



Subject: Technical Note Overview

Date: 4/10/98

Written by: Chris Lewicki

Reviewed by: Dr. K.C. Hsieh

Revision history:

Revision 1.0: Initial Draft

4/10/98

1. Document Overview

This is the *Document Overview*. It should concisely describe what the scope of the given Technical Note is, and nothing more. Care should be taken not to include information in the *Document Overview* that would change from revision to revision (i.e.: design numbers, assumptions, part numbers, etc...). By reading the *Document Overview*, in combination with the document subject, the reader should have a good idea on what is contained in the rest of the Technical Document. This document will detail the structure, organization and conventions of Technical Documents used in the Student Satellite Project.

2. Requirements

The **Requirements** section details the requirements of the system described in the applicable Technical Note, as well as the requirements that the aforementioned system satisfies for other systems. It should clearly list each requirement separately and provide further details as needed. Here are several requirements that are being set forth for our system of Technical Notes:

2.1 A Technical Note must follow the format set forth in the Technical Note template

The Technical Note template, “technote.dot” is available from the SSP Web Site at <http://www.physics.arizona.edu/ssp/documents/technotes/templates>

2.2 Technical Notes must be composed with portability in mind

In an effort to provide for future compatibility across efforts, students are encouraged to compose Technical Notes in a program that provides for portability and compatibility. A recent version of *Microsoft Word* or alternatively *Word Perfect* are the preferred word processing applications, although others may be used if they are first brought to the attention of and approved by the SSP Administration.

File formats such as plain text, HTML, Tex, LaTeX or other desktop publishing/typesetting packages are discouraged, due to their specialized nature and level of user experience required.

2.3 Technical Notes must be kept as current as possible

In order for Technical Notes to be useful, they must be kept nearly as current as the work they describe. The SSP Administration will not be imposing any external revision schedule on Technical Note authors, however, when complaints arise regarding the currency of a Technical Note, the administration will move to expedite the issuing of an updated revision.

2.4 Technical Notes will be centrally archived and distributed

To minimize the amount of confusion surrounding the various revisions of a Technical Note, SSP will have one, central electronic distribution site where all Technical Notes will be archived. The URL for this archive is <http://www.physics.arizona.edu/ssp/documents/technotes>. The format of the files to be distributed will be the original format of the Technical Note (MS Word, Word Perfect as outlined earlier), as well as the Internet standard “Adobe Acrobat” (Version 3.0). Free software to read *Adobe Acrobat* files may be downloaded from <http://www.adobe.com/>

Teams are discouraged from publishing their own Technical Notes on their web sites, as a lapse in maintenance may produce conflicting versions of the document available online. In a related requirement:

2.5 A summary of Technical Notes will be maintained

The SSP Administration will maintain a summary of Technical Notes in existence and in development. This list will contain a complete set of information regarding the status of all Technical Notes. In order to aid in the determination of the currency of a particular document, the SSP Administration will also maintain a list solely of updates to Technical Notes. If a Technical Note does not appear in the “Revisions List”, it is assumed to be a Revision 1.0.

2.6 New Technical Notes will be established as needed

As new issues arise, New Technical Notes will be initiated to provide for a more specific focus on particular items. New Technical Notes may be initiated at any time by teams by making a request with the SSP Administration.

3. Descriptions/Designs/Discussion

The third section of a Technical Note shall encompass the primary design details for the particular subject area. The author may subdivide the section as necessary, and may also choose an appropriate title for the section.

3.1 Purpose of Technical Notes

The system of Technical Notes has been established for three main reasons:

- 1) To document detailed design work on systems pertaining to SSP
- 2) To provide for transmission of design knowledge during student turnover
- 3) To help focus teams' efforts when working on SSP

There are also many ancillary benefits to a formal documentation system. These include helping information new members to a team on the current status of work in the team, communicating ideas to outside partners, and also to serve as a detailed record of design work during SSP design reviews, among others.

3.2 Formatting

A critical statement about document formatting: try to do as little as possible by using multiple returns, tabs, extra spaces, etc... Instead, let the predefined document styles do the formatting for you. If you find you need to define a new style in order to present the information in the way you want, let the SSP Administration know about it, and they will try to incorporate it into future templates. Also, use the various "Heading" styles to start off new sections or sub-sections within your Technical Note. Notice that the heading styles will automatically number the sections for you, so you don't need to do that. Following are some examples on sub-sections:

3.2.1 Sub-heading (Heading 3)

This is a sub-heading. You'll probably be using a lot of these (especially in Section 3, where authors will have most of the design details of their system).

3.2.1.1 Sub-sub-heading (Heading 4)

In the event that you should need to even further sub-divide, use Heading 4 style.

3.2.1.1.1 Sub-sub-sub-heading (Heading 5)

And if you really need it, Heading 5 (and even more) is available.

3.3 Font

The default font to be used in Technical Notes shall be 12-point "Times New Roman."

3.4 Inclusion of Graphics Files and Figures

To ensure that a Technical Document can be a "complete, self-contained package," authors should be sure to include graphics in the document as opposed to "referencing an external file." Although this will surely increase the size of the file, it will make the maintenance of the document much easier due to the need for only one file.

One problem with graphics files and word processors is compatibility. The SSP Administration is still experimenting with file formats and will suggest a file format when a best option is found. For now, however, candidate formats are Encapsulated Postscript (EPS), Windows Bitmap (BMP), TIFF image files, and Windows Metafiles (WMF). The graphics files for Figure 3-1 and Figure 3-2 are EPS files (version 4).



Figure 3-1: UASat Logo (3/1/98)



Figure 3-2: UASat logo with text (3/1/98)

An important item to note regarding included figures and graphics is that they should not be included in the document unless they are referred to or further explained in the text. For example, Figure 3-1 and Figure 3-2 are included to contrast the two versions of our “UASat” logo that are available. Figure 3-1 is the UASat logo without text, and should be used whenever the logo will be relatively small when printed. If, however, the printed logo will be fairly large, the graphic represented in Figure 3-2 should be used.

When working in MS Word, you will soon find that positioning of graphics is somewhat “challenging.” For example, Figure 3-1 and Figure 3-2 are positioned side-by-side with captions. This can not be accomplished by simply positioning the graphics via the mouse, nor can it be achieved by using graphics frames (Captions don’t work properly within frames). For this document, the page was split into two columns for the text area encompassing the graphics and captions, and then the column-widths were adjusted to make them fit on the page.

3.5 Equations

Teams are encouraged to include equations in their Technical Notes where appropriate. Authors may use the somewhat problematic *Equation Editor* within MS Word, or import equations as graphics from other programs. When including equations, authors may use the “Equation” caption to auto-number equations in the document. Equation 3-1 is the equation for the gravitational field of a distributed mass (such as the Earth), and was composed using MS Word’s internal equation editor. Equation 3-2 shows the same equation (although not quite correct) done in *MathCad* and pasted into this document. Another option would be to save the equation as a graphics file and insert it as a graphic element (EPS or another vector format would be best for this application).

$$U_g = -\frac{Gm}{r} \left[1 + \sum_{n=2}^{\infty} J_n \frac{P_n(\cos \theta)}{r^n} + \sum_{n=2}^{\infty} \sum_{m=1}^n J_n^m \frac{P_n^m(\cos \theta)}{r^n} \cos m(\phi - \phi_m) \right]$$

Equation 3-1

$$U_g := \frac{-Gm}{r} \left[1 + \sum_{n=2} J_n \cdot \frac{P_n(\cos(\theta))}{r^n} + \sum_{n=2} \sum_{m=1}^n (J^m)_n \cdot \left[\frac{P_n(\cos(\theta))}{r^n} \right] \cdot \cos \left[m \left[- \binom{n}{m} \right] \right] \right]$$

Equation 3-2

3.6 Cross References

This document has already referred to graphics (or rather their captions) several times. One way to do this, and ensure that these references are always current, is to use MS Word's "Cross Reference" feature, found in the insert menu. This way, you can add new figures, delete old ones, and change the order of others, and the references will always regenerate to point to the items they original referred to, even when the numbering changes. Note, however, that you have to use the "Caption" feature (described in section 4.1) in order for this to work.

3.7 Publishing of Technical Notes

When a team wants to make a Technical Note "official", they *publish* it. Teams may do this in a number of ways. First, the Technical Note should be complete, and ready-to-go. This means that there should need to be no further editing, formatting, or review. The Technical Note author should identify an appropriate Faculty mentor, or other qualified individual to review the document and verify that it is ready for *publishing*. This reviewer need not verify or critically review the accuracy or the design aspects that the Technical Note encompasses, but instead just read through it and verify that there are no blatant errors, omissions, or other problems that can be addressed before making the version "final."

Once the document has been reviewed, it can be submitted to the SSP Administration in a number of ways. Authors can email it to ssp-admin@physics.arizona.edu, make it (temporarily) available for download from a team web-site, bring it in to PAS 569 on disk (ZIP disk or floppy), or make arrangements to transfer it via FTP. The SSP Administration will then make the new revision known, update the Technical Note summary information, and then publish an original electronic version as well as an *Adobe Acrobat* version of the document on the SSP website.

4. Lists

As with any complex system, there will inevitably be "lists" of items which detail related groups of items pertaining to the subject of discussion. As with any listing of items, the potential exists for the information to become out-of-date. In order to provide information as to the currency of a particular table please include the date that the information was updated with each table.

4.1 Contact Information for SSP Administrators (List example 1)

Each list should be in its own sub-section, with an appropriate section title. The title can be applied by selecting the figure and using the "Caption" item from the "Insert"

menu in MS Word. Please use appropriate captions: “Table” for tables and “Figure” for any other type of graphic. Note also how the caption auto-numbering includes the major heading section as a part of the caption.

Table 4-1: SSP Administrative Contact Info (4/1/98)

Person	Title	Phone Number	Email
Dr. K.C. (Johnny) Hsieh	Project Initiator/Mentor	(520) 621-6772	hsieh@physics.arizona.edu
Chris Lewicki	Project Manager	(520) 977-0758	chrisl@arizona.edu
Brian Ibbotson	Administrative Assistant	(520) 621-2574	ibbotson@physics.arizona.edu
Brandon Singer	Administrative Assistant	(520) 621-2574	bsinger@physics.arizona.edu

Table 4-1 is an embedded Excel Spreadsheet, however, it has been included with the document, and is not a link to a file. Care should be taken to ensure that all included graphics and tables are embedded within the document, and not a reference to an external file.

4.2 SSP Teams (List example 2)

Table 4-2: SSP Teams (4/1/98)

Team Name	Abbreviation
Science	SCI
Mechanical Structures	MSA
Guidance, Navigation and Control	GNC
Power Generation and Distribution	PGD
Data and Command Handling	DCH
Tracking, Telemetry and Command	TTC
Strategic Technology Initiatives	STI (Laser Team)

Table 4-2 shows an example of using Microsoft Word tables for presenting tabular data. This particular format is the “Grid 8” style, which is an SSP favorite.

5. Interface Requirements and Specifications

The *Interface Requirements and Specification* section is where the details of how the system that you are describing “is connected” to the rest of the spacecraft. This may include any number of interfaces, depending on the subject area that you are documenting. Interfaces may include:

- 1) Mechanical Interfaces
- 2) Electrical Interfaces
- 3) Command Interfaces
- 4) Environmental Interfaces

Mechanical interfaces may include anything from bolt-hole patterns, to mounting location within the spacecraft.

Electrical interfaces should detail the specific methods for connecting one system to another (or a part to a controlling system). It should include information about “pin-

outs”, signal specifications, as well as describe the connector itself.

Command interfaces should be described in full for those systems that will accept or receive commanding or control from another system.

Lastly, environmental interfaces should detail any necessary methods required to ensure that a component is within certain environmental limits required for operation. This can include thermal interfaces, and possible techniques that may be implemented in order to provide that interface (such as mounting on an outside). This may also include electromagnetic or similar environments that may be needed.

6. Current Status

The section on current status should address the “maturity” of the document in various areas. Here the opportunity should be taken to address areas of the document that may be preliminary, and highlight others which may be considered to be complete. This section should be reviewed each time a new draft is published in order to ensure that these specific areas are examined at each revision.

This Technical Document is presently a draft for review, and will certainly be revised after viewing the initial reaction to it. The SSP Administration is publishing this document to give teams an initial idea on how to get started on Technical Notes, and will use the following experience to refine the text of this document.

7. Test Plan

The test plan section is for detailing methods of verification that requirements set out in Section 2 will be met. There should be at least one test plan for each requirement that is listed, and sometimes more depending on the application. If no test plan has been developed yet, a placeholder should exist in its place until such time that one is established.

Test plans may be simple summaries at first, but should develop into detailed, procedural plans for experiments and tests that will verify the achievement of the stated requirements.

Here are the “test plans” for this document, and the implementation of the Technical Notes system:

7.1 Requirement 2.1: A Technical Note must follow the format set forth in the Technical Note template

All Technical Notes submitted to the SSP Administration for publication shall be reviewed to ensure that they reasonably conform with the style and organization set forth in the Technical Note template.

7.2 Requirement 2.2: Technical Notes must be composed with portability in mind

The SSP Administration will only accept Technical Notes for publication in the formats outlined previously in this document, unless an arrangement has been made with the author otherwise. The SSP Administration will refuse documents in non-portable formats until they have been recomposed with regards to this requirement.

7.3 Requirement 2.3: Technical Notes must be kept as current as possible

The SSP Administration will periodically review the progress and status of all Technical Notes. No strict revision schedule will be imposed, unless the information provided by the team has been requested by another team and it is needed in order to allow the work of that team to continue.

7.4 Requirement 2.4: Technical Notes will be centrally archived and distributed

The SSP Administration will periodically check team web pages in order to ensure that teams are not distributing their own Technical Notes.

7.5 Requirement 2.5: A summary of Technical Notes will be maintained

The summary of Technical Notes will be a primary interface to retrieving the Technical Notes themselves. When the Technical Notes are updated, this document will be updated at the same time.

7.6 Requirement 2.6: New Technical Notes will be established as needed

Teams will be polled periodically to determine whether new Technical Documents need to be established, or if existing Technical Documents need to be split in order to more centrally focus on the systems being documented.

8. Concerns and Open Issues

This section is for the discussion of issues/concerns/problems regarding the design being discussed. Here is some problem terminology to use when categorizing and describing concerns and open issues of the subject area of the Technical Note.

8.1 Issue

An *issue* is a requirement that needs to be addressed. Something you don't want to forget.

8.2 Concern

Something categorized as a *concern* is in suspicion of failure to meet requirements, no proof, no testing simulations, still issues concerning design.

8.3 Problem

A *problem* arises when there is proof that a design or subsystem fails to meet requirements, i.e. There is a need to redesign or redefine requirements. Cost and/or Schedule exposure may also be above the threshold of significance.

9. References

The *References* section should list **all** references consulted and subsequently used in the development of the design documented. References should include **everything**, not just books, technical papers and journals, but also telephone conversations with related experts, relevant emails to outside experts and face-to-face meetings.

- [1] University of New Hampshire “Tech Notes”, obtained March 27, 1998, during UNH Site Visit.
- [2] Meeting with Dr. David J. Forrest, Associate Research Professor of Physics / Director UNH CatSAT Project. (Discussed implementation of CatSAT Tech Notes) 3/27/98
- [3] Fundamentals of Space Systems; Pisacane, Vincent L. and Moore, Robert C. Oxford University Press, 1994.