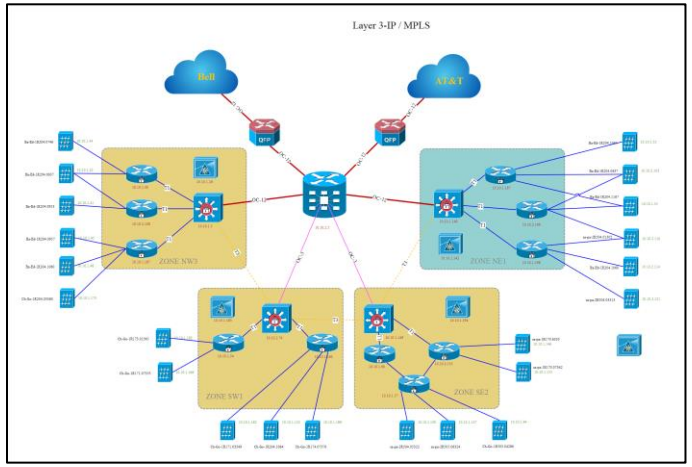
- Only 14.9% of blind adults have a bachelor's degree
  - compared to 34.2% of sighted individuals

- Braille literacy, accessible infrastructure
  - the high cost of educational materials

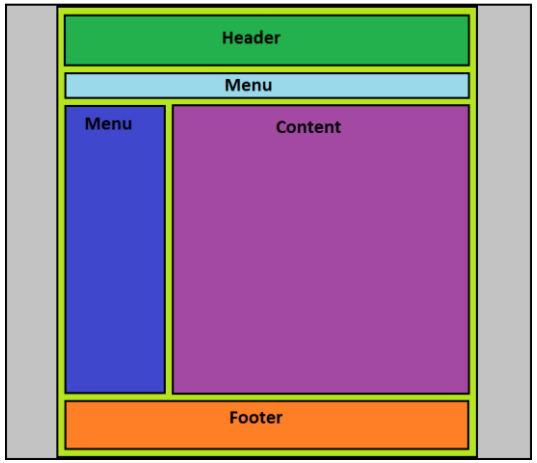
Are we prepared to teach students with unmet accessibility challenges? (2/2)

- Lack of accessible resources for students with disabilities

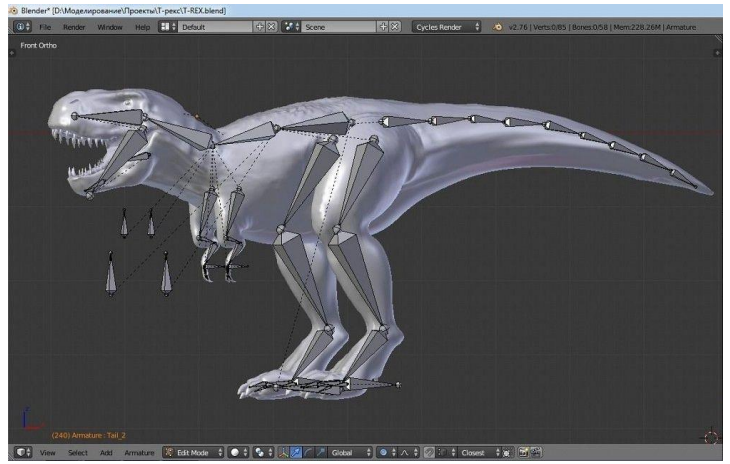
- Offices for Student Accessibility only refer to existing resources



Networking



Web development



3d modeling

Braille can only do so much: Mason’s case

- Legally blind student enrolled in a networking course
- Limited in representing complex visual elements such as a network diagram
- Absolute nightmare for the instructor
  - Did not know about Mason until the very first end

The disability excellence initiative

- Involve students with disabilities or directly experiencing accessibility or sustainability challenges in **co-designing and testing solutions** that address **unmet needs according to the "patient-innovator" model**.

- Objectives
  1. Identify accessibility challenges before students enroll in a course
  2. Work with faculty and students to address unmet needs
  3. Research, develop, and share open-source solutions with high SROI

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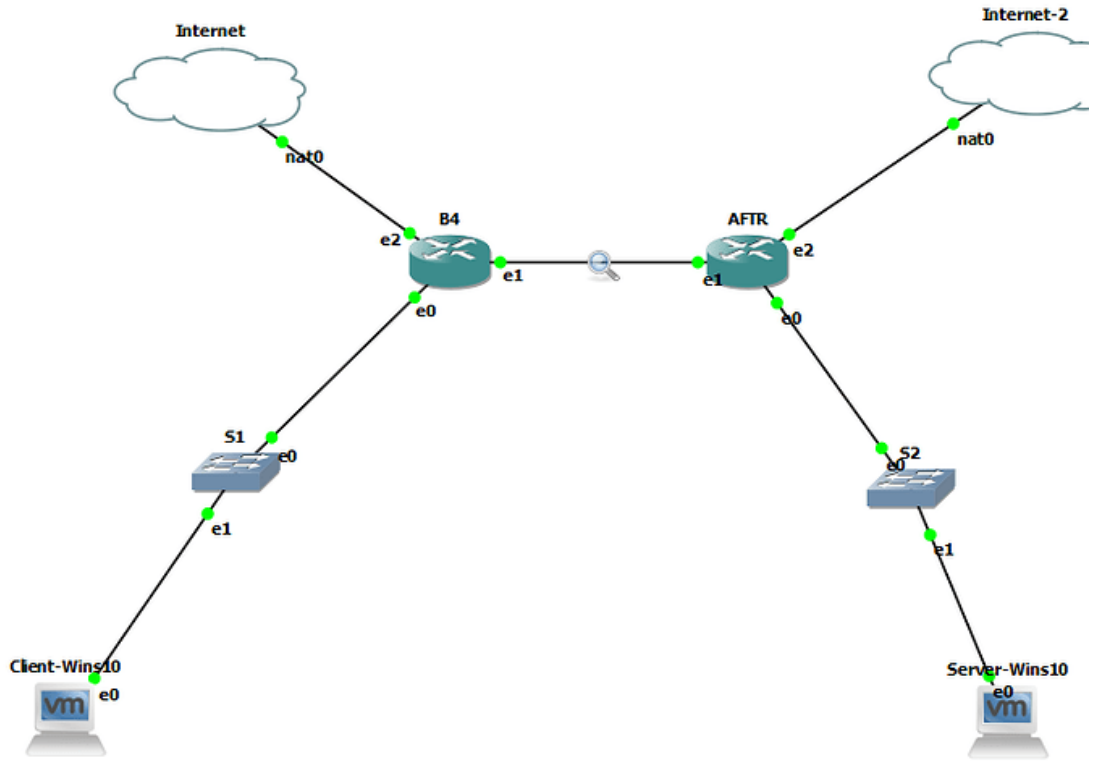
Tactile Network Topologies (TNT)

- An accessible toolkit for teaching networking
  - accessible to the blind and sighted
  - easy to adopt for teachers and schools

- Two components
  - Static tactile icons
  - A system for rendering them dynamic



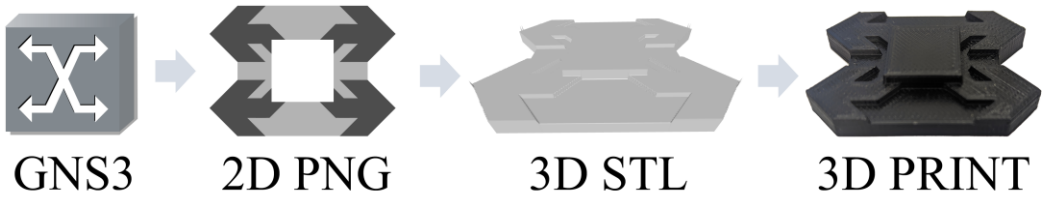
System architecture

Static 3d icons

- Easily recognizable 3d icons
- Manipulable
- Printable and affordable

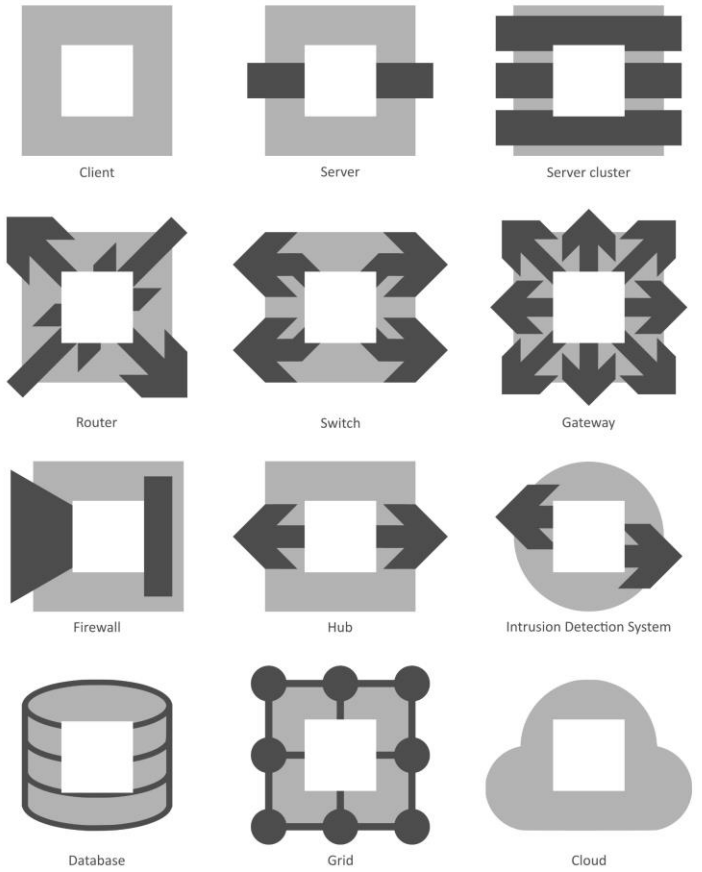
Interactivity layer

- Dynamic QR codes
- Configurable components
- Dynamic nature of networks

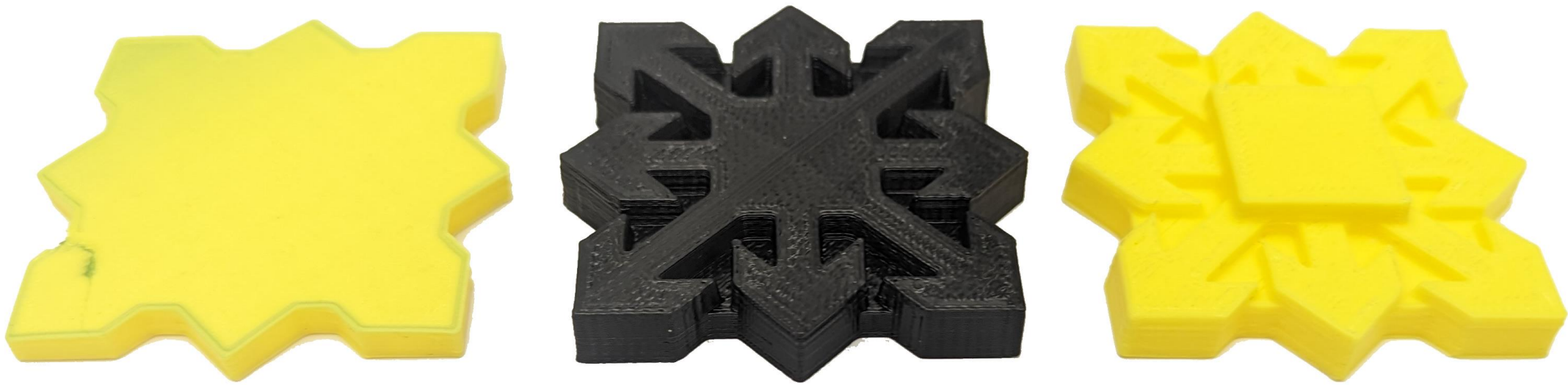


The icon set

- Selected the 12 most used icons GNS icons
- Converted them from an isometric view to a flat design
- Included space for QR code



The resulting icons



one layer two layers three layers

Results: one-layer toolkit

one layer

Toolkit 1 - one layer

	client	server	router	switch	cloud	firewall	cluster	gateway	hub	database	ids	grid
client												
server	3.3											
router	4.1	4.4										
switch	4.4	4.7	4.7									
cloud	4.3	3.8	4.7	4.1								
firewall	1.2	4.3	3.7	3.2	4.6							
cluster	2.9	4.7	4.8	4.5	4.4	1.9						
gateway	4.7	4.8	3.7	4.7	4.8	4.2	4.4					
hub	4.8	3.2	2.5	4.5	3.8	4.6	4.1	4.5				
database	1.1	4.3	4.6	4.3	2.9	4.4	3.7	4.9	4.1			
ids	4.4	4.7	4.3	4.4	2.2	4.5	4.4	4.1	4.3	4.8		
grid	4.9	4.5	4.7	4.7	4.8	4.9	4.5	4.7	4.7	4.6	4.3	

Results: two-layer toolkit

two layers

Toolkit 2 - two layers

	client	server	router	switch	cloud	firewall	cluster	gateway	hub	database	ids	grid
client												
server	3.4											
router	4.9	4.6										
switch	4.9	4.9	3.8									
cloud	3.8	4.1	4.5	4.8								
firewall	4.8	4.8	4.5	3.9	4.8							
cluster	4.8	4.5	4.5	4.9	4.9	4.5						
gateway	4.8	4.7	3.9	4.6	4.8	4.7	4.7					
hub	4.9	3.3	4.6	4.8	4.6	4.4	4.6	4.9				
database	4.9	4.7	4.5	4.5	4.8	4.6	4.8	4.7	4.7			
ids	4.5	4.6	4.5	4.5	3.6	4.7	4.7	4.7	4.8	4.7		
grid	4.8	4.8	3.8	4.3	4.7	4.8	4.9	4.3	4.7	4.8	4.7	

Results: three-layer toolkit

three layers

Toolkit 3 - three layers

	client	server	router	switch	cloud	firewall	cluster	gateway	hub	database	ids	grid
client												
server	3.7											
router	4.1	4.2										
switch	3.9	3.8	4.6									
cloud	4.7	4.5	4.4	3.9								
firewall	3.4	4.6	4.1	3.7	4.6							
cluster	3.2	4.4	4.7	4.8	4.2	3.5						
gateway	4.5	4.5	3.5	4.8	4.1	4.4	4.3					
hub	3.4	3.5	3.8	4.6	4.6	4.6	4.6	4.2				
database	2.1	4.8	4.2	2.1	3.9	4.4	4.8	4.5	4.1			
ids	4.6	4.4	4.3	4.6	3.2	4.2	4.3	4.1	4.3	4.7		
grid	4.6	4.5	4.5	3.8	4.6	4.9	4.5	4.6	4.7	4.3	4.1	

Conclusions and future work

- **Toolkit is available**
  - https://github.com/NicholasCaporusso/Tactile-Networking-Topology-Toolkit

- Current work
  - Developing the interactive part

- Next steps
  - Test and release the complete system with Clovernook