

USC Viterbi School  
of Engineering

Systems  
Architecting &  
Engineering  
Program

**SAE 599: Resilient, Cyber Secure Systems &  
System-of-Systems**

**Fall 2014—Thursday—6:40-9:20 PM**

**Location: RTH 109 (DEN Webcasted Class).**

**Instructor: Mr. Kenneth L. Cureton**

**Office: GER 216c**

**Office Hours: 5:30-6:30 PM Thursday**

**Contact Info: cureton@usc.edu**

**Office Phone: (213) 740-0867**

**Teaching Assistant: None**

**Course Description**

Provide System Engineers and Architects with methods and tools for the design and analysis of current and future complex systems and System-of-Systems, with emphasis on Cloud Computing, Cyber Security, and Resiliency.

**Learning Objectives**

- To provide students with the ability to develop & understand requirements and apply the right analytical methods when architecting complex System-of-Systems.
- To improve the students' understanding of the role of system architects and their relationship to systems engineering of complex System-of-Systems.
- To introduce the students to new and advanced topics relevant to complex System-of-Systems architecting and modeling, with emphasis on Cloud Computing, Cyber Security, and Resiliency.
- To improve the students' ability to generate a professional-level research paper, suitable for presentation at a systems engineering conference or publication in a professional journal.

**Prerequisite(s):** None; however, SAE 549 *Systems Architecting* is recommended

**Co-Requisite (s):** None

**Concurrent Enrollment:** None

**Recommended Preparation:** at least 2 years of Systems Engineering experience

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### **Course Notes**

This is a webcasted class in Distance Learning format via the USC Distance Education Network (DEN). All course materials (webcasted lectures, lecture notes, references, and reading material) are available on-line via the DEN Blackboard system. Student submission of assignments (homework, research paper) and recording of grades is accomplished on-line via the DEN. Although in-class attendance is encouraged, student interaction with the Instructor is normally on-line via the DEN or telephone, or off-line via e-mail.

### **Technological Proficiency and Hardware/Software Required**

Must have access to (and be proficient in the use of) a web browser in order to access course materials, view lectures, submit assignments, and interact with the Instructor.

### **THIS IS AN EXPERIENTIAL COURSE!**

This class is not a “one-way” lecture: student participation is strongly encouraged. You can work as individuals or as teams (working as teams is encouraged). Just as in the real world, interaction can be (but does not have to be) face-to-face. Student interaction does not even have to be real-time—you can use e-mail and DEN discussion groups and thus interact asynchronously regardless of Time Zone differences and regardless of time-of-day.

You will be asked to Peer Review and discuss each other’s work, namely your Homework Assignments and Abstract, and Research Paper. Each student is given their own Peer Review DEN Discussion Area.

There will be checkpoints in each lecture to allow Student questions in real-time. You should also document your questions and observations on the General DEN Discussion Board so that others may respond either in real-time or at a later date. This way, there is a record of all Peer Reviews, discussions, questions-and-answers, etc.

Student participation IS a factor in class grading!

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### Required Readings and Supplementary Materials

All required materials are available on-line via the DEN—no textbooks are required for purchase. However, the following materials from SAE 549 (a suggested—but not required—prerequisite for this course) are strongly recommended for reference:

- Rechtin, E. (1991). *Systems architecting: Creating and building complex systems*. Englewood Cliffs, NJ: Prentice Hall. ISBN: 0-13-880345-5  
This text is out of print, but is available in the USC Bookstore as the “Course Reader” for SAE 549.
- Maier, M., & Rechtin, E. (2009). *The art of systems architecting* (3rd ed.). Boca Raton, FL: CRC Press ISBN: 978-1-4200-7913-5
- Kate L. Turabian (April 2013). *A Manual for Writers of Research Papers, Theses, and Dissertations, Eighth Edition* by The University of Chicago Press, Hardback ISBN: 9780226816371, Paperback ISBN: 9780226816395

### Description and Assessment of Assignments

One Research Paper required of each student In place of a Final Exam. Students choose their research topic, and submit an abstract for approval by Instructor. Bi-weekly homework is required of each student in place of a mid-term exam.

### Grading Breakdown

Assignment	Points	% of Grade
Research Paper	200	67%
Homework #1	18	6%
Homework #2	18	6%
Homework #3	18	6%
Homework #4	18	6%
Homework #5	18	6%
Participation	10	3%
<b>TOTAL</b>	<b>300</b>	<b>100%</b>

### Assignment Submission Policy

Assignments are to be submitted on-line to the DEN Blackboard system, according to the published course schedule (see below). All assignments (including late submissions) are due no later than the scheduled Final Exam date—no submissions will be accepted beyond that date.

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### **Additional Policies**

#### **RESEARCH PAPER**

**GOAL:** Your paper must be purposeful—it should have an academically acceptable goal, something more than just demonstrating that you can accomplish research and write a cogent Research Paper that summarizes that research, as those are necessary but not sufficient goals for academic purposes.

For this class, your purpose should include two additional goals that are above and beyond conducting research and writing Masters-level Research Papers:

- Your first goal is to demonstrate that you understand and can properly apply the concepts presented in the class through the accomplishment of structured analyses of a technical topic. The required analyses are detailed in a Research Paper Checklist.
- Your second goal is to inform the reader and “teach” your Instructor regarding technical details of your chosen topic (or “teach” your Instructor regarding recent, state-of-the-art advancements in your chosen topic).

Failure to achieve any of the above will impact your paper’s grade!

**TOPIC:** Describe a complex system or system-of-systems and analyze it in terms of the class concepts. Your analysis should be quantitative where possible and provide qualitative discussions based on the analytical methods presented in this course, as detailed in the Research Paper Checklist.

Subject to my approval, you get to choose the topic:

- It can be a proposed complex system, including a concept of your own design.
- It can be ongoing or it can be past history.
- It can be something that you have been personally involved in, or something that interests you.
- It can be one of the disaster response system scenarios listed in the *Sample Application of Cloud Computing* (Week #4 Lecture)

**APPROVAL:** You must submit a one-page abstract regarding your proposed topic for approval. Please submit on-line via DEN Assignments no later than October 2, 2014.

**FORMAT:** Microsoft WORD (.DOC) or Adobe Acrobat (.PDF) format for abstracts and research papers. A list of sources and contacts is essential, listing what sources you used and anyone you interviewed. Be sure to provide the URLs of any Internet sources used in your research.

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The class website provides a list of topics from students in prior years. It also provides guidelines on how to write a research paper, with suggestions for format, organization, structure, and content of good research papers.

**LENGTH:** Experience to date shows that the average is somewhere around 25 pages, single-spaced, in 10 or 12-point type. Papers are NOT graded by their weight! Take as long as it takes to tell the story clearly and to present a well-organized analysis in terms of the course. N.B. very few papers of size less than 20 pages have been worthy of a good grade in this class. The point is not size, rather amount of analysis, which should be at least 15 pages of detailed analytical content.

**SOURCES:** You must properly reference all sources. We will use the turnitin.com service to look for matches with existing books, magazine and newspaper articles, journals, prior student papers, and all Internet sources. If you directly quote text from a source, you must properly designate quoted material “in quotation marks” or in italics, and give a citation for each quotation via a footnote or a numbered reference or in-text (author-date) notation. The amount of quoted text relative to the total text in your paper should be kept to a minimum—if excessive; this will detract from your paper’s grade.

**WARNING:** Failure to properly designate copy-and-pasted text will be considered as a violation of academic integrity (see University Policy Statements at the end of this syllabus). This includes quotations from your prior papers (e.g. from SAE 549 or other classes)! You can build on your own work from other classes, and from other author’s works, as long as you properly cite those references. You must not directly copy text from those sources (unless properly marked and cited as a quotation). Instead, you must add value by citing then restating such work in your own words plus your own enhancements, such that the combination has enhanced relevance to this class. You can directly copy graphics, tables, or figures if you give a citation for each copied item. Although there is no limitation on the relative amount of copied items, your own artwork—however crude yet clearly legible and illustrative—is always acceptable.

**LIMITS:** I cannot accept a request to limit access to your abstract or research papers. Although I do not plan to disseminate your work without your permission, I cannot guarantee that other people (including non-US citizens) will not view or handle your submitted materials. Thus you must not use classified, proprietary or company limited-distribution materials in your coursework. If your employer requires review and approval for your submitted materials (e.g. Public Affairs Office or Export Compliance Review) then you must obtain such approval within the deadlines listed in this syllabus. As the approval practices in many companies may be time consuming, the best practice is not to use company material at all.

**DELIVERY:** Please submit on-line via DEN Assignments no later than the scheduled final exam date (December 11, 2014).

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GRADING: Your research paper will be graded on the letter scale: A, A-, B+, B, B-, etc.

N.B. very few papers are worthy of an "A" grade in this class unless they exceed most of the requirements given in the Research Paper Checklist (i.e. have more than the minimum required analyses and/or more than the required depth of analyses). The checklist descriptions represent the minimum requirements for a passing grade ("B") in the class.

I have to turn in the class grades shortly after the end of the Semester (after Final Exams Week), so I'll inform you via e-mail regarding your research paper grade (as well as your overall grade) no later than two weeks after the paper is due.

Note: if your employer requires a written statement (or a signed postcard) for reimbursement for this class, then please provide me with the appropriate paperwork and a self-addressed, stamped-envelope (or postcard) before the end of the semester.

### **ADDITIONAL INFORMATION:**

- Please feel free to e-mail me for help in structuring your research plan. I will gladly work with you to review your outline, draft paper, potential references, etc.
- If English grammar, spelling and syntax are not your strong points, I strongly suggest that you obtain help in editing your text. Your grade depends on the clarity of presentation.

### **HOMEWORK**

GOAL: Starting with the FOURTH week's lecture (Sample Application of Cloud Computing), every two weeks you are to briefly analyze the sample application case study in terms of the material presented in the prior two weeks. Your goal is to demonstrate that you understood the architectural characteristics presented in those prior two weeks. Each of the five assignments uses the Sample Application presented in the 4<sup>th</sup> week as the context for analysis.

LENGTH: Two or three pages should be sufficient for each homework assignment. Keep your descriptions brief: accomplish your analysis in bullet format for each required analysis. Specific instructions for each of the five homework assignments are presented on-line in the DEN Assignments.

FORMAT: Electronic format: .DOC or .PDF or .PPT (a template .DOC file is provided for each assignment.) You do not need to indicate sources or references for homework submissions.

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**DELIVERY:** Please submit on-line via DEN Assignments no later than the designated due date. After that, you lose two points for that homework assignment each week that it is late. All homework is due no later than the scheduled Final Exam date—all missing assignments will receive a score of zero.

**GRADING:** Each homework submission will be graded on a scale of zero-to-18, based on your analysis of the prior two week's material. Specific instructions for each of the five homework assignments are presented on-line in the DEN Assignments. I'll grade and comment on your homework as soon as possible after the appropriate due date.

Your initial submission receives a temporary grade on the due date. You may optionally rework and resubmit that assignment one week later for a final grade on that assignment (your temporary grade becomes final grade on that assignment if not reworked and resubmitted.) This gives you time to complete initial submission & submit on time, then gives other students time to Peer Review everyone's initial submissions, then gives you time to incorporate Peer Review comments in your reworked assignment, and then resubmit for a final grade on that assignment.

### **FINAL GRADE**

**GRADING:** Your class grade is computed as follows:

First, your research paper letter grade is converted into a numerical score according to USC Grading Standards: 4.0 for A, 3.7 for A-, 3.3 for B+, 3.0 for B, 2.7 for B-, 2.3 for C+, 2.0 for C, 1.7 for C-, 1.5 for D+, 1.0 for D, 0.7 for D-, 0.0 for F. This score is then multiplied by fifty to achieve a point range of 200-to-0.

The total of all homework scores is added to the above. Note that the score for any one of the five homework assignments may range from 0 to 18 points.

Your level of participation in the class is added to the above. You'll receive all 10 points if you have a significant level of interaction with me and other students (on at least a weekly basis), either in-class or on-line or via e-mail. Occasional participation (more than once or twice) will receive 5 points, and if you choose to not participate in the lectures (other than submitting required assignments), then you'll receive zero points for participation.

The grand total of points is divided by 75 (to scale from four-to-zero):

**CLASS SCORE = (PAPER + HOMEWORK + PARTICIPATION) / 75**

(i.e. 67% for your research paper, 30% for your homework assignments, 3% for class participation.)

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This class score is converted into a letter grade for the class:

A	4.0 to above 3.7
A-	3.7 to above 3.3
B+	3.3 to above 3.0
B	3.0 to above 2.7
B-	2.7 to above 2.3
C+	2.3 to above 2.0
C	2.0 to above 1.7
C-	1.7 to above 1.5
D+	1.5 to above 1.0
D	1.0 to above 0.7
D-	0.7 to above 0.5
F	0.5 or below.

This letter grade is reported to USC as your class letter grade.

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### Course Schedule: A Weekly Breakdown

	Topics/Daily Activities	Readings and Homework	Deliverable/ Due Dates
Week 1 Aug 28	Syllabus, Definitions & Characteristics	Reading material and lecture notes on-line	None
Week 2 Sep 4	Characteristics of Cloud Computing Architectures	Reading material and lecture notes on-line	None
Week 3 Sep 11	Benefits & Drawbacks of Cloud Computing	Reading material and lecture notes on-line	<i>Personal Introduction</i>
Week 4 Sep 18	Sample Application of Cloud Computing	Reading material and lecture notes on-line	None
Week 5 Sep 25	Resilient Architecture in Cloud Computing	Reading material and lecture notes on-line	<i>Initial Homework #1 due Week 4 Case Study analysis with Week 2 &amp; 3 topics</i>
Week 6 Oct 2	Cyber Security for Cloud Computing (Part I) Assuring Availability: Fault Tolerance	Reading material and lecture notes on-line	<i>Research Paper Abstract Reworked Homework #1</i>
Week 7 Oct 9	Cyber Security for Cloud Computing (Part II) Assuring Integrity & Trust	Reading material and lecture notes on-line	<i>Initial Homework #2 due Week 4 Case Study analysis with Week 5 &amp; 6 topics</i>
Week 8 Oct 16	Cyber Security for Cloud Computing (Part III) Handling Accidental & Deliberate Threats	Reading material and lecture notes on-line	<i>Reworked Homework #2</i>
Week 9 Oct 23	Risk Management in Cloud Computing	Reading material and lecture notes on-line	<i>Initial Homework #3 due Week 4 Case Study analysis with Week 7 &amp; 8 topics</i>
Week 10 Oct 30	Interoperability Challenges in Cloud Computing (System-of-Systems)	Reading material and lecture notes on-line	<i>Reworked Homework #3</i>
Week 11 Nov 6	Architecture Modeling for Cloud Computing	Reading material and lecture notes on-line	<i>Initial Homework #4 due Week 4 Case Study analysis with Week 9 &amp; 10 topics</i>
Week 12 Nov 13	Complexity Theory Applied to Cloud Computing	Reading material and lecture notes on-line	<i>Reworked Homework #4</i>
Week 13 Nov 20	Guest Lecturer	Reading material and lecture notes on-line	<i>Initial Homework #5 due Week 4 Case Study analysis with Week 11 &amp; 12 topics</i>
Week 14 Nov 27	Holiday	None	None
Week 15 Dec 4	Study Days	None	None
FINAL Dec 11	None—no lecture	None	<i>Research Paper Due Reworked Homework #5</i>

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### **Statement for Students with Disabilities**

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. Website and contact information for DSP: [http://sait.usc.edu/academicsupport/centerprograms/dsp/home\\_index.html](http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html), (213) 740-0776 (Phone), (213) 740-6948 (TDD only), (213) 740-8216 (FAX) [ability@usc.edu](mailto:ability@usc.edu).

### **Statement on Academic Integrity**

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. *SCampus*, the Student Guidebook, ([www.usc.edu/scampus](http://www.usc.edu/scampus) or <http://scampus.usc.edu>) contains the University Student Conduct Code (see University Governance, Section 11.00), while the recommended sanctions are located in Appendix A.

### **Emergency Preparedness/Course Continuity in a Crisis**

In case of a declared emergency if travel to campus is not feasible, USC executive leadership will announce an electronic way for instructors to teach students in their residence halls or homes using a combination of Blackboard, teleconferencing, and other technologies.