

Updated defense display market assessment *

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ABSTRACT

This paper addresses the number, function and size of principal military displays and establishes a basis to determine the opportunities for technology insertion in the immediate future and into the next millennium. Principal military displays are defined as those occupying appreciable crewstation real-estate and/or those without which the platform could not carry out its intended mission. DoD "office" applications are excluded from this study. The military displays market is specified by such parameters as active area and footprint size, and other characteristics such as luminance, gray scale, resolution, angle, color, video capability, and night vision imaging system compatibility. Funded, future acquisitions, planned and predicted crewstation modification kits, and form-fit upgrades are taken into account. This paper provides an overview of the DoD niche market, allowing both government and industry a necessary reference by which to meet DoD requirements for military displays in a timely and cost-effective manner. The aggregate DoD installed base for direct-view and large-area military displays is presently estimated to be in excess of 313,000. Miniature displays are those which must be magnified to be viewed, involve a significantly different manufacturing paradigm and are used in helmet mounted displays and thermal weapon sight applications. Some 114,000 miniature displays are presently included within future weapon system acquisition plans. For vendor production planning purposes it is noted that foreign military sales could substantially increase these quantities. The vanishing vendor syndrome (VVS) for older display technologies continues to be a growing, pervasive problem throughout DoD, which consequently must leverage the more modern, especially flat panel, display technologies being developed to replace older, especially cathode ray tube, technology for civil-commercial markets. Total DoD display needs (FPD, HMD) are some 427,000.

1. INTRODUCTION

It is currently predicted that the flat panel display (FPD) component market will grow from \$9.4 billion in 1995, to \$22.5 billion by 2001, with market share of flat panel technology to remain over 86% liquid crystal display (LCD) oriented throughout this period.^{1,2} Because it is no longer a case of if, but when, flat panel technologies will come to the fore of military applications, it is imperative to assist decision makers both in government and the private sector to understand the magnitude of need as well as the timeline of opportunity for flat panel insertion into DoD fleets and foreign military sales. This paper provides a select number, by type, of existing platforms in the DoD operational inventory (plus, where available, those in foreign operational inventories), the type and number of on-contract future platforms coming into the inventory (or allocated to foreign sales), the timeline for their delivery, retirement or upgrade, and the number and character of displays each system utilizes or requires. By knowing this information now, on a DoD and foreign defense fleet-wide basis, the opportunity will be created for application of both government incentives and industry investment to prepare the groundwork for a timely response to military flat panel demand. Also, such timely decision-making now can minimize the costly and disruptive effects of the vanishing vendor syndrome (VVS) for older display technologies in fielded systems.

"Demand" relative to the DoD displays market is defined herein to be the number of displays of a given active area which are currently in a weapon system and will remain in operation long enough to experience at least one technology insertion, else will

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be an installed production item as part of an anticipated future acquisition funded by Congress.

The characterization of the DoD display market depends upon the authorized force structure and system mix. However, we have observed that the aggregate DoD FPD demand is growing even though DoD is downsizing for two reasons: (1) the VVS for CRTs and electromechanical (EM) displays; (2) the 12:1 return on investment (ROI) for FPDs. A weapon system is of no value if, due to unavailable displays, it cannot be delivered by a material command (e.g., AFMC, USAMC, SPAWAR) to a train/equip command (e.g., ACC, AMC, AETC) or, in turn, dispatched by a train/equip command to a commander-in-chief (CINC for USSOCOM, USTRANSCOM, NORAD, CINCPAC, et al.), or, in turn, used by a CINC for missions. The VVS for displays is beginning to cause such a problem. At the same time nascent new technologies require some investment to meet DoD needs.

We recognize a responsibility to the warfighter, the maintenance establishment, and the taxpayer [in that order]. Warfighters operate DoD systems, put their lives at risk, and are, therefore, our first consideration. Bringing military flat panel displays into the DoD inventory on a timely basis will serve the warfighter by providing a more mission capable piece of equipment which reduces crew workload while substantially improving situational awareness and combat exchange ratios. The maintenance establishment is served by reducing workload and need for spares due to a mean time between failure (MTBF) rate at least two orders of magnitude better than the out-going technologies. The taxpayer is served, first by decreasing DoD lifecycle cost expenditures, and second, by ultimately reducing the projected number of platforms (fleet sizes) necessary to achieve the fleet availability, sortie rates, and operational tempo needed to satisfy national military objectives.

2. DEFENSE DISPLAY MARKET ASSESSMENT

The method for gathering information into this paper was both "broad-spectrum" and "narrow-band." The "broad-spectrum" approach consisted in surveying reputable periodicals. The "narrow-band" approach entailed fax, e-mail, telephonic, and face-to-face inquiries to representatives of U.S. Army, Navy, Marines, Air Force and contractor programs regarding individual platforms. Dates, names, duty titles, office symbols, and telephone, fax, and/or e-mail numbers of sources are given in the endnotes of a new technical report AFRL-HE-WP-1998-0017 (Mar 98) by Desjardins and Hopper entitled "Military Display Market: First Comprehensive Edition" (see Ref. 1a). See also the 1998 SPIE paper by Desjardins and Hopper (Ref. 2).

We reviewed, edited and recorded reliable pieces of information on every DoD cockpit, crew-station, control center, training system and portable device covered by major publication sources. Information sought pertained to number and kind of display hardware per combat platform, schedules of development and delivery, display module footprint, bezel measurement, and active-area size, Congressional or programmatic decisions affecting these platforms is noted. Where possible, ancillary characteristics are noted of existing or upgrade displays regarding technology base, resolution, color, gray scale, NVIS compatibility, angle-of-view, video, and luminance. Where necessary, system details were obtained through direct contact with acquisition and logistic program offices, and private industry contractors. Aside from this activity, two primary government publications were used as reference: the USAF *Avionics Planning Baseline*³ and the Navy *Avionics Installation Plan*.⁴ Edited textual information from all sources became the basis for the appendices. Data extracted from the appendices on platform fleet strengths, numbers of displays by function per platform, and display size became part of the report section entitled "Results." Yet other information was extracted from the combat platforms data base to provide information for the "Discussion," including platform operational retention dates, new-platform or upgrade delivery dates, and definition of acronyms. Then each platform fleet was analyzed for total number of displays by size, and the results were tabulated across all DoD systems. It is this latter capstone effort which led to the six tables presented in this paper. The "Discussion" and "Conclusions" sections, however, draw upon all information available for the some 427,000 total DoD display needs analyzed.¹

It is expected that every DoD military platform planned for retention beyond the year 2009 will experience at least one form-fit-function or other display upgrade during its remaining life-cycle. Complete cockpit or crewstation redesigns can be anticipated for every 30 years of lifecycle. Most DoD inventory systems are now at or past their 10-20 year milestones and are in need of upgrade or replacement during the next 10-15 years based on technology of the future (FPD) rather than the past (CRT, electromechanical). The likelihood that any given combat platform display upgrade program will make the decision to transfer from existing CRT and electromechanical (EM) display interfaces to those incorporating flat panel technologies becomes ever more certain as time and experience proves this latter approach superior in terms of performance, reliability and lifecycle maintenance cost. A pervasive shift is underway toward such new display technology insertion, with over 45% of the 313,000 DoD weapon system installed displays having elected to convert. A proper study of the Quadrennial Defense Review results

will determine which platforms, to what level and over what time frames, future technology insertions can be expected.

The epocal transition from CRTs to FPDs means that technological insertions will occur more rapidly over the next ten years than at any time since the introduction and perfection of the CRT from the 1940s through the early 1980s. Furthermore, the extremely rapid evolution now underway in FPD technologies requires pre-programmed product improvement (P3I) technology insertion points for many weapon systems to upgrade their FPD technology every few years during production and retrofit programs.

3. RESULTS

The information presented here derives from an extensive platform data base in which displays are listed by type, size, number per platform, number of platforms per operational inventory, total number of displays per fleet, and technology base.¹ For CRT or flat panel based displays, the size is that of the active area, either as a width by height, diagonal or diameter. For EM displays the active area or bezel measurement is given instead (examples include the avionics attitude direction indicator (ADI), horizontal situation indicator (HSI), or bearing-heading-direction indicator (BHD)). The first step in the analysis is the grouping displays from various programs according to active area or bezel measurement. These intermediate results are then assessed to see which sizes represent the most significant DoD demand and which proximate sizes might lend themselves to a form-fit or redesign effort so as to achieve commonality. The program requirements regarding ancillary requirements (luminance, gray level, viewing angle, resolution, etc.) is also generally taken into account.

Existing DoD display sizes having quantities of 5,000 units or greater are tabulated in detail in Table I.

Existing DoD display sizes being used in 10 or more weapon systems programs are listed in Table II.

Tables III and IV show how existing display areas cluster about selected sizes, 10 in. and 19.5 in., respectively. Mechanical design changes might make some reduction in unique items possible for displays in a cluster.

DoD display sizes unique to a single platform (but multiple copies per platform) are listed in Table V.

Singularities are listed in Table VI. These displays exist in a quantity of one (1) in DoD.

Tables I and II are updates to the same tables of our 1998 SPIE paper (Ref. 1b).

Tables III-VI present new perspectives into the DoD military display market.

Table I. Display sizes having aggregate defense applications of five thousand units or greater.

Display Size, mm (in.)		Diameter	Platform	No.	Total	Current Technology	Comment
H x V	Diagonal						
30.16 x 17.46 (1.1875 x 0.6875)			M1A1	4327		LED	
			M1A2	392		LED	
			M1A2SEP	792	5511	LED	
37.59 x 17.53 (1.48 x 0.69)			M1	382		CRT mono	
			M1IP	485		CRT mono	
			M1A1	4327		CRT mono	
			M1A2	392	5586	CRT mono	
57.15 x 57.15 (2.25 x 2.25)			C-9A	20		EM	
			C-9B	29		EM	
			C-9C	3		EM	
			C-130H	560		AMLCD	
			KC-135E	300		AMLCD color	
			KC-135R	680		AMLCD color	
			KC-135T	108		AMLCD color	
			T-6A	8532	10232	AMLCD color	
71.25 x 30.48 (2.80 x 1.20)			ISHMRS	5041	5041	AMLCD mono.	
90.00 x 170.00 (3.54 x 6.69)			RAH-66	5200	5200	CRT color	
100.58 x 100.58 (3.96 x 3.96)			F-16A/B MLU	1796		AMLCD color	
			F-16C/D follow	1310		AMLCD color	
			T-6A	2844	5950	AMLCD 80:1, color	
127.00 x 127.00 (5.0 x 5.0)			AV-8B	164		CRT	
			F-14A/B		198	CRT	CRT
			F-15A/Bmsip	100		CRT	
			F-15C/D		408	CRT	CRT
			F-15E	890		CRT	
			F/A-18A/B	1473		CRT	
			F/A-18A/Bfms	1119		CRT	
			F/A-18C/D	2202		CRT	
			F/A-18C/Dfms1	518		CRT	
			F/A-18E/F	1334		CRT	
			F-117A	108		CRT	
			M1A2	392		CRT	
			E-2C	156		EM	
			E-3B	92		EM	
			E-3C	36		EM	
			E-4B	8		EM	
			E-8C	39		EM	
			C-130T	40		EM	
			KC-130F	76		EM	
			KC-130R	28		EM	
			KC-130T	40		EM	

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KC-130R	8	EM
CG 58	36	CRT

Table I (continued). Display sizes having aggregate defense applications of five thousand units or greater.

Display Size, mm (in.)		Diameter	Platform	No.	Total	Current Technology
H x V	Diagonal					
			CG 69	12		CRT
			C-9A	20		EM
			C-9B	29		EM
			C-9C	3		EM
			C-12C	21		EM
			C-12D	6		EM
			C-20A	12		EM
			C-20J	4	10584	EM
147.32 x 228.60	(5.8 x 9.0)		DACT	7000	7000	AMLCD color
	152.40	(6.0)	SHTU	6168	6168	LCD mono
158.75 x 158.75	(6.25 x 6.25)		F/A-18E/F	667		CRT
			F-22A	1056		AMLCD
			CV-22	200		AMLCD
			HV-22	192		AMLCD
			MV-22	1640		AMLCD
				60		CRT
			AH-64D	928		LCD
			C-17A	480		CRT
			C-18E	2		CRT
			T-43A	1	5226	CRT
200.00 x 150.00	(7.87 x 5.91)		RAH-66	5200	5200	CRT
	203.20	(8.0)	JSF	8934		AMLCD color
			JAST 75/25	30		AMLCD color
			HH-60G	172		CRT mono
			MH-60G	28		CRT mono
			SSN-688MkI	76		CRT color?
			SSN-688MkII	18		CRT color?
			SSN-688BSY	42		CRT color?
			NSSN	6		CRT color?
			SSN-21	6		CRT color?
			CH-53E	282		CRT mono
			CV 67	3	9597	CRT color
	238.76	(9.4)	M7 FIST	312		CRT
			V1 LCU	616		dLCD mono
			V1A1 LCU	888		AMLCD color
			V2 LCU	4965		dLCD mono
			V2A1 LCU	4461		AMLCD color
			Litton-3486	300	11542	AMLCD mono
	307.34	(12.1)	Crusader 3200			AMLCD color
			M88A2	90		AMLCD color

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Grizzly	1688	AMLCD color
M109	58	AMLCD

Table I (continued). Display sizes having aggregate defense applications of five thousand units or greater.

Display Size, mm (in.)		Diameter	Platform	No.	Total	Current Technology
H x V	Diagonal					
			M109 FMS	51		AMLCD
			ACE SS-5	120		AMLCD color
			ACE SS-Ultra	4		AMLCD color
			SH-60R	1250		AMLCD
			CH-60	600	7061	AMLCD
	330.20	(13.0)	SSN-21	9		CRT mono?
			SSN-21	39		Plasma mono
			SSN-21	3		AMLCD color?
			EP-3E	12		AMLCD color
			CVN 65	915		CRT color/mono
			CVN 74	2177		CRT color/mono
			CG 58	1080		CRT color/mono
			CG 58	48		AMLCD color
			DD 979	716		CRT color
			FFG 45	408		CRT color
			CV 67	42		CRT
			DDG 64	36		CRT
			CG 69	204		CRT
			LHD 3	126		CRT
			LHA 4	40		CRT
			LPD 15	33		CRT
			LSD 44	8		CRT
			ARS 51	8	5904	CRT
	355.60	(14.0)	AC-130H	32		CRTcolor, mono
			SSN-688	304		CRTmono?
			SSBN MkII	80		CRTmono
			HC-130N	20		CRTcolor?
			HC-130(H)N	20		CRTcolor?
			HC-130P	42		CRTcolor?
			MC-130P	56		CRTcolor?
			SSBN-726	80		CRTmono
			ES-3A	48		CRTcolor
			P-3C	2		CRT
			CVN 65	11		CRT
			CVN 74	3794		CRTcolor
			CG 58	720		CRTcolor
			CG 58	24		AMLCDcolor
			DD 979	432		CRTcolor
			FFG 45	612		CRTcolor, mono
			MC-130E	28		CRTmono?
			CV 67	183		CRT
			CG 69	672		CRT
			LPD 15	110		CRT
			ARS 51	4	7226	CRT
						SVGA color

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Table I (concluded). Display sizes having aggregate defense applications of five thousand units or greater.

Display Size, mm (in.)		Diameter	Platform	No.	Total	Current Technology
H x V	Diagonal					
482.60 (19.0)			C2V	318		CRT color?
			SSN-688MkI	76		CRT color?
			SSN-688MkII	54		CRT color?
			SSN-688BSY	42		CRT color?
			SSBN-726MkII		50	CRT mono?
			NSSN	115		CRT color
			SSN-21	84		CRT
			DDG-51	481		CRT color?
			EC-130E	96		CRT color
			P-3C UIIVPU	7		CRT color?
			P-3C UIVPU	7		CRT color?
			P-3C UIIIAIP	30		CRT color?
			P-3C UIIRAIP		30	CRT color?
			CVN 65	455		CRT color
			CVN 74	1744		CRT color
			CG 58	504		CRT color
			DD 979	120		CRT color
			FFG 45	204		CRT color
			C-26A, fms	13		CRT color
			TCU	2541		CRT color
			TCU, fms	142		CRT color
			CV 67	76		CRT
			CG 69	284		CRT
			LHA 4	15		CRT
			LPD 15	11		CRT
			LSD 44	16		CRT
			LSD 51	8		CRT
			ARS 51	4	7527	CRT

Table II. Sampling of display sizes having current DoD applications across 10 or more programs (< 5000 units each).

Display Size, mm (in.)	Platform (Number, Current Technology)
66.68 x 53.98 (2.625 x 2.13):	CVN 65 (1, LED), CVN 74 (7, LED), CG 58 (24, CRT), DDG 64 (36, LED), CG 69 (12, CRT), LHD 3 (7, CRT), LHA 4 (5, CRT), LSD 44 (16, CRT), LSD 51 (8, CRT), ARS 51 (4, CRT); Total = 120
69.85 diameter (2.75):	F/A-18A/B (409, CRT), F/A-18A/B fms (305, CRT), F/A-18C/D (612, CRT), F/A-18C/D fms (406, CRT),

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F/A-18E/F (548, CRT), CH-46E (243, CRT),
HH-60G (86, CRT), MH-60G (14, CRT), ARS 51 (4, CRT),
TH-57C (73, EM); **Total = 2700**

Table II (continued). Sampling of display sizes having current DoD applications across 10 or more programs (< 5000 units each).

101.60 x 69.85 (4.0 x 2.75):	KC-135E (450, CRT), C-135B (8, CRT), C-135C (4, CRT), C-135E (6, CRT), KC-135R (1020, CRT), KC-135T (162, CRT), NKC-135E (6, CRT), OC-135B (6, CRT), WC-135B, (8, CRT), WC-135W (6, CRT); Total = 1676
101.60 x 76.20 (4.0 x 3.0):	F-14A/B (198, EM), E-9A (2, CRT), DD 979 (24, CRT), FFG 45 (51, CRT), C-12F (2, CRT), C-12J (7, CRT), C-20B (25, CRT), C-20D (10, CRT), C-20E (8, CRT), C-26A,fms (13, LED), C-26B (21, LED), C-26D (7, LED), RC-12F (2, CRT), UC-12F (10, CRT), CV 67 (1, CRT), DDG 64 (36, CRT), CG 69 (12, CRT), LHA 4 (5, EL), LPD 15 (11, CRT), LSD 44 (8, CRT), LSD 51 (4, CRT), PC 11 (13, Plasma); Total = 471
101.60 x 101.60 (4.0 x 4.0):	F-15C/D (463, CRT), F-16C/D (2996, CRT), DC-130A (6, EM), C-12F (8, EM), C-12J (28, EM), C-22B (6, EM), UV-18 (2, CRT), CH-46E (486, AMLCD), A-10A (235, CRT), LSD 44 (32, Plasma), LSD 51(4, Plasma); Total = 4266
107.19 x 107.19 (4.22 x 4.22):	C-12 F1 (48, AMLCD), C-12 F2 (32, AMLCD), C-12 F3 (252, AMLCD), C-135B (4, AMLCD), C-135C (8, AMLCD), C-135E (12, AMLCD), OC-135B (10, AMLCD), WC-135B (4, AMLCD), WC-135W (10, AMLCD), KC-135E (750, AMLCD), KC-135R (1700, AMLCD), KC-135T (220, AMLCD), NKC-135E (10, AMLCD), MH-47D (44, AMLCD), MH-60L (144, AMLCD); Total = 3248
107.95 x 82.55 (4.25 x 3.25):	CVN 65 (1, CRT), CVN 74 (7, CRT), CG 58 (168, CRT), DD 979 (144, CRT), FFG 45 (306, CRT), CV 67 (2, CRT), DDG 64 (216, CRT), CG 69 (96, CRT), LPD 15 (66, CRT), AS 39 (12, CRT), E-6B (30, CRT); Total = 1048
114.30 x 88.90 (4.5 x 3.5):	F/A-18C/D (612, dLCD), F/A-18C/Dfms (406, dLCD), F/A-18E/F (667, CRT), E-9A (2, CRT), CV-22 (50, AMLCD), HV-22 (48, AMLCD), MV-22 (425, AMLCD), KC-130T (32, CRT), C-130H (199, LCD), CV 67 (1, dLCD); Total = 2442
120.65 diameter (4.75):	C-130H (334, CRT), EC-135C (16, CRT), EC-135E (8, CRT), EC-135K (2, CRT), EC-135N (2, CRT), NKC-135E (2, CRT), OC-135B (6, CRT), RC-135S (6,CRT), RC-135U (6,CRT), RC-135V (24, CRT), RC-135W (18, CRT), RC-135X(3,CRT),TC-135S (2,CRT),TC-135W (2,CRT); Total=431
127.00 x 107.95 (5.0 x 4.25):	AH-64A (1516, EM), E-8C (26, EM),, C-130T (40, EM), C-137B (4, EM), C-137C (8, EM), KC-130F (76, EM), KC-130R (28, EM), KC-130T (40, EM), LC-130R (8, EM), T-43A (12, EM); Total = 1758

Table II (concluded). Display sizes having current DoD applications across 10 or more programs (< 5000 units each).

127.00 x 133.35 (5.0 x 5.25):	CT-43A (2, EM), AT-38B (146, EM), EC-130E (30, EM), EC-130H (30, EM), WC-130H (20, EM), HC-130H (2, EM), A-10A (235, EM), OA-10A (140, EM), HH-1N (50, EM), HH-60G (172, EM), MH-60G (28, EM), C-137B (4, EM), C-137C (8, EM), CH-47D (262, EM), UH-60A (1788, EM), UH-60L (948, EM), UH-60Q (8, EM), EH-60A (120, EM), EH-60L (12, EM), MH-60A (24, EM), UH-3H (108, EM), VH-3A (8, EM); Total = 4145
228.60 diagonal (9.0):	AC-130H (27, CRT), F-14A/B (198, CRT), F-14D (51, CRT), C2V (106, TFEL), MH-53J (82, AMLCD), SH-60F (154, CRT), HH-60G (17, CRT), HH-60H (40, CRT), HH-60J (42, CRT), UH-1N (100, CRT), LCAC (180, CRT), HC-130N (10, CRT), HC-130(H)N (10, CRT), HC-130P (21, CRT), MC-130P (28, CRT), CVN 65 (11, CRT), CVN 74 (77, CRT), CV 67 (1, CRT), LPD 15 (22, CRT), DD 979 (48, CRT), FFG 45 (102, CRT), MC-130E (28, CRT), SSN-688MkI (38, CRT), SSN-21 (3, CRT), SSN-688MkII (9, CRT), SSN-688BSY (21, CRT), NSSN (3, CRT), EP-3E (36, CRT), P-3C (638, CRT); Total = 2089
264.16 diagonal (10.4):	V2A2 LCU (1684, AMLCD), P-3C (287, AMLCD), PPWS (2, AMLCD), Talon FRPRW (17, AMLCD), Galaxy 1100 (134, AMLCD), PEN 10 (1200, AMLCD), PEN 10 FMS (24, AMLCD), 486LT FMS (400, AMLCD), PC Mobile (5, AMLCD), CDA (5, AMLCD); Total = 3758
336.55 diagonal (13.25):	DD 979 (408, CRT), FFG 45 (459, CRT), CV 67 (7, CRT), DDG 64 (216, CRT), LHD 3 (238, CRT), LHA 4 (25, CRT), LPD 15 (572, CRT), LSD 44 (8, CRT), ARS 51 (16, CRT), AS 39 (202, CRT); Total = 2151
342.90 diagonal (13.5):	EC-130E (15, CRT), LCAC (90, CRT), CG 58 (48, CRT), DD 979 (240, CRT), FFG 45 (357, CRT), CV 67 (16, CRT), DDG 64 (792, CRT), CG 69 (24, CRT), LHD 3 (49, CRT), LHA 4 (15, CRT), LPD 15 (22, CRT), LSD 44(24, CRT), LSD 51 (12, CRT), ARS 51 (8, CRT); Total = 1712
349.25 diagonal (13.75)	CG 58 (72, CRT), CG 69 (24, CRT), DD 979 (24, CRT), FFG 45 (153, CRT), CV 67 (36, CRT), DDG 64 (648, CRT), LHD 3 (854, CRT), LHA 4 (15, CRT), LPD 15 (22, CRT), LSD 44 (8, CRT), ARS 51 (4, CRT), AS 39 (100, CRT); Total = 1960
406.40 diagonal (16.0)	CVN 65 (4, CRT), CG 58 (288, CRT), FFG 45 (204, CRT), CV 67 (73, CRT), LHD 3 (7, CRT), LHA 4 (10, CRT), LSD 44 (24, CRT), LSD 51 (4, CRT), ARS 51 (16, CRT), PC 11 (52, CRT); Total = 682
431.80 diagonal (17.0):	SSN-688MkI (152, CRT), SSBN-726MkI (16, CRT), SSBN-726MkII (60, CRT), NSSN (24, CRT), SSN-21 (3, CRT), EP-3E (36, CRT), CVN 65 (343, CRT), CVN 74 (203, CRT), CG 58 (233, CRT), CG 69 (12, CRT), DDG-51 (720, CRT), DDG-51 (96, Plasma); Total = 1898

Table III. Example of display size clustering about a key center point (10 in. diagonal). Range: 9.5-10.5 in. (or 7.5 – 8.5 in. by 5.5 – 6.5 in., and *vice versa*).

System	No.	Total	Technology
241.30 diagonal (9.1)			
SH-60B	266		CRT
GETAC N	135		LCD
GETAC N, fms	15		LCD
GETAC NX, fms	50		LCD
GETAC I	70		LCD
GETAC IX	37		LCD
CDA	592		AMLCD
LHD 3	7		dLCD
LHA 4	10	1182	AMLCD
243.84 diagonal (9.6)			
M58	170	170	LCD
247.65 diagonal (9.75)			
LPD 15	22	22	CRT
254.00 diagonal (10.0)			
YAL-1A 14			AMLCD?
CG 58	12		CRT
CG 69	12		CRT
LHA 4	10	48	CRT
259.08 diagonal (10.2)			
P-3C	55	55	Plasma
260.35 diagonal (10.25)			
CG 69	72	72	AMLCD
263.53 diagonal (10.38)			
FFG 45	51	51	CRT
264.16 diagonal (10.4)			
V2A2 LCU	1684		AMLCD
P-3C	287		AMLCD
PPWS	2		AMLCD
Talon FRPRW	17		AMLCD
Galaxy 1100	134		AMLCD
PEN 10	1200		AMLCD
PEN 10, fms	24		AMLCD
486LT, fms	400		AMLCD
PC Mobile	5		AMLCD
CDA	5	3758	AMLCD
266.70 diagonal (10.5)			
DD 979	48		AMLCD
CV 67	1		AMLCD
CG 69	24		CRT
LHD 3	7		CRT
LHA 4	5		CRT
LPD 15	11		CRT
ARS 51	4	100	AMLCD
190.50 x 139.70 (7.5 x 5.5)			
MH-53J	164	164	CRT
190.50 x 144.14 (7.5 x 5.63)			
DD 979	264	264	CRT
190.50 x 146.05 (7.5 x 5.75)			
CVN 65	2		CRT
CVN 74	7		CRT
CG 58	48	57	CRT
192.00 x 144.00 (7.56 x 5.72)			
RTU-E	505		AMLCD
RTU-E, fms	202	707	AMLCD
192.02 x 144.02 (7.56 x 5.67)			
Humvee	300		AMLCD
Litton-1486	1100	1400	AMLCD
193.68 x 139.70 (7.625 x 5.5)			
F-117A	54		CRT
P-3C	168	222	CRT
193.68 x 142.88 (7.625 x 5.625)			
LHA 4	15	15	CRT
193.68 x 146.05 (7.625 x 5.75)			
DDG 64	157		CRT
PC 11	13	170	CRT
193.80 x 143.00 (7.63 x 5.63)			
FFG 45	357	357	CRT
195.07 x 145.03 (7.68 x 5.71)			
C-130H	119	119	CRT
195.26 x 146.05 (7.69 x 5.75)			
CG 58	12		LCD
CG 69	12	24	LCD

Table III (concluded). Example of display size clustering about a key center point (10 in. diagonal).
Range: 9.5-10.5 in.
(or 7.5 – 8.5 in. by 5.5 – 6.5 in., and *vice versa*).

Size, mm (in.)	No.	Total	Technology
211.20 x 158.40 (8.31 x 6.24)			
RLT 410C	44		AMLCD
RLT 410C,fms	18	62	AMLCD
212.73 x 158.75 (8.375 x 6.25)			
CV 67	1	1	Plasma
214.31 x 160.34 (8.4375 x 6.3125)			
LHA 4	25	25	Plasma
215.90 x 158.75 (8.5 x 6.25)			
CVN 65	2	2	LCD
215.90 x 161.93 (8.5 x 6.375)			
LHA 4	5	5	AMLCD
215.90 x 165.10 (8.5 x 6.5)			
CVN 65	1		CRT
CV 67	1		CRT
CG 69	144		Plasma
	72		CRT
	13		AMLCD
UH-3H	54		CRT
PC 11	13	298	AMLCD
144.78 x 210.82 (5.7 x 8.3)			
EC-130E	45		CRT
WC-130H	30		CRT
C-130E	735		CRT
C-130H	840	1650	CRT
146.05 x 195.26 (5.75 x 7.6875)			
LHD 3	7	7	CRT
149.23 x 196.85 (5.875 x 7.75)			
LHA 4	5	5	CRT
149.23 x 200.03 (5.875 x 7.875)			
C-141C	252	252	AMLCD
151.64 x 196.60 (5.97 x 7.74)			
EA-6B	250	250	CRT
210.82 x 157.48 (8.3 x 6.2)			
M1A2 SEP	792		AMLCD
Wolverine	465		AMLCD
M2A3/M3A3	2218	3485	LCD
211.14 x 158.75 (8.31 x 6.25)			
DDG 64	36	36	AMLCD
211.14 x 160.34 (8.31 x 6.31)			
CVN 65	3		AMLCD
CVN 74	42	45	AMLCD

Table IV. Example of display size clustering about a reference point (19.5 in. diagonal). Range: 17-22 in.

System	No.	Total	Technology
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431.80 diagonal (17.0)

SSN-688MkI	152		CRT
SSBN-726MkI	16		CRT
SSBN-726MkI	60		CRT?
NSSN	24		CRT
SSN-21	3		CRT
EP-3E	36		CRT
CVN 65	343		CRT
CVN 74	203		CRT
CG 58	233		CRT
CG 69	12		CRT
DDG-51	720		CRT
DDG-51	96	1898	Plasma

438.15 diagonal (17.25)

CV 67	1	1	CRT
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444.50 diagonal (17.5)

CV 67	3	3	CRT
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457.20 diagonal (18.0)

CVN 65	1		CRT
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461.96 diagonal (18.1875)

LHD 3	7	7	CRT
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463.55 diagonal (18.25)

DD 979	24		CRT
CG 69	12		CRT
LSD 44	40		CRT
LHA 4	5	81	CRT

465.14 diagonal (18.3125)

LHA 4	5	5	CRT
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466.73 diagonal (18.375)

PC 11	39		CRT
AS 39	2	41	CRT

469.90 diagonal (18.5)

C-26B	10		CRT
UC-26C	1		CRT
LHA 4	5	16	CRT

473.08 diagonal (18.625)

LHD 3	35		CRT
LHA 4	5	40	CRT

476.25 diagonal (18.75)

CG 58	24		CRT
CV 67	2		CRT
LHA 4	25		CRT
LPD 15	22	69	CRT

479.43 diagonal (18.875)

LHA 4	5	5	CRT
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482.60 diagonal (19.0)

C2V	318		CRT
SSN-688MkI	76		CRT
SSN-688MkII	54		CRT
SSN-688BSY	42		CRT
SSBN-726MkII	50		CRT
NSSN	115		CRT
SSN-21	84		CRT
DDG-51	481		CRT
EC-130E	96		CRT
P-3C UIIVPU	7		CRT
P-3C UIVPU	7		CRT
P-3C UIIIAIP	30		CRT
P-3C UIIIRAIP		30	CRT
CVN 65	455		CRT
CVN 74	1744		CRT
CG 58	504		CRT
DD 979	120		CRT
FFG 45	204		CRT
C-26A, fms	13		CRT
TCU	2541		CRT
TCU, fms	142		CRT
CV 67	76		CRT
CG 69	284		CRT
LHA 4	15		CRT
LPD 15	11		CRT
LSD 44	16		CRT
LSD 51	8		CRT
ARS 51	4	7527	CRT

484.19 diagonal (19.0625)

LHD 3	49		CRT
LHA 4	10	59	CRT

485.78 diagonal (19.125)

LHD 3	28		CRT
LHA 4	100		CRT
LSD 44	8		CRT
LSD 51	4	140	CRT

487.36 diagonal (19.1875)

CV 67	1		CRT
CG 69	12		CRT
LHA 4	5	18	CRT

Table IV (concluded). Example of display size clustering about a reference point (19.5 in. diagonal). Range: 17-22 in.

Size, mm (in.)
System **No.** **Total** **Technology**

488.95 diagonal (19.25)

CV 67	11		CRT
LHD 3	154		CRT
LHA 4	45		CRT
LPD 15	22		CRT
LSD 44	24		CRT
LSD 51	20		CRT
ARS 51	8	284	CRT

490.64 diagonal (19.31)

DDG 64	36		CRT
LHD 3	7		CRT
LHA 4	10	53	CRT

492.13 diagonal (19.375)

DDG 64	36		CRT
LHD 3	238		CRT
LHA 4	40	314	CRT

493.71 diagonal (19.4375)

LHA 4	5	5	CRT
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495.30 diagonal (19.50)

CV 67	10		CRT
LHD 3	7		CRT
LSD 44	8		CRT
LSD 51	4	29	CRT

498.48 diagonal (19.625)

CV 67	3	3	CRT
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500.06 diagonal (19.69)

DDG 64	36	36	CRT
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501.65 diagonal (19.75)

CV 67	15		CRT
LHD 3	7		CRT
LHA 4	5		CRT
LPD 15	11	38	CRT

504.83 diagonal (19.875)

ARS 51	4	4	CRT
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506.41 diagonal (19.9375)

LHA 4	5	5	CRT
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508.00 diagonal (20.0)

CVN 65	26		CRT
CVN 74	4326		CRT
CG 58	96		CRT
DDG 64	36		CRT
CG 69	108		CRT
LHD 3	56		CRT
LHA 4	20		CRT
LSD 44	16		CRT
LSD 51	8	4692	CRT

511.18 diagonal (20.125)

AS 39	4	4	CRT
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512.76 diagonal (20.1875)

LHA 4	5	5	CRT
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514.35 diagonal (20.25)

CV 67	2		CRT
LHD 3	7	9	CRT

517.53 diagonal (20.375)

LHA 4	5	5	CRT
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520.70 diagonal (20.5)

DD 979	24	24	CRT
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523.88 diagonal (20.625)

LHA 4	5	5	CRT
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527.05 diagonal (20.75)

DD 979	24		CRT
LHD 3	7	31	CRT

533.40 diagonal (21.0)

Cmdr TOC	15		Plasma
CVN 65	13		CRT
CVN 74	35		CRT
CG 58	24		CRT
DD 979	48		CRT
YAL-1A28	163		AMLCD

558.80 diagonal (22.0)

CV 67	4	4	CRT
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568.33 diagonal (22.375)

LHA 4	5	5	CRT
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577.85 diagonal (22.75)

CV 67	2	2	CRT
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584.20 diagonal (23.0)

CVN 74	28	28	CRT
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Table V. Display sizes unique to a given system (platform/program) one or more in quantity.

Display Size, H x V mm (in) (unless otherwise noted)	Platform	No.	Technology				
				762.00 diagonal (30.0)	NSSN	6	CRT
				1295.4 x 1295.4 (51.0 x 51.0)	SSBN-726MkII	10	EL
63.50 diameter (2.499)	AV-8B	145	CRT	121.92 x 236.22 (4.8 x 9.3)	B-52H	188	LED
106.68 x 55.88 (4.2 x 2.2)	EA-6B	250	CRT	134.62 x 236.22 (5.3 x 9.3)	B-52H	94	LED
146.05 diameter (5.75)	EA-6B	125	CRT				
151.64 diameter (5.97)	EA-6B	125	CRT	190.50 x 139.70 (7.5 x 5.5)	MH-53J	164	CRT
151.64 x 196.60 (5.97 x 7.74)	EA-6B	250	CRT				
				98.43 diameter (3.875)	AH-1F	944	EM
101.60 x 127.00 (4.0 x 5.0)	F-14A/B	396	EM				
				88.90 x 66.68 (3.50 x 2.625)	CH-46E	486	CRT
71.12 diagonal (2.8)	F-14D	51	CRT	146.05 x 48.26 (5.75 x 1.9)	CH-46E	243	EM
127.00 x 177.80 (5.0 x 7.0)	F-14D	51	CRT				
133.35 x 136.65 (5.25 x 5.38)	F-14D	153	CRT	92.71 x 45.72 (3.65 x 1.8)	CH-47D	131	dLCD
				107.19 x 106.68 (4.22 x 4.20)	CH-47F	1200	AMLCD
187.20 x 225.81 (7.37 x 8.89)	F-15A/B	100	CRT				
103.89 diameter (4.09)	F-15C/D	408	CRT	71.12 x 50.80 (2.8 x 2.0)	MH-53E	44	CRT
76.20 x 88.90 (3.0 x 3.5)	F-15E	184	CRT	83.82 x 72.39 (3.30 x 2.85)	OH-58D	406	dLCD
				162.56 x 121.92 (6.4 x 4.8)	OH-58D	812	CRT
61.59 diagonal (2.425)	F-16C/D	1498	CRT				
62.48 diagonal (2.46)	F-16C/D	363	CRT	90.00 x 170.00 (3.54 x 6.69)	RAH-66	5200	CRT
77.98 diameter (3.07)	F-16C/D	941	CRT	200.00 x 150.00 (7.87 x 5.91)	RAH-66	5200	CRT
125.73 x 99.06 (4.95 x 3.9)	F/A-18E/F	667	CRT	69.85 x 57.15 (2.75 x 2.25)	TH-57B	47	EM
33.02 x 22.86 (1.3 x 0.9)	F-22	704	CRT	69.85 x 76.20 (2.75 x 3.0)	TH-57C	73	EM
70.51 x 58.01 (2.776 x 2.284)	F-22	352	CRT	88.90 x 82.55 (3.5 x 3.25)	TH-57C	146	EM
99.06 x 73.66 (3.9 x 2.9)	F-22	704	AMLCD				
198.12 x 198.12 (7.8 x 7.8)	F-22	352	AMLCD				
				33.34 diameter (1.3125)	UH-1N	200	CRT
40.00 diameter (1.575)	M2A3/M3A3	2218	CRT	63.50 diagonal (2.499)	UH-1N	100	CRT
				127.25 x 133.60 (5.01 x 5.26)	UH-1N	130	EM
41.15 x 23.11 (1.62 x 0.91)	M1A2SEP	1584	CRT	52.39 x 12.70 (2.0625 x 0.5)	UH-3H	54	LED
				71.44 x 93.38 (2.8125 x 0.875)	UH-3H	54	dLCD
87.63 x 36.07 (3.45 x 1.42)	M2A2ODS	1570	LED				
				86.36 x 139.70 (3.4 x 5.5)	E-2C	234	CRT
243.84 diagonal (9.6)	M58	170	LCD	269.24 x 269.24 (10.6 x 10.6)	E-2C	126	CRT
				317.50 x 254.00 (12.5 x 10.0)	E-2C	108	AMLCD
185.42 x 139.70 (7.3 x 5.5)	LAV	34	CRT				
				129.54 x 129.54 (5.1 x 5.1)	E-4B	8	EM
254.00 x 203.20 (10.0 x 8.0)	AAAV	3081	AMLCD	355.60 x 355.60 (14.0 x 14.0)	E-4B	16	Plasma
147.32 x 228.60 (5.8 x 9.0)	DACT	7000	AMLCD	80.66 x 66.68 (3.1875 x 2.625)	E-6B	45	CRT
				187.33 x 141.29 (7.375 x 5.56)	E-6B	15	CRT
223.96 x 97.96 (8.82 x 3.86)	RLT 88	215	LCD	327.03 x 244.48 (12.875x9.68)	E-6B	30	CRT
152.40 diagonal (6.0)	SHTU	6168	LCD	203.20 x 83.82 (8.0 x 3.3)	E-8A	40	dLCD
				66.80 x 9.53 (2.63 x 0.375)	E-8C	85	CRT
101.60 x 38.10 (4.0 x 1.5)	RF-5022	3309	AMLCD	69.85 x 53.98 (2.75 x 2.125)	E-8C	85	CRT
				146.05 x 38.10 (5.75 x 1.50)	E-8C	65	LCD
71.25 x 30.48 (2.80 x 1.20)	ISHMRS	041	AMLCD	158.75 x 172.21 (6.25 x 6.78)	E-8C	26	CRT
				514.35 x 400.05 (20.25x15.75)	E-8C	234	CRT
327.66 diagonal (12.9)	ACE SS-20	32	AMLCD				
				38.10 x 20.64 (1.5 x 0.81)	E-9A	12	LED
408.94 diagonal (16.1)	SPARCstation	94	AMLCD	44.45 x 11.11 (1.75 x 0.44)	E-9A	4	LED
				57.15 x 44.45 (2.25 x 1.75)	E-9A	2	CRT
198.12 diagonal (7.8)	HTU	3000	LCD	84.66 x 38.10 (3.33 x 1.5)	E-9A	2	CRT
				158.75 x 82.55 (6.25 x 3.25)	E-9A	2	LCD
47.49 x 26.04 (1.87 x 1.025)	FLTS	340	LCD	190.50 diagonal (7.5)	E-9A	4	CRT

234.95 x 190.50 (9.25 x 7.5)	E-9A	2	CRT	209.55 x 107.95 (8.25 x 4.25)	CVN 74	7	EL
259.08 x 194.56 (10.2 x 7.66)	E-9A	2	CRT	282.58 x 207.96 (11.13 x 8.19)	CVN 74	7	CRT
Table V (continued). Display sizes unique to a given system (platform/program), one or more in quantity.				288.92 x 95.25 (11.38 x 3.75)	CVN 74	14	LED
Size, H x V mm (in)				387.35 x 288.93 (15.25x11.375)	CVN 74	7	CRT
(unless otherwise noted)				407.99 x 300.04 (16.06x11.81)	CVN 74	7	CRT
Platform				492.13 x 368.30 (19.38 x 14.5)	CVN 74	14	CRT
No.				584.20 diagonal (23.0)	CVN 74	28	CRT
Technology				601.98 x 441.96 (23.7 x 17.4)	CVN 74	7	CRT
95.25 x 190.50 (3.75 x 7.5)	P-3C	60	EL	1041.40 x 635.00 (41.0 x 25.0)	CVN 74	7	Plasma
101.60 diameter (4.0)	P-3C	236	CRT	1092.2 x 1092.2 (43.0 x 43.0)	CVN 74	14	CRT / LCD
101.60 x 152.40 (4.0 x 6.0)	P-3C	999	Plasma	57.15 x 12.70 (2.25 x 0.5)	CV 67	1	dLCD
101.60 x 171.45 (4.0 x 6.75)	P-3C	3	Plasma	63.50 x 53.975 (2.5 x 2.125)	CV 67	2	CRT?
104.14 x 104.14 (4.1 x 4.1)	P-3C	985	AMLCD	63.50 x 54.10 (2.5 x 2.13)	CV 67	2	CRT
139.70 x 139.70 (5.5 x 5.5)	P-3C	368	CRT	76.20 x 44.45 (3.0 x 1.75)	CV 67	1	dLCD
157.48 x 210.82 (6.2 x 8.3)	P-3C	20	CRT	79.38 x 12.70 (3.125 x 0.5)	CV 67	1	LED
182.88 X 137.16 (7.2 X 5.4)	P-3C	35	CRT	79.38 x 14.29 (3.13 x 0.56)	CV 67	2	dLCD
228.60 diameter (9.0)	P-3C	632	CRT	80.96 x 63.50 (3.1875 x 2.5)	CV 67	1	dLCD
259.08 diagonal (10.2)	P-3C	55	Plasma	92.25 x 76.20 (3.75 x 3.0)	CV 67	1	LED
360.68 diagonal (14.2)	P-3C	35	AMLCD	95.25 x 25.40 (3.75 x 1.0)	CV 67	2	LED
406.40 diameter (16.0)	P-3C	650	CRT	100.01 x 77.79 (3.94 x 3.06)	CV 67	3	dLCD
				104.78 x 200.15 (4.125 x 7.88)	CV 67	3	EL
114.30 x 152.40 (4.5 x 6.0)	S-3B	119	CRT	106.36 x 82.55 (4.19 x 3.25)	CV 67	1	CRT
120.65 x 158.75 (4.75 x 6.25)	S-3B	119	CRT	114.30 x 17.46 (4.5 x 0.69)	CV 67	1	LED
163.83 x 236.22 (6.45 x 9.3)	S-3B	119	CRT	131.36 x 101.60 (5.1875 x 4.0)	CV 67	2	CRT
177.80 x 241.30 (7.0 x 9.5)	S-3B	119	CRT	133.35 diagonal (5.25)	CV 67	6	CRT
285.75 x 222.25 (11.25 x 8.75)	S-3B	119	CRT	136.53 x 30.16 (5.38 x 1.19)	CV 67	1	LED
368.30 x 279.40 (14.5 x 11.0)	S-3B	238	CRT	146.05 x 112.71 (5.75 x 4.44)	CV 67	1	CRT
				177.80 x 133.35 (7.0 x 5.25)	CV 67	4	CRT
134.62 x 124.46 (5.3 x 4.9)	VC-25A	12	CRT	177.80 x 139.70 (7.0 x 5.5)	CV 67	2	CRT
				180.98 x 136.53 (7.125x5.375)	CV 67	2	CRT
98.43 x 73.03 (3.875 x 2.875)	CVN 65	1	CRT	185.74 x 30.16 (7.31 x 1.19)	CV 67	1	LED
130.18 x 123.83 (5.125x4.875)	CVN 65	2	CRT	193.68 x 120.65 (7.63 x 4.75)	CV 67	1	dLCD
215.90 x 158.75 (8.5 x 6.25)	CVN 65	2	LCD	206.38 x 155.58 (8.13 x 6.13)	CV 67	1	AMLCD
241.30 x 184.15 (9.5 x 7.25)	CVN 65	1	CRT	207.96 x 79.38 (8.19 x 3.13)	CV 67	2	Plasma
241.30 x 209.55 (9.5 x 8.25)	CVN 65	1	CRT	212.73 x 158.75 (8.375 x 6.25)	CV 67	1	Plasma
247.65 x 184.15 (9.75 x 7.25)	CVN 65	34	CRT	215.90 x 279.40 (8.5 x 11.0)	CV 67	4	CRT
254.00 x 69.85 (10.0 x 2.75)	CVN 65	1	LCD	219.08 x 171.45 (8.625 x 6.75)	CV 67	3	CRT
279.40 x 368.30 (11.0 x 14.5)	CVN 65	1	CRT	227.01 diagonal (8.9375)	CV 67	1	CRT
317.50 x 368.30 (12.5 x 14.5)	CVN 65	12	CRT	238.13 x 174.63 (9.38 x 6.88)	CV 67	1	CRT
330.20 x 254.00 (13.0 x 10.0)	CVN 65	1	CRT	241.30 x 161.93 (9.5 x 6.375)	CV 67	1	CRT
381.00 x 304.80 (15.0 x 12.0)	CVN 65	2	CRT	244.48 x 158.75 (9.625 x 6.25)	CV 67	1	CRT
419.10 x 323.85 (16.5 x 12.5)	CVN 65	1	CRT	260.35 x 63.50 (10.25 x 2.5)	CV 67	4	Plasma
457.20 x 381.00 (18.0 x 15.0)	CVN 65	2	CRT	273.05 x 374.65 (10.75x14.75)	CV 67	1	CRT?
463.55 diameter (18.25)	CVN 65	5	CRT	285.75 x 228.60 (11.25 x 9.0)	CV 67	4	CRT
482.60 x 381.00 (19.0 x 15.0)	CVN 65	1	CRT	330.20 x 260.35 (13.0 x 10.25)	CV 67	14	CRT
1066.80 diagonal (42.0)	CVN 65	2	CRT / LCD	387.35 diagonal (15.25)	CV 67	1	CRT
				409.58 diagonal (16.125)	CV 67	3	CRT
76.20 x 15.88 (3.0 x 0.625)	CVN 74	14	LED	438.15 diagonal (17.25)	CV 67	1	CRT
82.55 x 19.05 (3.25 x 0.75)	CVN 74	7	LED	444.50 diagonal (17.5)	CV 67	3	CRT
88.90 x 23.81 (3.5 x 0.94)	CVN 74	7	LED	498.48 diagonal (19.625)	CV 67	3	CRT
98.43 x 200.03 (3.88 x 7.88)	CVN 74	7	CRT	558.80 diagonal (22.0)	CV 67	4	CRT
107.95 x 12.7 (4.25 x 0.5)	CVN 74	49	LED	577.85 diagonal (22.75)	CV 67	2	CRT
107.95 x 23.81 (4.25 x 0.94)	CVN 74	7	LED	603.25 diagonal (23.75)	CV 67	1	CRT
107.95 x 84.14 (4.25 x 3.31)	CVN 74	14	CRT	656.80 diagonal (27.0)	CV 67	4	CRT
119.06 x 7.94 (4.69 x 0.31)	CVN 74	42	LED	698.50 diagonal (27.5)	CV 67	1	CRT
131.76 x 19.05 (5.19 x 0.75)	CVN 74	7	LED	1524.00 diagonal (60.0)	CV 67	3	CRT
146.05 x 7.94 (5.75 x 0.31)	CVN 74	42	LED				
158.75 x 22.23 (6.25 x 0.88)	CVN 74	7	LED	50.80 diameter (2.0)	DDG 51	192	CRT
177.80 x 160.34 (7.0 x 6.3125)	CVN 74	21	CRT	177.80 x 228.60 (7.0 x 9.0)	DDG 51	449	CRT
184.15 X 158.75 (7.25 X 6.25)	CVN 74	7	CRT				
196.85 x 149.23 (7.75 x 5.88)	CVN 74	7	AMLCD	38.10 x 15.88 (1.50 x 0.625)	DDG 64	216	LED
203.20 x 279.40 (8.0 x 11.0)	CVN 74	7	CRT	50.80 x 15.88 (2.0 x 0.625)	DDG 64	72	LED
207.96 x 104.78 (8.19 x 4.13)	CVN 74	7	LCD	69.85 x 15.88 (2.75 x 0.625)	DDG 64	144	LED

131.76 x 77.79 (5.187 x3.0625)	LHD 3	14	CRT	206.38 x 106.36(8.125x4.1875)	LHA 4	5	Plasma
138.11 x 30.16 (5.4375x1.1875)	LHD 3	168	dLCD	207.96 diagonal (8.1875)	LHA 4	5	CRT
146.05 x 195.26 (5.75x7.6875)	LHD 3	7	CRT	207.96x106.36(8.1875x4.1875)	LHA 4	5	EL
180.98 x 139.70 (7.125 x 5.5)	LHD 3	7	CRT	209.55 x 157.16 (8.25 x 6.1875)	LHA 4	5	dLCD
212.73 diagonal (8.375)	LHD 3	7	CRT	214.31x160.34(8.4375x6.3125)	LHA 4	25	Plasma
225.43 diagonal (8.875)	LHD 3	14	CRT	215.90 x 109.54 (8.5 x 4.3125)	LHA 4	5	Plasma
231.78 x 101.60 (9.125 x 4.0)	LHD 3	7	Plasma	215.90 x 161.93 (8.5 x 6.375)	LHA 4	5	AMLCD

Table V (continued). Display sizes unique to a given system (platform/program), one or more in quantity.

Size, H x V mm (in) (unless otherwise noted)	Platform	No.	Technology				
247.65 x 106.36 (9.75x4.1875)	LHD 3	14	Plasma	238.13 diagonal (9.375)	LHA 4	5	AMLCD
255.59 x 209.55(10.0625x8.25)	LHD 3	7	CRT	244.48 x 184.15 (9.625 x 7.25)	LHA 4	5	CRT
276.23 diagonal (10.875)	LHD 3	14	CRT	301.63 x 222.25 (11.875x8.75)	LHA 4	70	CRT
282.58 x 209.55 (11.125x8.25)	LHD 3	14	CRT	327.03 diagonal (12.875)	LHA 4	5	CRT
320.68 diagonal (12.625)	LHD 3	91	CRT	327.03x263.53(12.875x10.375)	LHA 4	5	CRT
331.79 diagonal (13.0625)	LHD 3	7	CRT	355.60 x 284.16(14.0x11.1875)	LHA 4	25	CRT
336.55 x 279.40 (13.25 x 11.0)	LHD 3	147	CRT	366.55 diagonal (13.25)	LHA 4	5	CRT
350.84 diagonal (13.8125)	LHD 3	8	CRT	390.53x284.16(15.375x11.188)	LHA 4	10	CRT
374.65 diagonal (14.75)	LHD 3	14	CRT	390.53x287.34(15.375x11.313)	LHA 4	15	CRT
388.94 x 292.10(15.3125x11.5)	LHD 3	14	CRT	403.23 diagonal (15.875)	LHA 4	5	CRT
390.53 x 296.86(15.3811.688)	LHD 3	14	CRT	404.81 diagonal (15.9375)	LHA 4	810	CRT
461.96 diagonal (18.1875)	LHD 3	7	CRT	407.99 diagonal (16.0625)	LHA 4	10	CRT
688.98 diagonal (27.125)	LHD 3	7	CRT	415.93 diagonal (16.375)	LHA 4	30	CRT
704.85 diagonal (27.75)	LHD 3	14	CRT	465.14 diagonal (18.3125)	LHA 4	5	CRT
895.35 diagonal (35.25)	LHD 3	7	CRT	479.43 diagonal (18.875)	LHA 4	5	CRT
1231.90 diagonal (48.5)	LHD 3	14	CRT	493.71 diagonal (19.4375)	LHA 4	5	CRT
19.05 x 15.08 (0.75 x 0.59375)	LHA 4	5	LED	506.41diagonal (19.9375)	LHA 4	5	CRT
20.64 x 6.35 (0.8125 x 0.25)	LHA 4	200	LED	512.76 diagonal (20.1875)	LHA 4	5	CRT
22.23 x 12.70 (0.875 x 0.5)	LHA 4	25	LED	517.53 diagonal (20.375)	LHA 4	5	CRT
39.69 x 19.05 (1.5625 x 0.75)	LHA 4	10	LED	523.88 diagonal (20.625)	LHA 4	5	CRT
44.45 x 9.53 (1.75 x 0.375)	LHA 4	20	LED	568.33 diagonal (22.375)	LHA 4	5	CRT
47.63 x 15.88 (1.875 x 0.625)	LHA 4	5	LED	666.75 diagonal (26.25)	LHA 4	5	CRT
50.80 x 19.05 (2.0 x 0.75)	LHA 4	10	LED	669.93 diagonal (26.375)	LHA 4	5	CRT
55.56 x 17.15 (2.1875 x 0.625)	LHA 4	20	LED	700.09 diagonal (27.5625)	LHA 4	5	CRT
57.15 x 19.05 (2.25 x 0.75)	LHA 4	10	LED	920.75 diagonal (36.25)	LHA 4	5	CRT
60.33 x 44.45 (2.375 x 1.75)	LHA 4	5	CRT	927.10 diagonal (36.5)	LHA 4	5	CRT
68.26 x 23.81 (2.6875 x .9375)	LHA 4	20	LED	1282.70 x 1016.00 (50.5 x 40)	LHA 4	5	CRT
77.79 x 15.88 (3.0625 x 0.625)	LHA 4	5	dLCD	1397.00 diagonal (55.0)	LHA 4	5	CRT
77.79 x 33.34 (3.0625x1.3125)	LHA 4	5	LED	1403.35 diagonal (55.25)	LHA 4	5	CRT
80.96 x 9.53 (3.1875 x 0.375)	LHA 4	10	dLCD	1625.60 diagonal (64.0)	LHA 4	5	CRT
85.73 x 11.11 (3.125 x 0.4375)	LHA 4	5	LED	1635.13 diagonal (64.375)	LHA 4	5	CRT
85.73 x 25.40 (3.375 x 1.0)	LHA 4	20	LED	1714.50 diagonal (67.5)	LHA 4	10	CRT
90.49 x 9.53 (3.5625 x 0.375)	LHA 4	15	dLCD	666.75 diagonal (26.25)	LHA 4	5	CRT
90.49 x 19.05 (3.5625 x 0.75)	LHA 4	5	LED	669.93 diagonal (26.375)	LHA 4	5	CRT
101.60 x 85.73 (4.0 x 3.375)	LHA 4	5	CRT	700.09 diagonal (27.5625)	LHA 4	5	CRT
103.19 x 25.40 (4.0625 x 1.0)	LHA 4	5	dLCD	920.75 diagonal (36.25)	LHA 4	5	CRT
104.78 x 84.14 (4.125 x 3.3125)	LHA 4	10	CRT	927.10 diagonal (36.5)	LHA 4	5	CRT
114.30 x 85.73 (4.5 x 3.375)	LHA 4	10	CRT	1282.70 x 1016.00 (50.5 x 40)	LHA 4	5	CRT
119.06 x 90.49 (4.6875x3.5625)	LHA 4	5	CRT	1397.00 diagonal (55.0)	LHA 4	5	CRT
123.83 x 19.05 (4.875 x 0.75)	LHA 4	10	LED	1403.35 diagonal (55.25)	LHA 4	5	CRT
127.00 x 73.03 (5.0 x 2.875)	LHA 4	5	dLCD	1625.60 diagonal (64.0)	LHA 4	5	CRT
149.23 x 196.85 (5.875 x 7.75)	LHA 4	5	CRT	1635.13 diagonal (64.375)	LHA 4	5	CRT
171.45 x 139.70 (6.75 x 5.5)	LHA 4	5	CRT	1714.50 diagonal (67.5)	LHA 4	10	CRT
193.68 x 142.88 (7.625x5.625)	LHA 4	15	CRT	666.75 diagonal (26.25)	LHA 4	5	CRT
196.85 diagonal (7.75)	LHA 4	5	CRT	669.93 diagonal (26.375)	LHA 4	5	CRT
196.85 x 25.40 (7.75 x 1.0)	LHA 4	5	dLCD	700.09 diagonal (27.5625)	LHA 4	5	CRT
196.85 x 123.83 (7.75 x 4.875)	LHA 4	10	Plasma	920.75 diagonal (36.25)	LHA 4	5	CRT
200.03 diagonal (7.875)	LHA 4	15	CRT	927.10 diagonal (36.5)	LHA 4	5	CRT
200.30 x 101.60 (7.886 x 4.0)	LHA 4	5	Plasma	1282.70 x 1016.00 (50.5 x 40)	LHA 4	5	CRT
203.20 x 127.00 (8.0 x 5.0)	LHA 4	10	EL	1397.00 diagonal (55.0)	LHA 4	5	CRT
				1403.35 diagonal (55.25)	LHA 4	5	CRT
				1625.60 diagonal (64.0)	LHA 4	5	CRT
				1635.13 diagonal (64.375)	LHA 4	5	CRT
				1714.50 diagonal (67.5)	LHA 4	10	CRT
				104.78 x 19.05 (4.125 x 0.75)	LSD 44	24	LED
				196.85 x 127.00 (7.75 x 5.0)	LSD 44	32	EL
				1263.65 x 1016.00 (49.75 x 40)	LSD 44	16	CRT
				20.64 x 11.11 (0.8125 x 0.4375)	ARS 51	16	LED
				41.28 diameter (1.625)	ARS 51	24	CRT
				44.45 x 14.29 (1.75 x 0.5625)	ARS 51	8	LED
				57.15 x 15.88 (2.25 x 0.625)	ARS 51	32	LED
				63.50 x 19.05 (2.5 x 0.75)	ARS 51	72	LED
				66.68 x 14.29 (2.625 x .5625)	ARS 51	4	LED
				69.85 x 34.93 (2.75 x 1.375)	ARS 51	4	LED
				73.03 x 22.23 (2.88 x 0.88)	ARS 51	4	dLCD
				84.14 x 66.68 (3.3125 x 2.625)	ARS 51	4	CRT
				92.08 x 19.05 (3.625 x 0.75)	ARS 51	4	dLCD
						12	LED
				112.71 x 12.70 (4.4375 x 0.5)	ARS 51	4	LED
				120.65 x 90.49 (4.75 x 3.5625)	ARS 51	4	CRT
				142.88 x 31.75 (5.625 x 1.25)	ARS 51	4	LED
				150.81x185.74(5.9375x7.3125)	ARS 51	4	CRT
				163.51 x 12.70 (6.4375 x 0.5)	ARS 51	8	LED
				222.25 x 222.25 (8.75 x 8.75)	ARS 51	8	Plasma
				411.16 diagonal (16.1875)	ARS 51	4	CRT
				504.83 diagonal (19.875)	ARS 51	4	CRT

642.94 diagonal (25.3125)	ARS 51	4	CRT	120.65 x 95.25 (4.75 x 3.75)	UC-26C	1	CRT
				130.17 x 110.33 (5.13 x 4.34)	UC-26C	1	EM
79.38 x 63.50 (3.125 x 2.5)	AS 39	4	CRT	130.97 x 130.97 (5.16 x 5.16)	UC-26C	1	EM
92.08 x 61.91 (3.625 x 2.4375)	AS 39	2	dLCD	203.20 x 171.45 (8.0 x 6.75)	UC-26C	1	CRT
103.19 x 82.55 (4.06 x 3.25)	AS 39	1	Plasma				
115.88 x 114.46 (4.56 x 5.69)	AS 39	2	CRT	170.18 x 170.18 (6.7 x 6.7)	C-40A	18	AMLCD
123.83 x 163.51 (4.88 x 6.44)	AS 39	4	AMLCD				
165.10 x 22.23 (6.5 x 0.875)	AS 39	8	CRT	144.78 x 238.25 (5.7 x 9.38)	AC-130H	54	CRT
223.84 diagonal (8.8125)	AS 39	2	CRT				
Table V (concluded). Display sizes unique to a given system (platform/program), one or more in quantity.				127.00 x 114.3 (5.0 x 4.5)	HC-130H	2	EM
Size, H x V mm (in) (unless otherwise noted)				104.78 diameter (4.125)	LC-130R	8	CRT
Platform	No.	Technology		172.72 x 172.72 (6.8 x 6.8)	MC-130H	184	CRT
354.01x280.99(13.9375x11.063)	AS 39	4	CRT	25.40 diameter (1.00)	MC-130P	56	CRT
511.18 diagonal (20.125)	AS 39	4	CRT				
1133.48 diagonal (44.625)	AS 39	3	CRT	40.64 diameter (1.6)	C-130H	16	LCD
				105.00 diameter (4.13)	C-130H	161	CRT
33.34 x 15.88 (1.3125 x 0.625)	PC 11	26	dLCD	113.79 x 87.63 (4.48 x 3.45)	C-130H	1120	AMLCD
57.15 x 25.40 (2.25 x 1.0)	PC 11	13	dLCD	124.65 diameter (4.91)	C-130H	161	CRT
60.33 x 14.29 (2.375 x 0.5625)	PC 11	26	dLCD	195.07 x 145.03 (7.68 x 5.71)	C-130H	119	CRT
60.33 x 17.15 (2.375 x 0.675)	PC 11	13	dLCD				
65.09 x 31.75 (2.5625 x 1.25)	PC 11	13	dLCD	11.11 x 7.94 (0.4375 x 0.3125)	C-141C	126	dLCD
66.68 x 25.40 (2.625 x 1.0)	PC 11	26	dLCD	22.23 x 11.11 (0.875 x 0.4375)	C-141C	252	LED
68.26 diameter (2.6875)	PC 11	13	CRT	63.50 x 60.33 (2.5 x 2.375)	C-141C	63	AMLCD
68.26 x 26.99 (2.6875 x 1.0625)	PC 11	13	dLCD	88.90 x 77.79 (3.5 x 3.0625)	C-141C	252	dLCD
73.03 x 53.98 (2.875 x 2.125)	PC 11	13	dLCD?	107.95 x 82.55 (4.25 x 3.25)	C-141C	189	dLCD
80.96 x 58.74 (3.1875 x 2.3125)	PC 11	13	AMLCD	149.23 x 200.03 (5.875x7.875)	C-141C	252	AMLCD
90.49 x 77.79 (3.5625 x 3.0625)	PC 11	26	dLCD				
100.01 x 30.16(3.9375x1.1875)	PC 11	13	dLCD	83.82 x 68.58 (3.3 x 2.7)	C-141B	200	AMLCD
101.60 x 28.58 (4.0 x 1.125)	PC 11	13	dLCD?				
149.23 x 17.15 (5.875 x 0.675)	PC 11	13	dLCD?	88.90 x 101.60 (3.5 x 4.0)	KC-10A	118	CRT
153.99 x 15.88 (6.0625 x 0.625)	PC 11	13	dLCD	122.17 x 103.12 (4.81 x 4.06)	KC-10A	118	EM
42.86 diameter (1.6875)	LCM 8	768	EM	57.15 x 60.33 (2.25 x 2.375)	T-3A	110	LED
79.38 diameter (3.125)	LCM 8	192	EM	95.25 x 82.55 (3.75 x 3.25)	T-3A	220	EM
85.73 x 22.23 (3.375 x 0.875)	LCM 8	96	dLCD	158.75 x 31.75 (6.25 x 1.25)	T-3A	110	LED
				158.75 x 50.80 (6.25 x 2.0)	T-3A	110	LED
98.43 x 79.38 (3.88 x 3.13)	Mark V boat	40	dLCD				
120.65 x 92.08 (4.75 x 3.63)	Mark V boat	40	dLCD	50.80 x 121.92 (2.0 x 4.8)	T-6A	1422	CRT
201.61 x 180.98 (7.94 x 7.13)	Mark V boat	20	CRT	96.52 x 48.26 (3.8 x 1.9)	T-6A	1422	CRT
220.66 x 165.10 (8.69 x 6.50)	Mark V boat	60	AMLCD				
				82.80 x 82.55 (3.26 x 3.25)	T-38A	386	EM
87.31 x 23.81(3.4375 x .9375)	LCU 1600	34	dLCD				
88.90 x 22.23 (3.5 x 0.875)	LCU 1600	34	dLCD	88.90 x 129.54 (3.5 x 5.1)	T-38C	850	AMLCD
196.85 x 260.35 (7.75 x 10.25)	LCU 1600	34	CRT				
				98.04 x 98.04 (3.86 x 3.86)	T-39N	34	CRT
228.60 x 228.60 (9.0 x 9.0)	C-5A/B/C 254	CRT		137.16 x 137.16 (5.4 x 5.4)	T-39N	17	CRT
101.60 x 79.38 (4.0 x 3.125)	C-12A	80	CRT	101.60 x 25.40 (4.0 x 1.0)	T-41D	3	Plasma
99.06 diameter (3.9)	C-17A	240	CRT	114.30 x 79.38 (4.5 x 3.125)	T-43A	12	CRT
190.50 x 63.50 (7.5 x 2.5)	C-17A	120	LED	215.90 diameter (8.5)	T-43A	48	CRT
107.95 x 66.68 (4.25 x 2.63)	C-21A	80	LCD	46.99 diameter (1.85)	T-45A	174	CRT
66.80 x 151.89 (2.63 x 5.98)	C-22B	3	CRT	105.66 x 105.66 (4.16 x 4.16)	T-45A	348	EM
73.03 diameter (2.875)	C-26B	11	CRT				
80.96 diameter (3.1875)	UC-26C	1	EM				
85.73 x 85.73 (3.375 x 2.5)	UC-26C	1	EM				
107.95 x 128.59 (4.25x5.0625)	UC-26C	1	CRT				

Table VI. Singularities list. Display sizes of which there is only one in number in DoD.

Size, mm (in.) H x V (unless otherwise noted)	Platform	Current Technology
57.15 x 12.70 (2.25 x 0.5)	CV 67	dLCD
76.20 x 44.45 (3.0 x 1.75)	CV 67	dLCD
79.38 x 12.70 (3.125 x 0.5)	CV 67	LED
80.96 diameter (3.1875)	UC-26C	EM
80.96 x 63.50 (3.1875 x 2.5)	CV 67	dLCD
85.73 x 85.73 (3.375 x 2.5)	UC-26C	EM
92.25 x 76.20 (3.75 x 3.0)	CV 67	LED
98.43 x 73.03 (3.875 x 2.875)	CVN 65	CRT
103.19 x 82.55 (4.06 x 3.25)	AS 39	Plasma
106.36 x 82.55 (4.19 x 3.25)	CV 67	CRT
107.95 x 128.59 (4.25 x 5.0625)	UC-26C	CRT
114.30 x 17.46 (4.5 x 0.69)	CV 67	LED
120.65 x 95.25 (4.75 x 3.75)	UC-26C	CRT
130.17 x 110.33 (5.13 x 4.34)	UC-26C	EM
130.97 x 130.97 (5.16 x 5.16)	UC-26C	EM
136.53 x 30.16 (5.38 x 1.19)	CV 67	LED
146.05 x 112.71 (5.75 x 4.44)	CV 67	CRT
185.74 x 30.16 (7.31 x 1.19)	CV 67	LED
193.68 x 120.65 (7.63 x 4.75)	CV 67	dLCD
203.20 x 171.45 (8.0 x 6.75)	UC-26C	CRT
206.38 x 155.58 (8.13 x 6.13)	CV 67	AMLCD
212.73 x 158.75 (8.375 x 6.25)	CV 67	Plasma
227.01 diagonal (8.9375)	CV 67	CRT
238.13 x 174.63 (9.38 x 6.88)	CV 67	CRT
241.30 x 161.93 (9.5 x 6.375)	CV 67	CRT
241.30 x 184.15 (9.5 x 7.25)	CVN 65	CRT
241.30 x 209.55 (9.5 x 8.25)	CVN 65	CRT
244.48 x 158.75 (9.625 x 6.25)	CV 67	CRT
254.00 x 69.85 (10.0 x 2.75)	CVN 65	LCD
273.05 x 374.65 (10.75 x 14.75)	CV 67	CRT?
279.40 x 368.30 (11.0 x 14.5)	CVN 65	CRT
330.20 x 254.00 (13.0 x 10.0)	CVN 65	CRT
342.90 x 273.05 (13.5 x 10.75)	CVN 65	CRT
355.60 x 304.80 (14.0 x 12.0)	CVN 65	CRT
387.35 diagonal (15.25)	CV 67	CRT
419.10 x 323.85 (16.5 x 12.5)	CVN 65	CRT
438.15 diagonal (17.25)	CV 67	CRT
482.60 x 381.00 (19.0 x 15.0)	CVN 65	CRT
603.25 diagonal (23.75)	CV 67	CRT
698.50 diagonal (27.5)	CV 67	CRT

4. DISCUSSION

Key aspects of five example U.S. Navy, Army, Marine and Air Force programs are provided.

5.1 Bradley Fighting Vehicle

The Bradley Fighting Vehicle is comprised of four separate variants: M2A2 ODS, M2A3/M3A3, C2V and M7 FIST.

The full production run for the M2A2 ODS Bradley will be 1570 platforms, with 227 of these allocated to provide chassis for the M7 FIST variant.⁵ There are two electronic displays supporting the mission of this vehicle. The Digital Compass Display (DCD), otherwise known as the "Tac/Nav" display by vendor KVH Industries, Newport, Rhode Island, uses a housing enclosure measuring 4.88 x 5.00 x 1.55 in. (W x H x D). The technology is passive liquid crystal, utilizing back-light and heated back-plane. The Integrated Sight Unit (ISU) is a seven-segment light emitting (LED) diode array, composed of four segments, for use by the gunner. The LEDs are situated within an aperture measuring 0.65 x 0.21 in.⁶ The fielding of the Driver's Viewer Enhancer display, also intended for the M2A3/M3A3, has been suspended due to need for further development.

Regarding M2A3/M3A3, the M3A3 is a cavalry platform whereas the M2A3 is an infantry vehicle, both, however, using the same set of five electronic displays. Among these is the Improved Bradley Acquisition Sight (IBAS), using an embedded P-43 phosphor monochrome CRT with 10 shades of gray. A separate but similar CRT drives the imagery for the Commander's Independent Viewer (CIV).⁷ Yet other visual systems include the Commander's Tactical Display (CTD) and Squad Leader's Display (SLD), both having bezels measuring 11.0 x 9.5 in. Both are passive liquid crystal-based displays and can be operated in monochrome or color, with 81 color groups per inch, 32 undithered shades of gray, and 342.626 nits (100 ftL) luminance.⁸ Both the CIV and a Remote Biocular Viewer are provided imagery from the same color CRT. There is also a Driver's Navigation Display (DND), comprised of a passive monochrome LCD with backlight and heated back-plane, with a bezel measuring 4.88 x 5.00 in.

The C2V Bradley has a total of four electronic displays. One of these is the Commander's Display, based on thin film electro-luminescence technology, with an over-all footprint of 11 x 8 in. (W x H). There are otherwise three CRT-based Common Hardware Software displays, known as "CHS II," having 1280 x 1024 resolution, with an instrument footprint measuring 17.5 x 17.5 in. The C2V can actually be configured with up to four CHS II displays, with flat panel technology as an alternate. The current schedule calls for ten C2Vs delivered by FY2000 and the full 106 by FY2006.⁹

The M7 FIST program is currently in Engineering, Manufacturing and Development (EMD) stage. Four electronic displays are planned. One of these, using 1987 vintage passive liquid crystal technology, will part of the Forward Entry Device (FED), a militarized, portable 286 laptop computer. A second display, part of the Targeting Station Control Panel (TSCP), will employ monochrome electroluminescent technology for alpha-numerics, formatted in 13 lines of 23 characters, with an instrument footprint measuring 7.0 x 9.0 in. The Digital Compass Display (otherwise known as the "Driver's Navigational Display") comes from the ODS variant, unchanged. The Biocular Display Unit (BDU) will use CRT technology, with 800 active lines horizontal by 480 lines vertical resolution.¹⁰ Additionally, an A3 BFIST, based on the M2A3 chassis, is in early program stages. This will add 122 more vehicles to the FIST fleet. Final design had not been established as of Jan 99 when the M7 FIST was last reviewed.¹¹

5.2 Common Large Area Display Set (CLADS)

The Common Large Area Display Set (CLADS) initiative entails a joint upgrade of up to four aircraft, three USAF: E-3B/C AWACS, E-8C JSTARS, EC-130E ABCCC and one USN: E-2C Hawkeye, all sharing the common denominator of high-maintenance, low MTBF 19 in. CRTs.

The CLADS R & M Improvement Program Critical Design Review for E-3B/C occurred March 11, while the Preliminary Design Reviews for E-2C, E-8C and EC-130E occurred March 12, 1997 proposing form, fit function replacement of each aircraft's approximately 19 in. CRTs. The target display relative to E-3B/C is the Situation Display Console Color Monitor Assembly (footprint = 15.5 (w) x 18.25 (h) in.), of which there are 14 per aircraft (448 total across 23 B models and 9 C models), while that for Navy's E-2C is the Enhanced Main Display Unit (footprint = 21.75 (w) x 15.97 (h) in.),

of which there are three per aircraft (126 total across 42 aircraft). On the other hand, CLADS focusses on the Improved Graphics Displays (footprint = 20.25 (w) x 15.75 (h) in.) for USAF's fleet of 13 E-8C, of which there are 18 per aircraft (234 displays total). As to the ABCCC configuration, which is installed on eight of the 15 EC-130Es, each aircraft comprises 12 Battle Station Airborne Color Displays (BSACD). These are color CRTs supplied by Astronautics of America oriented in portrait mode, with noninterlacing raster. There are a total of 96 displays fleet-wide. The useful CRT area is 151.25 square inches with an active 17.6 in. diagonal (like the E-8 JSTARS displays). The maximum replacement assembly dimensions are 14.4 (w) x 17.7 (h), 22.81 in. diagonal and 21 in. depth at 15 degree angle.¹² The CLADS effort envisions replacing each of the aforementioned CRT displays with a commercial 21 in. diagonal 1280 x 1024, 24 bit, full color display using either AC Gas Plasma, AMLCD or other flat panel technology. Specified performance includes contrast of 10:1, 0.1 to 30 fL luminance, non-operating temperatures of -40 to +70C, 30 degrees horizontal/25 degrees vertical viewing angle and 3350 hours MTBF.¹³

5.3 Naval Special Warfare Rigid Hulled Inflatable Boat (11 meter)

In service since October 1998, the 11 m Naval Special Warfare Rigid Hulled Inflatable Boat (NSW RHIB) is an integral part of USSOCOM assets. All display modules are commercial grade equipment acquired at catalogue price with the ability to undergo the rigors of sea state four (6-10 foot waves) with water crashing over the console. The NSW RHIB program received the David Packard Award for excellence in acquisition, signed off by USD (A&T) Jacques Gansler on May 4, 1998. As of November 1998, there were twenty 11 m boats in service, with an additional 50 on order (a 10 m version of this craft, with the same display set, proved a failure under sea trials because of boat instability in rough seas). There are a total of three electronic displays on board. The 841 Radar display by Furuno, with 4.875 x 6.50 in. active area, is monochrome, using dichroic liquid crystal (dLCD) technology. The 1600 F GPS display, whose information is linked to the 841, is also monochrome dLCD, with a 3.5 x 4.75 in. active area, full sunlight readable but with off-axis viewability limited to approximately 45 degrees. The IC-M127 by ICOM, also dLCD, has a monochrome display with 3.0 x 1.5625 in. active area. Some RHIBs have the IC-M126 instead, but this has the same size display.¹⁴

5.4 Advanced Amphibious Assault Vehicle (AAAV)

The AAAV Preliminary Design Review was completed in December 1997, with the first three prototypes scheduled to appear in June 1999 and another 11 to follow prior to low rate production start in 2003. Production will eventually ramp to 50 units per quarter until production completion in 2012, with 1013 total production vehicles.¹⁵ The displays have been described with the following performance features: 640 x 480 color groups (77 color pixels per inch) minimum resolution, 4:3 aspect ratio, quad or triad pixel arrangement, 60 Hz refresh and a minimum active viewing area of 10 x 8 in, as defined in the "Critical Item Development Specification." Full sunlight readability will be based on analysis of operating environment.¹⁶ As of January 1999, a somewhat altered display picture had evolved, where new requirements were envisioned for two separate platforms: large area displays for 78 AAAV (C) platforms and a suite of two 8 (w) x 5 (h) in. and two 10 (w) x 8 (h) in. displays for some 2 - 3,000 AAAV (P) platforms. Although the technology choice is currently AMLCD, it is already predicted this will change by the year 2000 when the program will have entered Engineering and Manufacturing phase. A trade-off study is currently due in the April-May 1999 time-frame.¹⁷

5.5 Joint Helmet Mounted Cueing System

Vision Systems, International (Kaiser/Elbit) is on contract to McDonnell Douglas (Boeing) to provide some 1750 display units for the Joint Helmet Mounted Cueing System. The display engine is to be a 0.5 in. diameter active area CRT provided by Hughes or Thompson (with an unspecified lower truncation). As of October 1997, when the program had achieved Critical Design Review for Engineering, Manufacturing and Development, the system was intended for the following aircraft: F-15 C/D, F-18 C/D/E/F and F-22, F-16 (Lockheed Martin, as associate contractor, will use GFE to provide JHMCS to these latter aircraft), with a delivery schedule as follows:¹⁸

	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10
F-22	0	0	40	55	13	25	25	25	25	25
F-15	10	50	80	80	40	0	0	0	0	0
F-16	12	50	75	62	25	0	0	0	0	0

5. CONCLUSIONS AND RECOMMENDATIONS

The over-all numbers of DoD military display sizes, programs and applied technologies are presented in this paper for those sizes representing demand of 5,000 units or greater. Our technical report includes all DoD military displays.¹

Regarding technologies, it is to be noted that across all DoD military systems, 46% of total displays are implemented with, or are planning to be implemented with, a form of flat panel. Within the flat panels, 76% are LCD, dLCD or AMLCD. That is, 35% of total DoD displays use, or plan to use, LCD flat panel technologies. Some 11% of total DoD displays use non-LCD flat panel technology, such as electroluminescent, thin film electroluminescent, light emitting diode or plasma, representing 0.9%, 1.7%, 6.2% and 2.3% of total DoD usage, respectively. Meanwhile, approximately 48% of DoD displays currently utilize a CRT implementation. The remaining 6% of total DoD displays are incandescent or electromechanical (to date, a coherent effort to gather information for electromechanical and incandescent displays has not been made; thus, future studies may show that this percentage is larger).

Given the dramatically smaller mean-time between failure rate of installed older technologies (CRT and EM, in particular), relative to flat panel technologies, coupled with a dwindling industrial base and consequently increasing per unit purchase price for the older technologies, it can be anticipated that the part of the current DoD inventory using older technologies will, at some point, require technology upgrade via form-fit or instrument panel re-design. It is, therefore, recommended that particular if not priority consideration be given to the process of replacing older technology displays. Such attention would reduce the number of systems that become unavailable for use (or are available with diminished operational capability) due to the vanishing vendor syndrome (VVS), which plagues the older technologies, CRT and EM, in particular.

Yet an additional factor in determining demand is the re-design and integration of control panels comprising switches and annunciator lights into large area direct view electronic multifunction displays for affordability and added capability.

The majority of display sizes are unique to a single DoD program. In fact, 515 out of 748 display sizes listed fit this category. An obvious recommendation stems from this observation: DoD program offices should, whether in acquiring new systems or upgrading those already fielded, capitalize on commonality by leveraging off existing or planned program acquisitions across all Services to reduce non-recurring engineering and maximize volume purchasing. Given the number of unique sizes, this approach would obviously mean fewer upgrades that are purely form-fit-function (hence of higher initial cost), while the long term prospect is greater savings over succeeding retrofits. We recognize that, short of an instrument panel redesign (partial or full), existing crewstation configuration imposes a limitation to the latitude any one program has in terms of display size conversion.

Some of the 748 display sizes currently in use can be logically grouped into size categories. Those specific sizes that are already the most prolific are identified. The 9.4 in. diagonal active area display, for instance, represents 3.7% of total DOD displays (97% of which are either AMLCD or dLCD). Also, the 5.0 x 5.0 in. size represents 3.4% (85% of which are currently CRTs). The 2.25 x 2.25 in. size accounts for 3.3% (99.5% of which are currently AMLCD). The 8.0 in. diagonal active area display represents 3.1% (of which 93.4% are AMLCD), while the 19.0 in. diagonal size represents 2.4% (of which 100% are CRT). The 12.1 in. diagonal size represents 2.3% (100% of which are AMLCD). This data, correlating sizes to technologies, should be used as baseline information ("what is") in any acquisition program involving displays (to decide "what will be").

The present results for display sizes signal the rallying point about which the process of achieving greater commonality can evolve. It is the recommendation of this report, both to DOD and industry, that they take advantage of this information to reduce, over time, the number of unique sizes.

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