Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Defense Advanced Research Projects Agency	Date: March 2019
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603760E / *COMMAND, CONTROL AND COMMUNICATIONS SYSTEMS*

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
Total Program Element	-	103.577	185.984	232.134	-	232.134	188.881	239.338	215.676	210.270	-	-
CCC-02: *INFORMATION INTEGRATION SYSTEMS*	-	45.168	105.316	133.539	-	133.539	112.617	181.705	204.268	210.270	-	-
CCC-06: *COMMAND, CONTROL AND COMMUNICATION SYSTEMS*	-	58.409	80.668	98.595	-	98.595	76.264	57.633	11.408	0.000	-	-

A. Mission Description and Budget Item Justification

The Command, Control and Communications Systems Program Element is budgeted in the Advanced Technology Development Budget Activity because its purpose is to demonstrate and evaluate advanced information systems research and development concepts.

The success of military operations depends on timely, reliable, secure, and synchronized dissemination of command and control and relevant situational awareness information to every military echelon. While wired communications and networks are fairly well developed, providing assured high-bandwidth mobile wireless capabilities that match or exceed commercial wired infrastructure is needed to meet the demands of military users. The goal of the Information Integration Systems project is to develop and demonstrate technologies that will provide effective communications to U.S. forces. Approaches to this goal include developing technologies in these areas:
- High-Capacity Links technologies - enables greater back-haul capability.
- Advanced Networking technologies - supports resilience, adaptability, scalability, and composable systems to enable adaptive effects webs.
- Low Probability of Detection and Anti-Jam (LPD/AJ) technologies - provides assured communications in very high-threat environments.
- Novel Radio Frequency and Spectral Sensing (RF/SS) - supports efficient spectrum management in congested environments and detection of electromagnetic threats.

B. Program Change Summary ($ in Millions)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Previous President's Budget	106.787	185.984	158.245	-	158.245
Current President's Budget	103.577	185.984	232.134	-	232.134
Total Adjustments	-3.210	0.000	73.889	-	73.889
• Congressional General Reductions	-6.750	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	3.933	0.000			
• SBIR/STTR Transfer	-0.393	0.000			
• TotalOtherAdjustments	-	-	73.889	-	73.889

Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Defense Advanced Research Projects Agency	Date: March 2019
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide I* BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603760E *I COMMAND, CONTROL AND COMMUNICATIONS SYSTEMS*

Change Summary Explanation

FY 2018: Decrease reflects Congressional reduction, SBIR/STTR transfer, offset by reprogrammings.

FY 2019: N/A

FY 2020: Increase reflects initiation of the Information Based Multi-level secure Mosaics (IBM2), Composable Logistics and Information Omniscience (LogX), Decomp/Recomp programs, and classified program expansion.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Defense Advanced Research Projects Agency			Date: March 2019
Appropriation/Budget Activity 0400 / 3	R-1 Program Element (Number/Name) PE 0603760E / *COMMAND, CONTROL AND COMMUNICATIONS SYSTEMS*	Project (Number/Name) CCC-02 / *INFORMATION INTEGRATION SYSTEMS*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
CCC-02: *INFORMATION INTEGRATION SYSTEMS*	-	45.168	105.316	133.539	-	133.539	112.617	181.705	204.268	210.270	-	-

A. Mission Description and Budget Item Justification

The success of military operations depends on timely, reliable, secure, and synchronized dissemination of command and control and relevant situational awareness information to every military echelon. While wired communications and networks are fairly well developed, providing assured high-bandwidth mobile wireless capabilities that match or exceed commercial wired infrastructure is needed to meet the demands of military users. The goal of the Information Integration Systems project is to develop and demonstrate technologies that will provide effective communications to U.S. forces. Approaches to this goal include developing technologies in these areas:

- High-Capacity Links technologies - enables greater back-haul capability.
- Advanced Networking technologies - supports resilience, adaptability, scalability, and composable systems to enable adaptive effects webs.
- Low Probability of Detection and Anti-Jam (LPD/AJ) technologies - provides assured communications in very high-threat environments.
- Novel Radio Frequency and Spectral Sensing (RF/SS) - supports efficient spectrum management in congested environments and detection of electromagnetic threats.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Secure Handhelds on Assured Resilient networks at the tactical Edge (SHARE)	13.042	28.996	22.942
Description: The goal of the Secure Handhelds on Assured Resilient networks at the tactical Edge (SHARE) program is to develop innovative networking and information sharing approaches that enable U.S. and coalition forces to coordinate tactical operations effectively, efficiently, and securely by eliminating today's prohibitive security cost and complexity barriers. SHARE will provide the level of security provided by today's communications systems, while managing trust at the tactical edge. Building upon the Spectrum Efficiency and Access program, which is budgeted in this PE/Project, and research into the use of commercial systems and infrastructure to support military operations, SHARE provides new opportunities for U.S. and coalition forces to gain and maintain a tactical advantage on the battlefield. Coordination includes providing all the information required to enable the command and control necessary to plan and execute operations in all phases of warfare. Technology from this program will transition to the Services and DoD Agencies that work with coalition partners. ***FY 2019 Plans:*** - Integrate and test multi-level, handheld software and new networking architecture supporting the sharing of information at multiple security levels. - Evaluate user interfaces with operational transition partners. - Conduct controlled, limited field experimentation on handheld devices, demonstrating multi-level secure information sharing and network security. - Develop and update automated network configuration software, ensuring compatibility with handheld and network approach.			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Defense Advanced Research Projects Agency		Date: March 2019
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603760E / *COMMAND, CONTROL AND COMMUNICATIONS SYSTEMS*	**Project (Number/Name)** CCC-02 / *INFORMATION INTEGRATION SYSTEMS*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
- Conduct system security assessment and compliance with overall program sharing and security objectives. ***FY 2020 Plans:*** - Conduct research and experimentation using SHARE software prototype that further supports creation of automated network configuration software. Experiments will test compatibility with existing operationally deployed handheld devices. - Conduct field experimentation during multiple DoD-sponsored coalition exercises to validate SHARE system security and performance. - Begin transition of SHARE software to DoD partners, e.g. the joint Tactical Assault Kit (TAK) development team, for follow-on software configuration management and accreditation for use on approved DoD handheld systems. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** The FY 2020 decrease reflects a shift from research to integration of SHARE technologies into existing handheld programs.			
Title: Dynamic Network Adaptation for Mission Optimization (DyNAMO)	14.643	20.965	18.985
Description: Wireless networks have evolved into complex systems having many configurable parameters and features, including link data rates, power settings, inter-network gateways, and security associations. The optimal settings for these features vary greatly depending on the mission for which the network is deployed and the environment in which it is operating. Currently, the majority of these features are optimized off-line for specific scenarios and assumptions and are pre-set before use in a mission. There is no capability for the settings to adapt if the actual mission or environment differs from the original assumptions used to configure the network. The problem is exacerbated in scenarios in which intelligent adversaries can affect the topology and operation of the network unpredictably and on short timescales. Furthermore, future operations will include multiple, different radios interconnected on the same platform, and those existing networks lack a common standard for interoperability. The DyNAMO program will develop software that addresses the incompatibilities preventing information sharing across independent airborne networks and develop new approaches to configure and control networks and networks of networks for operation in dynamic and contested environments. The program will address optimization within legacy and future military networks, interactions between networks, and availability of necessary network services to support mission success. Technologies developed under this program will transition to the Services. ***FY 2019 Plans:*** - Continue development and integration of initial instantiation of real-time optimization algorithms in radio hardware. - Conduct hardware-in-the-loop testing of integrated system with instantiations of inter-network coordination, mission-based control, and real-time optimization. - Integrate final instantiation of inter-network coordination, mission-based control, and real-time optimization algorithms in radio hardware. - Conduct ground test of integrated system.			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Defense Advanced Research Projects Agency		Date: March 2019
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603760E / *COMMAND, CONTROL AND COMMUNICATIONS SYSTEMS*	**Project (Number/Name)** CCC-02 / *INFORMATION INTEGRATION SYSTEMS*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
- Conduct field test of integrated system with instantiations of inter-network coordination, mission-based control, and real-time optimization to show the quantitative and qualitative value of DyNAMO for a variety of military missions. ***FY 2020 Plans:*** - Integrate program software into tactical radio hardware. - Demonstrate Army, Navy, and Air Force scenarios. - Demonstrate information hyperlayer over diverse networks with publish/subscribe services. - Complete final program demonstrations and transition activities that demonstrate both interoperability and ability to adapt to real-time degradations and changing user needs. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** The FY 2020 decrease reflects final demonstrations and completion of proof of concepts.			
Title: Geospatial Cloud Analytics (GCA) ***Description:*** The Geospatial Cloud Analytics (GCA) program will develop technology to access and analyze global-scale, multimodal geospatial data and pilot an analytics-as-a-service business model. Exploiting multiple sources and modalities at a global scale requires the development of technologies and systems that provide common access points to commercial data, computational power to preprocess data and make it exploitable by analytical tools, and new models supporting sensing and analytics as services, including sharing of tools and results between individuals and consortiums. GCA creates a capability for near real time monitoring of global events and change detection across various environments and warfighting domains, building upon the Secure Handhelds on Assured Resilient networks at the tactical Edge (SHARE) coalition warfighter information sharing program, also budgeted in this PE/Project. By exploiting the vast amounts of geospatial information from new commercial satellite constellations and other sources, GCA will create the technology foundations needed to provide global awareness of gray zone activities. It will do so by augmenting commercial capabilities with defense assets, not vice versa, and thereby will improve speed, agility, and scalability. Technology from this program will transition to the Services and DoD Agencies. ***FY 2019 Plans:*** - Analyze computational architectures and frameworks for GCA analytics services at global scale. - Demonstrate the ability of the software infrastructure to support global-scale analytics on relevant problem sets. - Demonstrate gray zone indicators and warnings for high-impact, destabilizing global events such as droughts, crop failures, and illegal fishing. - Experiment with approaches for offering analytics services for use by DoD users and others. ***FY 2020 Plans:*** - Create and test an analytics marketplace that combines the multi-source, multi-modality platform with global-scale analytics. - Demonstrate ability for DoD users to use the analytics services provided by the analytics marketplace.	7.032	21.965	19.993

Exhibit R-2A, RDT&E Project Justification: PB 2020 Defense Advanced Research Projects Agency		Date: March 2019
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603760E / *COMMAND, CONTROL AND COMMUNICATIONS SYSTEMS*	**Project (Number/Name)** CCC-02 / *INFORMATION INTEGRATION SYSTEMS*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
- Refine the analytics services and marketplace based on feedback from end users. - Begin development of additional future marketplace offers based on feedback from end users. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** The FY 2020 decrease reflects a shift from platform and software development into testing of the analytics marketplace.			
Title: Network Universal Persistence (Network UP) ***Description:*** Current radios send network control information and data using the same wireless link. This produces a common failure mode when that wireless link degrades. In many of today's military wireless networks, even brief wireless link outages create a loss of network connectivity that can take more than two minutes to recover once the wireless link is re-established. During these network outages, data transmission is not possible. Building on technologies explored in the Secure Handhelds on Assured Resilient networks at the tactical Edge (SHARE) program, also in this PE/Project, the Network UP program will develop and demonstrate radio technology that maintains network reliability through periods of frequent signal degradation that routinely occur in military operational environments. Isolation of critical control channel information in a separate, robust wireless link will allow creation of a protected control channel that can maintain network reliability even when the data channel is lost. The Network UP program will develop technology and a prototype system that enables military wireless networks to send data over dynamic, unstable wireless links. The program will develop approaches to separate the control and data planes across different wireless links and design and implement mechanisms to maintain synchronization across those separate links. Technologies developed under this program will transition to the Services. ***FY 2019 Plans:*** - Begin preliminary design of a radio architecture and supporting technology that implement separate control and data channels. - Begin preliminary design of network architectures and technologies that enable creation of a network with physically separated control and data links. - Begin early lab testing of radio and network architectures and technology approaches. ***FY 2020 Plans:*** - Demonstrate a communication system that provides reliable communications in the presence of jamming. - Demonstrate physical communications channel divided into two separate functions and radio frequency bands. - Complete design of radio architectures and build and test prototypes. - Complete design of network architectures and build and test prototypes. - Demonstrate radio architectures in highly mobile scenarios with large amounts of environmental attenuation. ***FY 2019 to FY 2020 Increase/Decrease Statement:***	-	12.377	20.964

Exhibit R-2A, RDT&E Project Justification: PB 2020 Defense Advanced Research Projects Agency		Date: March 2019
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603760E / *COMMAND, CONTROL AND COMMUNICATIONS SYSTEMS*	**Project (Number/Name)** CCC-02 / *INFORMATION INTEGRATION SYSTEMS*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
The FY 2020 increase reflects increased effort dedicated to prototype building and testing.			
Title: Protected Forward Communications (PFC)	-	12.593	19.580
Description: The collaborative application of combat power in ground tactical operations demands reliable exchange of rich information and precise coordination of actions across various echelons. These operations take place over three critical conversations: (1) to coordinate the actions of a local group, (2) to coordinate group and airborne assets, and (3) to interact with rear echelon command. The communication links over which these three conversations take place are at risk from jamming and geolocation operations conducted with increasingly sophisticated exploitation and denial technology employed by our adversaries. This problem is compounded by demands for ever-increasing capacity of these links. The Protected Forward Communications (PFC) program will build on technical advances in resilient, efficient, and aware communications technology to design a single communication architecture to protect all three conversations from jamming and geolocation. PFC builds on technology developed in the Secure Handhelds on Assured Resilient networks at the tactical Edge (SHARE) program, also budgeted in this PE/Project. PFC is generally applicable to small unit operations and is particularly relevant to the close air support (CAS) function typically executed by the Joint Terminal Attack Controller (JTAC) or Forward Air Controller (FAC). The PFC program will transition to the Services. ***FY 2019 Plans:*** - Commence algorithm design for implementation and control of all three communication techniques. - Begin concept validation through modeling and simulation. - Establish readiness of constituent link technologies for all three communication techniques. ***FY 2020 Plans:*** - Conduct simulation and modeling of systems in representative operating environments to assess resistance to geolocation and jamming. - Conduct system engineering reviews to ensure design readiness for further development. - Conduct experimental validation of key design elements. - Develop size, weight, and power estimates for complete prototype and complete system. - Produce fully qualified design of PFC communication system with data artifacts. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** The FY 2020 increase reflects a shift from modeling and simulation to experimental and demonstration validation.			
Title: Information Based Multi-level secure Mosaics (IBM2)	-	-	10.365
Description: Information Based Multi-level secure Mosaics (IBM2) will develop network and data management tools for automating establishment of cross-domain networks and managing information flow to support on-the-fly adaptive effects webs.			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Defense Advanced Research Projects Agency		Date: March 2019
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Today the operational configure time required to make systems share information in battle, even when using networks designed to interoperate, is on the magnitude of weeks to months, but effective joint multi-domain battle integration time is needed in minutes or faster. Technology advances are making it possible to pass messages across heterogeneous waveforms and networks, but there are no technologies today that can determine if it is the right data most important to end users and systems. Building upon technologies developed in the Dynamic Network Adaption for Mission Optimization (DyNAMO) program (budgeted in this PE/ Project), IBM2 will combine network management with information exploitation and fusion technology to route information in an understandable context, based upon information need and value. IBM2 also seeks to address multi-level security configuration issues that often add delays and limit interoperability. Technology developed by this program will transition to the Services. ***FY 2020 Plans:*** - Assess effectiveness of machine learning, artificial intelligence (AI) techniques for understanding context and information value at user, system, and mission nodes. - Begin development of algorithmic techniques for determining global information relevance and importance and converting it to local context. - Begin development of algorithms for auto-generating security labels for multi-level security gateways as appropriate for protecting sources. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** Increase in FY 2020 reflects program initiation.			
Title: Composable Logistics and Information Omniscience (LogX)	-	-	9.365
Description: The Composable Logistics and Information Omniscience (LogX) program will develop planning and execution software to enable resilient and survivable logistics. The software will integrate enhanced situational awareness, dynamic composition of sustainment options, and accelerated Course of Action (COA) development. Based upon technologies developed in the Prototype Resilient Operations Testbed for Expeditionary Urban Systems of Systems (PROTEUS) program (budgeted in PE 0603766E, Project NET-01), the LogX capability will allow users to achieve a more distributed and resilient logistics command and control (C2) system utilizing planned cloud-based data environments. The new capability will be tested in an experimental environment tied to current logistics datasets. Technologies from this program will be transitioned to the Services, combatant commands, including U.S. Transportation Command. ***FY 2020 Plans:*** - Initiate development of situational awareness, composition, and COA development tools. - Demonstrate standalone capability for using only enterprise situational awareness.			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Defense Advanced Research Projects Agency		Date: March 2019
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603760E / *COMMAND, CONTROL AND COMMUNICATIONS SYSTEMS*	**Project (Number/Name)** CCC-02 / *INFORMATION INTEGRATION SYSTEMS*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
- Begin integration of test environment with limited complexity logistics data set. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** The FY 2020 increase reflects program initiation.			
Title: Decomp/Recomp ***Description:*** A future Joint Multi-Domain Battle force must be able to interoperate amongst heterogeneous systems rapidly, as well as use those systems in new ways. The battle network must be able to access latent capability provided by existing systems to build and close a wide range of effects chains. Resources in the battlespace will need to be repurposed with minor modification in ways for which they may not have been initially designed to create new capability without resorting to traditional acquisition. The Decomp/Recomp program will develop technology to enable efficient software modification to enable the integration or adaptation of electronic military systems to create new capability rapidly. Using techniques developing in the commercial software community and building on insights developed in the System of Systems Integration Technology Experimentation (SoSITE) program (budgeted in PE0603766E/Project NET-01); technology developed under the Decomp/Recomp program will decompose existing programmable military electronic system software into building blocks that can be rapidly reassembled into new, interoperable functions. The program will ensure performance reliability meets mission expectations with minimal to no formal validation and verification. The program aims to provide this degree of integration and adaptation on mission-relevant timelines, hours to days instead of months to years. Technologies developed under this program will transition to the Services. ***FY 2020 Plans:*** - Begin to demonstrate, through modeling and simulation, ability to identify mission capability from component systems. - Begin development of automated processes to validate and verify that adapted applications perform as intended when installed during demonstrations. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** The FY 2020 increase reflects program initiation.	-	-	11.345
Title: 100 Gb/s RF Backbone ***Description:*** The proliferation of video, voice, chat, and other important data-streams on the battlefield is driving a need for higher capacity, reliable, assured, and all-weather communications that are deployable on a wide range of air, ground, and maritime platforms. The goal of this High-Capacity Links technologies program is to demonstrate a 100 Gigabit-per-second (Gb/s) radio frequency (RF) backbone that will meet the anticipated mid-term (within 3-10 years) wireless networking capacity needs of deployed military forces. A millimeter-wave (mmW) solution will provide high capacity and all-weather resiliency but presents technical challenges that include the generation of higher-order waveforms (beyond common data link), efficient power transmission, high-speed routing, and low-noise receivers. This program seeks to develop the constituent subsystems (waveform	3.233	2.433	-

Exhibit R-2A, RDT&E Project Justification: PB 2020 Defense Advanced Research Projects Agency		Date: March 2019
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603760E / *COMMAND, CONTROL AND COMMUNICATIONS SYSTEMS*	**Project (Number/Name)** CCC-02 / *INFORMATION INTEGRATION SYSTEMS*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
generation, efficient power amplifiers, and receivers) and spatial multiplexing architectures to construct an all-weather mmW 100 Gb/s backbone at half the SWaP consumption of the current Optical RF Communications Adjunct (ORCA) system. Technology developed under this program will transition to the Services and other government agencies. ***FY 2019 Plans:*** - Integrate prototype onto test aircraft and conduct air-to-ground testing. - Complete air-to-ground testing and conduct flight demonstrations. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** The FY 2020 decrease reflects program completion.			
Title: Spectrum Efficiency and Access ***Description:*** The Federal Government is working to transition large swaths of spectrum (up to 500 MHz) from Federal (DoD is the primary contributor) to civilian use for broadband telecommunications. The DoD will need more highly integrated and networked sensor and data capacity over the next decades and will therefore need new technology that requires less spectrum to operate. The objective of the Spectrum Efficiency and Access program is to investigate improvements in spectral reuse, such as spectrum sharing of sensor and radar bands with communication systems. The program will leverage technologies originally developed for radar anti-jam and interference mitigation that could enable spectrum sharing by allowing overlay of communications within the same spectral footprint. The approach will include exploring real-time control data links between radars and communications systems and developing the advanced waveforms and components to enable radars and communication networks to operate in close proximity. The ultimate goal is to turn the DoD spectrum loss into a net gain of up to hundreds of MHz in capacity. Technology from this program will transition to the Navy, Army, and Missile Defense Agency (MDA). ***FY 2019 Plans:*** - Demonstrate spectrum maneuver command and control concepts. - Finalize design of a system capable of dynamically controlling radio frequency signatures while maintaining high accuracy target tracking. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** The FY 2020 decrease reflects program completion.	6.059	5.987	-
Title: Communication in Contested Environments (C2E) ***Description:*** The Communication in Contested Environments (C2E) program sought to address communications problems anticipated in networked airborne systems in the mid-21st century. Expected growth in sensor systems, unmanned systems, and internetworked weapons systems strained the size of networks that current communications technology could support in the contested environment. As adversary capabilities advanced, the DoD needed new techniques to quickly and efficiently	1.159	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2020 Defense Advanced Research Projects Agency		Date: March 2019
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603760E / *COMMAND, CONTROL AND COMMUNICATIONS SYSTEMS*	**Project (Number/Name)** CCC-02 / *INFORMATION INTEGRATION SYSTEMS*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
accommodate better networking and improved communications capabilities, specifically communications systems with higher capacity, lower latency, greater jamming resistance, and reduced detectability. As part of Advanced Networking technologies efforts, the C2E program addressed these needs with a three-pronged approach: first, it developed heterogeneous networking capabilities and advanced communication technology for airborne systems. Low Probability of Detection (LPD), Anti-Jam (AJ), low latency, and high capacity communication protocols were developed. Second, the program created a government controlled and maintained reference architecture for communications systems that drew from commercial communication architectures. The defense contractor community built specific communications systems based upon this reference architecture. Finally, C2E created a government controlled development environment to allow for rapid refresh of communications technology and allowed third party native application and waveform developers to contribute their own communications technologies. Technologies from this program transitioned to the Navy.			
Accomplishments/Planned Programs Subtotals	45.168	105.316	133.539

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Specific programmatic performance metrics are listed above in the program accomplishments and plans section.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Defense Advanced Research Projects Agency			Date: March 2019
Appropriation/Budget Activity 0400 / 3	R-1 Program Element (Number/Name) PE 0603760E / *COMMAND, CONTROL AND COMMUNICATIONS SYSTEMS*	Project (Number/Name) CCC-06 / *COMMAND, CONTROL AND COMMUNICATION SYSTEMS*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
CCC-06: *COMMAND, CONTROL AND COMMUNICATION SYSTEMS*	-	58.409	80.668	98.595	-	98.595	76.264	57.633	11.408	0.000	-	-

A. Mission Description and Budget Item Justification

This project funds classified DARPA programs that are reported in accordance with Title 10, United States Code, Section 119(a)(1) in the Special Access Program Annual Report to Congress.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Classified DARPA Program	58.409	80.668	98.595
Description: This project funds Classified DARPA Programs. Details of this submission are classified. ***FY 2019 Plans:*** Details will be provided under separate cover. ***FY 2020 Plans:*** Details will be provided under separate cover. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** Details will be provided under separate cover.			
Accomplishments/Planned Programs Subtotals	58.409	80.668	98.595

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Details will be provided under separate cover.