

Readiness Assessment for Video Cell Phones

SE 602

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Executive Summary

This report presents analysis regarding the level of readiness of video cell phone technology. Video phones are devices capable of sending audio and video simultaneously from one source to another over normal phone lines. We've seen video enabled cell phones that look stunningly better than past video phones. So the capability of video cell phones is there. This Technology Readiness Level (TRL) analysis is going to be useful for deciding the adoption of video phone technology. The initial readiness assessment shows that videophones are a relatively mature technology, which leads us to believe that they have just not been put in the form factor that is going to make them a smashing success.

Introduction

This report will present analysis regarding the level of readiness of video cell phone technology. Ketan Dadia and Mike DiGiovanni produced this report along with the analysis included in the report.

The rest of the report will go over the history of video phones in their other form factors, give a more in depth description of the purpose of this report, describe how the analysis was performed and ultimately it will present the results of the TRL application and a summary of the document

Background

This has been done as part of an exercise for a technology assessment course under the supervision of Professor Wang. A needs assessment for video cell phones was already completed as a previous exercise in this course.

Video phones are devices capable of sending audio and video simultaneously from one source to another over normal phone lines. Theoretically, this should bring forth a more emotional means of communication; however, past instances of video phones did not have that occur.

Cell phones can combat many of these issues and that is the reason for this needs assessment. Cell phones can be used practically anytime, anywhere; Transmission speeds can be much higher than landlines. We've seen video enabled cell phones that look stunningly better than past video phones. This shows us that the bad quality of previous video phones can easily be overcome. This can easily be seen in Europe, where video is commonly sent to and from cell phones. Users there have grown accustomed to the fees associated with the ease of sending and receiving video.

The next generation of video cell phones has the capability to be more emotional. You can bring friends and family with you to exotic destinations and talk to them as though they were there. This was something that was impossible with past video phones due to their size and need for a landline.

Technology Readiness levels have various uses. Their primary use is in helping management make decisions regarding a technology's lifecycle. This knowledge can be used to help manage funding for a technology as well and where the next phase of the technology should head.

Purpose

The analysis done for this document is to determine whether or not the current technology for video cell phones is ready for the world to adopt and enjoy and the point in its lifecycle that the technology

is currently at. This analysis could be used by anyone planning to manage a project built around video cell phones. It could help to estimate funding or decide what the next step for video cell phones should be.

Limitations

We've provided analysis based on the entire videophone technology. Since general videophones are so tightly entwined with video cell phones, this seems like the best way to provide analysis of the readiness of video cell phones.

The TRLs and TRL calculator also have their own inherent limitations. It's hard to say whether or not these calculations are scientific or just something thrown together. Does the TRL really provide meaningful data to analyze? Other sources have said that TRLs are not sufficient for defining the true readiness of a technology (5). TRLs are a relatively new thing and are still unproven. Conducting the analysis is also a time sink. A lot of paperwork and reporting is involved in providing meaningful analysis. Additionally, System engineering items not handled in early stages of TRLs (5). TRL tells us nothing about potential, only where we are now.

History

1964 was the start of the complete failure of video phones. AT&T unveiled Picturephone, a system to transmit both audio and video over a telephone lines. (2) The hardware and service were both expensive and the systems never faced widespread installation. In 1970, Picture Phone is offered to the public at \$160 a month. Shortly after that, Ericsson shows off the first trans-atlantic video phone call.

The 1980s brought forth a series of video conferencing systems. In 1982 Compression Labs began selling a \$250,000 system with \$1000 an hour lines (4) PictureTel followed with a cheaper system at \$80,000 and \$100 an hour lines. Towards the end of the 80's Motorola released a still picture phone. At \$1,500 it proved to be too expensive to be successful and it was abandoned in 1989.

In 1991 Picture Tel released a cheaper video conferencing system at \$20,000 and \$30 an hour. Later that year IBM and PictureTel collaborate to demonstrate videophone on PCs. This led to many videophone solutions being developed that use a pc. That continued throughout the 90s but never really caught on with the public. In 1992 AT&T released a videophone for the home market at \$1,500.

In the 2000s video capabilities on cell phones start to become widespread. Nearly every cell phone has at least picture capabilities. Many begin to be able to send video with sound, although not in real time.

This is for several reasons. One reason was the cost. Another reason for the failure of picture phones was privacy. People do not always want to be seen by the person they are talking to. With fixed location picture phones, you were stuck looking at a wall if someone decided they didn't want to be on camera.

Picture quality was yet another issue that contributed to the demise of past implementations. Many early implementations were black and white with low frame rates. This made for unemotional video.

There was a period in the 90's where relatively low cost video phones hit the market. Those failed as well. The failure of those was that they weren't designed for business use, and the average home user does not just want a static scene when people call somebody. This is why video cell phones can be successful. With every video cell phone call your caller will see you in a new location with new background. This brings some excitement to video phones.

Current status brings us to cellular video phones. As of today, video phones still have not hit the mainstream. People don't know who has video cell phones and many people have not used them. Video cell phones are the next step and possibly the phase with the most promise of success.

They are portable, hardware independent, easy to use, they can be cheap. Cell phones are widespread with video features already creeping into mainstream cell phones. Cell phones are hot products; throwing video phone capabilities into this would be a future strategy. Video cell phones could be the turning point for today's videophones.

Methodology

TRL analysis has been in use by NASA for many years. The first incarnation of TRLs involved seven levels and encompassed start until launch. The current version of TRLs involves nine levels and was expanded to track readiness post implementation, when a technology is finally out in the wild.

The below table is a table of the definitions of the various levels of TRLs.

Level	Definition
1	Basic principles observed and reported
2	Technology concept and/or application formulated
3	Analytical and experimental critical function and/or characteristic proof of concept
4	Component and/or breadboard validation in laboratory environment
5	Component and/or breadboard validation in relevant environment
6	System/subsystem model or prototype demonstration in a relevant environment (Ground or Space)
7	System prototype demonstration in an operational (space) environment
8	Actual system completed and (flight) qualified through test and demonstration (Ground and Space)
9	Actual system (flight) proven through successful mission operations

Table 1 (6)

Instrumentation

The TRL calculator is an excel file. It contains a series of macros and set of question that once answered provides an analysis of the readiness of a technology at that point in time. The questions are separate into hardware and software categories to provide that someone using it will not have to face questions that may not be applicable. Since this tool uses the same questions every time it is used, this can be applied to multiple projects to get an idea of their readiness with respect to each other.

The calculator provides a view into the past but cannot help in predicting what the future holds for a given technology. The results can be used to aid deciding where to head in the future though. Mature technologies are more likely to pay off on investments, whereas a new technology is much riskier. This could also be used as a sort of gauge toward how far you are in reaching the next TRL.

Results

Overall the video cell phone technology that we analyzed achieved green levels of readiness at level 8 for all of technology, manufacturing, and programmatic readiness. We set the green level at 100%. We achieved yellow levels of readiness up to level 8 for programmatic readiness, level 8 for technology readiness, and level 9 for manufacturing readiness. The yellow point was set at 67%. Results can be seen in the below figure.

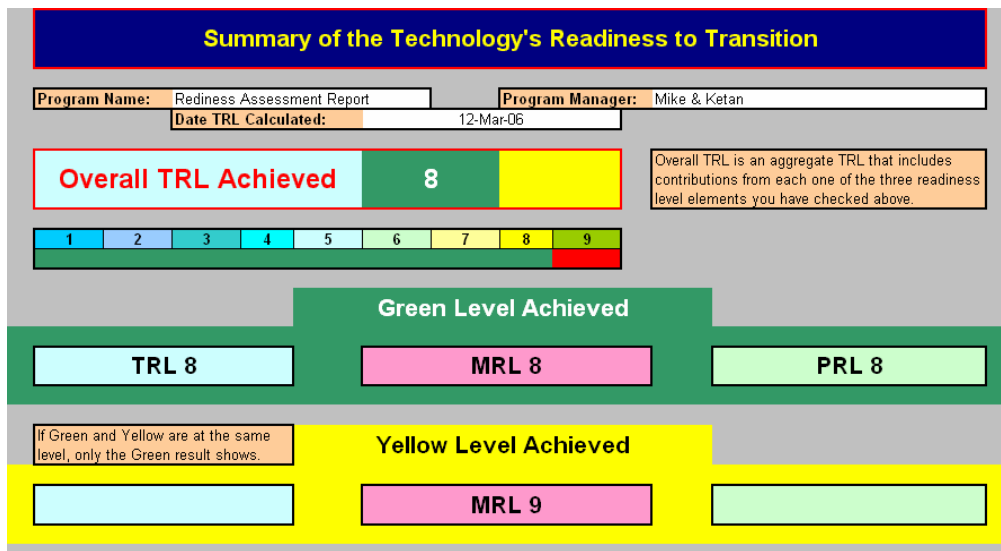


Fig. 1 TRL Summary

We achieved green levels here with one hundred percent coverage of the criteria. These are the basic levels of the technology before any implementation work is done. The first 8 levels were achieved due to the maturity of the technology. As was explained in the history, video phones have been around for quite a while.

For TRL 9 we achieved a red level. There were 14 criteria to be met. We met 10 of those. This is the final level and it shows us that we are not at a level where our technology is going around and being used. Detailed information about the TRL is defined in the appendix.

Concluding Remarks

The TRL Calculator simplifies the process of applying TRLS to research and development programs. This has helped us to gauge the readiness of video cell phones. It looks like the technology is definitely ready. Most of the phases have been completed. Based on our current results it looks like the next

phase of videophones will be a much more mature technology. Based on early phase history it looks like the next phase could be approaching marketability very soon. Positive outcomes are in the very near future.

References

1. W. Nolte, B Kennedy and R. Dziegiel, Technology Readiness Calculator, 6th Annual IDIA Systems Engineering Conference, October 20-23, 2003
2. http://muse.jhu.edu/demo/technology_and_culture/v044/44.1lipartito.html,
3. <http://dailywireless.org/modules.php?name=News&file=article&sid=4946>
4. <http://myhome.hanafos.com/~soonjp/vchx.html>
5. <https://www.safaq.hq.af.mil/organizations/ace/documents/tra.ppt>
6. <http://www.dtic.mil/ndia/2003systems/nolte.ppt>
7. http://en.wikipedia.org/wiki/Technology_Readiness_Levels

Appendix

Fig 2 shows the selection for demonstration environment, this provides a base set of readiness. The selection chosen has been selected because of the past history of video phones.

Hardware and Software Calculator									
Technology Readiness Level Achieved					Technical:				
1	2	3	4	5	6	7	8	9	
100%									

Only Hardware
 Only Software
 Hardware & Software

Program Name: Rediness Assessment Report Program Manager: Mike & Ketan
 Date TRL Computed: 12-Mar-06

TOP LEVEL VIEW -- Demonstration Environment (Start at top and pick the first correct answer)

Has an identical unit been successful on an operational mission (space or launch) in an identical configuration?
 Has an identical unit been demonstrated on an operational mission, but in a different configuration/system architecture?
 Has an identical unit been mission (flight) qualified but not operationally demonstrated (space or launch)?
 Has a prototype unit been demonstrated in the operational environment (space or launch)?
 Has a prototype been demonstrated in a relevant environment, on the target or surrogate platform?
 Has a breadboard unit been demonstrated in a relevant (typical, not necessarily stressing) environment?
 Has a breadboard unit been demonstrated in a laboratory (controlled) environment?
 Has analytical and experimental proof-of-concept been demonstrated?
 Has a concept or application been formulated?
 Have basic principles been observed and reported?
 None of the above

Source: James W. Bilbro, NASA, Marshall SFC, May 2001

Fig. 2 Top Level View

TRL's 1 through 8 were completely filled in as the technology is already here. We've provided screenshots of all criteria in the sections for reference.

TRL 1: Completed

Do you want to assume completion of TRL 1?
 H/SW Both Ques Catgry % Complete **TRL 1 (Check all that apply or use slider for % complete)**
 Completion of this level is assumed. No questions need to be answered at TRL 1.

Comments:

TRL 2: Completed

Do you want to assume completion of TRL 2?
 H/SW Both Ques Catgry % Complete **TRL 2 (Check all that apply or use slider for % complete)**
 Completion of this level is assumed. No questions need to be answered at TRL 2.

Comments:

TRL 3: Completed

Do you want to assume completion of TRL 3?
 H/SW Both Ques Catgry % Complete **TRL 3 (Check all that apply or use slider for % complete)**
 Completion of this level is assumed. No questions need to be answered at TRL 3.

TRL 8: Completed

H/SW Both	Ques Catgry	% Complete	TRL 8 (Check all that apply or use sliders)	Reset Level 8
B	T	100	Components are form, fit, and function compatible with operational system	
H	M	100	Cost estimator <125% cost goals (e.g., design to cost goals met for LRIP)	
B	T	100	System is form, fit, and function design for intended application and use on system platform	
B	T	100	Form, fit, and function demonstrated in eventual platform/weapon system	
H	M	100	Machining and tooling demonstrated in production environment	
B	T	100	Interface control process has been completed	
S	P	100	Manufacture user documentation completed and under configuration control	
B	P	100	Mart training documentation completed and under configuration control	
B	P	100	Mart maintenance documentation completed and under configuration control	
B	T	100	Final architecture diagrams have been submitted	
H	M	100	Manufacturing processes demonstrated by pilot line, LRIP, or similar item production	
H	M	100	Manufacturing processes demonstrate acceptable yield and producibility levels	
S	T	100	Software thoroughly debugged	
B	T	100	All functionality demonstrated in simulated operational environment	
H	M	100	Manufacturing process controlled to 4-sigma or appropriate quality level	
H	M	100	All materials are in production and readily available	
B	T	100	System qualified through test and evaluation on actual platform (DT&E completed)	
S	P	100	Maintainability, reliability, and supportability data collection has been completed	
S	P	100	W&A validation, rtop completed, software works in real world	
B	T	100	DT&E completed, system meets specifications	
S	P	100	W&A accreditation, rtop completed, software authorized for use in intended weapon system	
H	M	100	Ready for Full Rate Production	

TRL 9: is for a system that has been proven through successful use. 90% of documentation and training has been implemented. 85% of initial production and evolutionary milestones has been reached.

H/SW Both	Ques Catgry	% Complete	TRL 9 (Check all that apply or use sliders)	Reset Level 9
B	T	100	Operational Concept has been implemented successfully	
H	M	100	Cost estimates <110% cost goals or meet cost goals (e.g., design to cost goals met)	
H	M	85	Affordability issues built into initial production and evolutionary acquisition milestones	
H	M	100	Design stable, few or no design changes	
B	T	100	System has been installed and deployed in intended weapon system platform	
B	P	100	Safety/Adverse effects issues have been identified and mitigated.	
B	T	100	Actual system fully demonstrated	
B	P	90	Training Plan has been implemented.	
B	P	100	Supportability Plan has been implemented.	
B	P	100	Program Protection Plan has been implemented.	
B	T	85	Actual mission system "flight proven" through successful mission operations (OT&E completed)	
H	M	100	All manufacturing processes controlled to 6-sigma or appropriate quality level	
H	M	100	Stable production	
B	P	90	All documentation completed	