Open Atomic Ethernet Specification

This repository contains the LaTeX source for the Open Atomic Ethernet (OAE) specification document.

Document Structure

The specification is organized into the following chapters:

1. **Principles of Operation** -- Overview of high-level ideas behind atomic ethernet. Not meant to explain theory or implementation. It is to give a conceptual backplane for the rest of the document.
2. **Bits and Bytes** -- Deep dive into the bits and bytes and frame formats of atomic ethernet. Explains the operation of each byte, and the state machines governing transitions.
3. **Cells and Links** -- Explores the fundamental elements of atomic ethernet: CELLs (reactive, self-contained participants) and LINKs (bidirectional tunnel-elements between CELLs). Covers failure modes, discovery protocols, and the importance of triangular relationships for atomicity.
4. **Transactions** -- Details the mathematical foundations of reversible transactions, including vector-based data modeling, invertible operations, and state updates. Specifies how transactions can be precisely undone for rollback, audit, and error recovery.
5. **Architecture** -- Describes the slice engine design and architectural framework with four Shannon-like levels of information processing. Covers ANT and BEE scouting protocols for local and global network exploration.
6. **Topology** -- Examines graph-aware determinism and network resilience metrics. Introduces concepts like algebraic connectivity and edge-disjoint paths to measure and ensure network robustness under failures.
7. **History** -- Traces the evolution of networking protocols from ALOHA to modern Ethernet, with special focus on ATM's flow control debates and InfiniBand's innovations in reliability and performance.
8. **Theory** -- Challenges conventional networking concepts and terminology. Introduces new frameworks for understanding information, causality, and quantum mechanics in the context of distributed systems.

I think we're missing a chapter currently

- **Addressing and Routing** -- Details the algorithm for building Trees and using trees to restrict addressability. Explains the shortcomings of source/destination addressing.

Building the Document

Prerequisites

- A LaTeX distribution (e.g., MacTex)
- The `tufte-book` document class
- Required LaTeX packages (specified in `oae-settings.tex`)

Building

To build the complete specification:

```
latex OAE-SPEC-MAIN.tex
bibtex OAE-SPEC-MAIN.tex
latex OAE-SPEC-MAIN.tex
latex OAE-SPEC-MAIN.tex
```

This will generate `OAE-SPEC-MAIN.pdf` containing the complete specification.

Structure

The main file is designed to be extremely simple, and require no changes when writing new content other than adding new chapters.

```
\documentclass[justified,nobib,oneside]{tufte-book}

\input{oae-settings}
\input{oae-commands}

\title{Open Atomic \\ Ethernet}
\author{}
\date{June 2025}
\publisher{Open Compute Project -- OAE Workstream}

\begin{document}
  \frontmatter\pagenumbering{roman}

  \maketitle

  \tableofcontents

  \mainmatter\setcounter{page}{1}\pagenumbering{arabic}

  \subfile{chapters/01_principles-of-operation}
  \subfile{chapters/02_bits-and-bytes}
  \subfile{chapters/03_cells-and-links}
  \subfile{chapters/04_transactions}
  \subfile{chapters/05_architecture}
  \subfile{chapters/06_topology}
  \subfile{chapters/07_history}
  \subfile{chapters/08_theory}

\end{document}
```

Chapters

Structure

Each chapter is stored in the `chapters/` directory as a separate `.tex` file. The main document (`OAE-SPEC-MAIN.tex`) includes these chapters using the `\subfile` command.

```
\documentclass[../OAE-SPEC-MAIN.tex]{subfiles}

\title{Principles of Operation}

\begin{document}

\chapter{Principles of Operation}\label{sec:principles-of-operation}

%...

\end{document}
```

Handouts

Each chapter is designed to compile into a PDF containing only the chapter content. No additional changes or modifications to the preamble are required.

```
latex 00_chapter.tex
bibtex 00_chapter.tex
latex 00_chapter.tex
latex 00_chapter.tex
```

Making Changes

When modifying a chapter, follow this workflow to ensure safe editing:

1. **Create a Working Copy**
    - Copy only the chapter you want to modify to a work-in-progress copy
    - Example: `chapters/[PLB]03_cells-and-links.tex`
2. **Make Your Changes**
    - Edit the working copy
    - verify your changes locally with the per-chapter output PDF
3. **Replace Original**
    - Create a backup of the original chapter
    - Replace the original with your verified working copy
    - Ensure the full document compiles

This workflow ensures you always have a backup and can verify changes before replacing the original file.

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