Appendix

A. Discussion Of Project Direction And Scope

What, Why, How:

A **toolkit** that leverages the **gig technology** to implement a **4k experience**, providing **empowerment** and **agency** for student and educators.

Questions:

1. Current streaming service and implementation options? (ultragrid)
2. What is the process?
3. Can we integrate the remote control, video conference, and video streaming into one tool?

What is the toolkit?

1. Is the toolkit just a process?
2. Is it just a video hosting and categorization?
3. How does it serve education?
4. How does it solve current experience issues?
5. How does it help collaboration?
6. How can it minimize bugs in whole process/solve bugs?

Items In Project:

1. The toolkit (what is it, how does it help, what does it address?)
2. The gig (central, core and directly/indirectly related to everything)
3. The microscope (an application of the gig, location, management, optimization)
4. Video storage (size, method of compiling)
5. Video streaming (latency, frames per second, packet loss)
6. Video recording (start/stop recording from stream? Locally recorded and sent from camera? EPB contact for diverting into database?)
7. Experience (holistic workflow for all users involved, more than just usability, facilitate education, independence, personalization)
8. Education (research, documentation, collaboration,
9. Students (one end user, the primary user)
10. Student research (needed documentation, independence, identity in projects)
11. Educators (tools for innovative methods, facilitation)

12. Community partners (funding, support, assets)
13. The asks for partners (clear, concise, focused, driven, objective)
14. The mentors (problem solving, conceptualizing)
15. Using the mentors (communication, focus)
16. Local microscope (managment? advantage?)
17. Research materials (sending, managment)
18. Project management for students (specimen/recording matching)

Problems in Project:

1. The user experience (students, teachers, others?)
2. Physical control
3. Remote control
4. Latency
5. Video storage, access, and categorization
6. Student workflow
7. Teacher workflow
8. Microscope technician workflow
9. Public access
10. Teacher needs/goals
11. Student needs/goals
12. Specimen origin and sending
13. **Scalable: solves ubiquitous problems**

Focus Points for Project:

1. Scalable Toolkit (modular, purpose driven, solves ubiquitous problems)
2. Educational (quantifiable and experiential)
3. The Gig (the driving technology)

Categories of Project

Big Categories:

1. Our Process of Development (includes: mentors, schedules, grants, development, pilot…)
2. The Toolkit: (deliverable, includes: all other elements above)

ToolKit Categories:

1. Location (microscope operator, remote controller)
2. Role (teacher, scientist, student, technician)
3. Software (Lifesize, HP Remote Graphics, Olympus Cell Sense, UltraGrid)
4. Education (STIs, learning goals)

5. Technology (the software end of the tool)

Possible Elements of Toolkit:

1. Training (teachers, students, school)
    a. History (past projects, success', stories)
    b. Workflow (setting up accounts, sending specimen, scheduling microscope, workday, recording stream, storing and tagging videos, documentation, searching database, downloading/editing/sharing videos)
    c. Demo (real-time runthrough of workflow)
    d. Follow up and maintenance?
    e. Questions
2. Setup process (hardware/software, instructions, walkthroughs?)
3. Hardware elements (user-end+technician hardware? Or just user software?)
    a. Hi-res screen for 4k streaming
    b. Workstation
    c. Physical remote microscope control tool
4. Modular software (based on educational goals? packaged by field of study?)
    a. Can we integrate the remote control, video conference, and video streaming into one tool (current usage is very complex)
    b. High-res video conference tool
    c. Microscope remote control tool
    d. Video capturing from stream with control tool
    e. Video storage and categorization tool (for collecting materials)
    f. Video sharing and community collaboration tool (community-based research)
    g. Project creation and submission tool (for teachers and students)
    h. User accounts (teachers, students, admins, researchers)
    i. User permissions and account restrictions/customization
    j. Teacher task/project creation and student project submission
    k. Open-source and community sharing of videos?
    l. Scheduling for microscope usage tool
    m. Reporting bugs or issues
    n. Community discussion forum

Minimal Usage Tools:

1. High-res Video Conference tool
2. 4k Video Stream Tool
3. Video Capturing Tool from stream (UltraGrid? With UI for stop and start. EPB? Quality issues? guaranteed quality directly from camera but requires more work for technician and matching issues. Includes extensive tagging)

4. Microscope Remote Control Tool (current: HP Remote Graphics)

Educational Tools:

1. Project Creation and Submission Tool (for teachers and students. Meeting STIs? Packaged by subject/focus)
2. Microscope Scheduling Tools
3. Project Scheduling tools (for remote collaboration)
4. Multi-person conference call for students remotely collaborating
5. Multi-source control tool on Microscope for remotely collaborating (would need admin for passing control)
6. Student communication form

Open Community Sharing Tools: (complex user types)

1. Multi-user types
2. Complex Community Forum Tool (moderators, students, teachers, researchers, admins)
3. Video Sharing Tool (searchable, restrictable, subject/topic based)

Note:

With minimal implementation we could allow for a streamlined process of simple accessing, controlling, and recording the 4k system with no community collaboration, minimal video storage usability, and 1 to 1 video conferencing. User account customization could be non-existence with a preset admin role and user role. Students would need to work alongside their teacher at all times and system wide scalability would be limited because of scheduling/coordinating/usability constraints with multi-user access to a single hub microscope.

If the system scales in the future and there were multiple microscopes with multiple schools,.extensive management would be needed but it would allow for efficient use of each scope. If many teams wanted to study the same specimen, or if they were interested in working with another team's specimen, a system could be created to publish projects, specimens, times across the network, or just around a local microscope-based hub. Microscopes can become resources that feed into the student's research and collaboration. As more scopes are added, more resources can be available because a big restriction is the physical microscope which can only look at one specimen at a time and can be controlled by one user at a time.

If we start by building a system based in Chattanooga with one microscope, one school, one class, and several teams, we could show how it allows for larger scale collaboration. However, it would not show how the system enables not only microscope to user interaction, but also user to user interaction across physical and education borders, such as between two different schools.I f we could pull in one more school, besides the STEM school, we would have opportunities to test and display the collaborative and scheduling capabilities of the system.

A big picture scale could implement a full kit that allows students to collaborate in a open/semi-open community, researching on the 4K system, and aligning to big picture goals provided by teachers. However user accounts and team forums give the students some independence on what they do and how they work. As more schools implement the system more collaboration and research can occur, and as more cities integrate their own microscope, more hubs for research can be built into into the system. Specimen videos can be filed into the database for sharing and future student research, moderated and restricted as needed to negate plagiarism. GPS locations and brief student reflections can accompany each video so that future community based research can build on past student work. This builds both the larger scale access to general resources for research as well as local and trending topics, such as the Tennessee river contamination and green works cleaning supplies.

The video storage and community system could look similar to JSTOR, a database for journals, books, scholarly articles and primary sources. It is a open-source mentality in sharing and because it is high-school students, conducting relatively low-stakes research, it could go thorugh.

This could be a platform and initial community for integrating other technologies that run on the gig. What does the gig really offer? **It offers the opportunity to do more in virtual spaces.** Other technologies can leverage this system if it is built with the focus on modular, topic based implementation. Do you want to offer high-power, virtual workstations? Virtually collaborate on cinematic video editing? Host hi-res video conferencing sessions? Remotely conduct surgeries? The platform could represent a methodology for systems like these to be built.

Platform Vs. Toolkit:

A toolkit provides a set of features assisting/enabling the specific application of 4k Microscope use/collaboration. A platform facilitates the general application of gigabit enabled technologies, the 4k microscope project being the first. Scalability could mean scalability of the toolkit, which means simply making it able to fit various situations specifically using the 4k microscope in an educational setting, or scalability of the platform, which means crafting the system to accommodate our 4k project needs in a way that additionally fits the current hole in the puzzle of gigabit networks and growing high-capacity, high-demanding technologies. In the first case of creating a toolkit, we are focusing on solving the 4k problem in a scientific, educational situation-- a specific application of the gigabit network that is limited in scope and solves limited problems. However, if we construct a toolkit for the 4k project that fits a platform mold of implementing gigabit technologies, we are both solving the 4k problem and opening a doorway into further innovation around the gig. A platform would work toward solving ubiquitous problems in gigabit networking, while building a focused, useful, and now fully robust and scalable toolkit for virtual control of 4k microscope for scientific research in educational systems.