Spectrum Collaboration Challenge

Phase 2 Frequently Asked Questions (FAQ)

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Revision 11

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Revision Summary

Section	Revision	Description	Date
Q50	11	Added	12/13/18
Q47-Q49	10	Added	11/9/18
Q40-Q46	9	Added	11/7/18
Q38-Q39 Q6	8	Added Clarified latency requirements	10/11/18
Q34-Q37	7	Added	10/1/18
Q26-Q33	6	Added	9/10/18
Q23-Q25 Q16-Q17 Q6	5	Added Corrected the performance threshold variable name Clarified requirement for transmission within bandwidth	8/30/18
Q13-Q22 Q6	4	Added Revised required throughput levels	8/8/18
Q10-Q12	3	Added	4/13/18
Q8-Q9 Q6	2	Added Clarified bandwidth for given SNR	3/29/18
Q1 – Q7	Initial		2/13/18

DARPA Spectrum Collaboration Challenge (SC2)
Phase 2 Frequently Asked Questions

Q50: Are teams that did not pass the Payline Criterion, as described in PE2 Scoring Procedures, eligible for prizes?

A50: All teams that qualified for PE2 and did not win a prize have the opportunity to submit updated CIRNs to be eligible for Prizes of $375,000. A team is eligible to win a prize if their submitted image passes the PE2 qualification test and the PE2 payline criterion. Prizes will be awarded in order, according to the team ranking established in PE2, until available funds have been exhausted.

Submissions are due January 11th, 2019 at 6:00 AM EST. Each evaluation against the PE2 payline criterion will be conducted using 5 CIRNs, as was done at PE2.

To collect a prize, teams are required to submit a technical paper, per the SC2 Rules. Teams will have 3 weeks from the date of their payline success notification to submit the technical paper and necessary payment information.

Q49: For PE2, may scenarios include interference sources which do not broadcast their spectrum usage via the CIRN Interaction Language (CIL)?

A49: Yes.

Q48: For PE2 scenarios which change the allowed center frequency and bandwidth, will Colosseum's center frequency during the scenario?

A48: No.

Q47: For PE2, how do incumbents indicate an incumbent gate violation using the CIRN Interaction Language (CIL)?

A47: The passive incumbent indicates gate violation in the threshold_exceeded field of the CIL Report Message and Violation Message.

The DSRC-like incumbent indicates the occurrence of a gate violation if mandate_count > mandates_achieved as indicated in the CIL Detailed Performance Message.

Q46: How is a Measurement Period (MP) scored if the total data offered to a radio in the MP is less than the specified *min_throughput_bps* Performance Threshold (PT)?

A46: During such a MP, the *min_throughput_bps* PT is reduced to match the offered data.

Q45: Are Measurement Periods (MPs) defined by the integer portion of the transmit time recorded in the .drc logs?

A45: No. The start of the first 1-second-long measurement period is defined by the match start time reported by Colosseum. Packets are attributed to 1-second-long MPs according to their sent timestamp relative to the match start time.

Q44: How many opportunities will teams be given to pass the Payline Round as defined in the PE2 Scoring Procedures document?

A44: Teams will be given at least 5 attempts. To the degree possible, teams will be given attempts with different ensembles.

Q43: Per the PE2 Scoring Procedures document, how are the number of IMs achieved in the baseline stage measured?

A43: $MO(t)$ is determined for the ensemble as outlined in the PE2 Scoring Procedures document. The MPs where $MO(t)$ achieves is maximum value are recorded (there may be more than one). The lead position's baseline stage score is defined as the maximum number of IMs achieved in any of those MPs. The number of IM's achieved by the non-lead position teams are taken from the same MP.

Q42: In scenarios in which incumbents also transmit data, are the incumbent's team's Individual Mandates (IMs) included into the calculation of $MO(t)$ as defined in the PE2 Scoring Procedures document?

A42: No.

Q41: In order to measure throughput performance per Q6, is the TRPR tool used?

A41: No. DARPA has developed custom tools which calculate throughput using logs produced by MGEN.

Q40: In order to measure throughput performance per Q6, how often is throughput calculated?

A40: Throughput is computed each Measurement Period (MP) as defined in the PE2 Scoring Procedures document.

Q39: Per Q19 and Q5, is there a complete list of all scenario bandwidths a CIRN will be asked to support for PE2?

A39: A CIRN may need support all of the following scenario bandwidths for PE2: 5 MHz, 8 MHz, 10 MHz, 20 MHz, 25 MHz, 40 MHz.

Q38: For PE2, What is the maximum total throughput requested of a single node?

A38: 25 Mbps.

Q37: What is the maximum value for *max_latency_s*?

A37: There is no upper bound on *max_latency_s*.

Q36: Can file transfers overlap such that a new packet burst occurs before *file_transfer_deadline_s* has elapsed from the previous burst?

A36: Yes.

Q35: For PE2, what is the maximum number of flows for a node to handle simultaneously?

A35: There is no upper bound on the number of flows a node may be requested to handle.

Q34: For PE2, must packets be delivered in-order to receive credit for packet delivery?

A34: No.

Q33: For PE2, will two transmit and two receive antennas be available in all matches?

A33: Yes.

Q32: For PE2, will the same *mandated_outcomes.json* file be supplied to all nodes within a network?

A32: Yes.

Q31: For PE2, will all IP traffic flows have a corresponding mandated outcome?

A31: Yes.

Q30: Per Q6, is it acceptable if a CIRN submission meets the specified total throughput, but fails to deliver all flows?

A30: Yes.

Q29: Will all scored IP-traffic flows use port numbers greater or equal to 5000?

A29: Yes.

Q28: For PE2, if the IP traffic flow persists across stage boundaries, can steady state period (SSP) times be met across stage boundaries?

A28: Yes.

Q27: When *scenario_center_frequency* in *environment.json* changes during a match, does this value supersede the value of *center_frequency* set in *colosseum_config.ini*?

A27: Yes.

Q26: For PE2, is the parameter *goal_set* in *mandated_outcomes.json* relevant to the score?

A26: This parameter is used only by the visualization engine and has no bearing on the score.

Q25: For PE2, will IP traffic flows include TCP traffic?

A25: No.

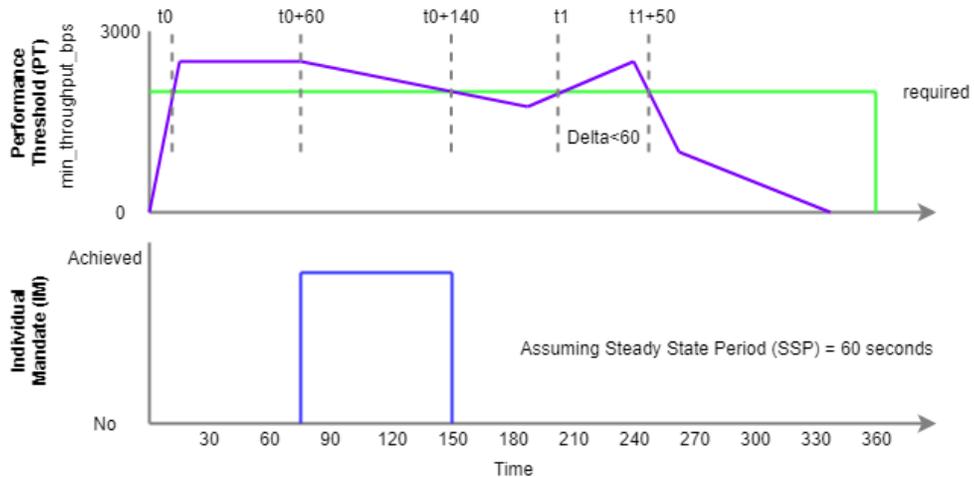## Q24: For PE2, will IP traffic flows include fragmented packets?

A24: No.

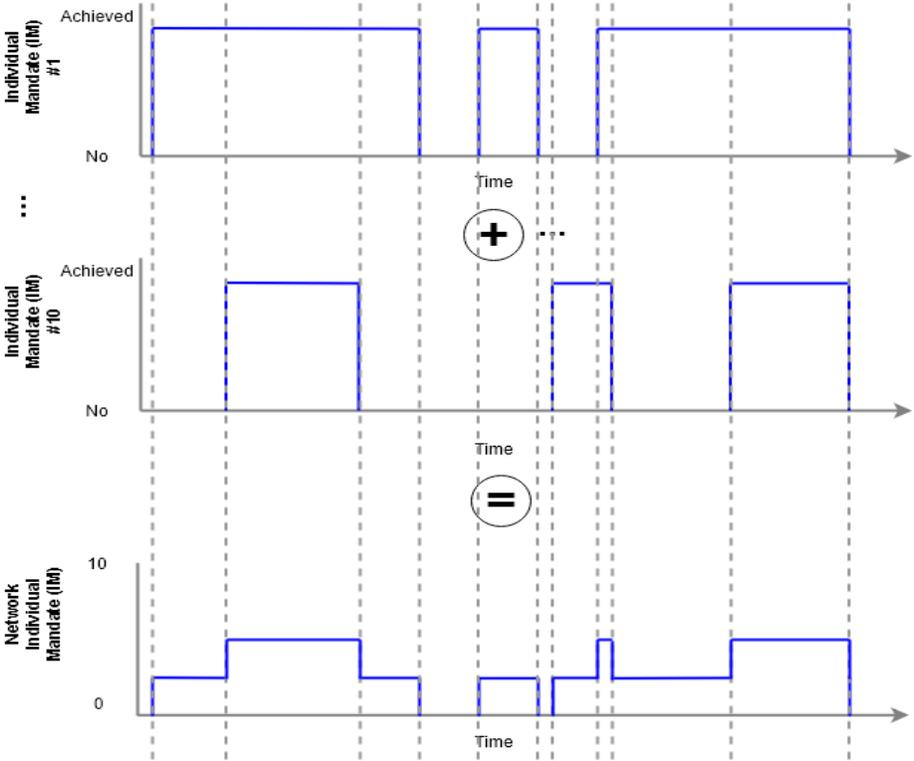## Q23: For PE2, how will file transfers be modeled?

A23: File transfers are modeled as a short burst of UDP packets whose aggregate payload is equal to the original file size.
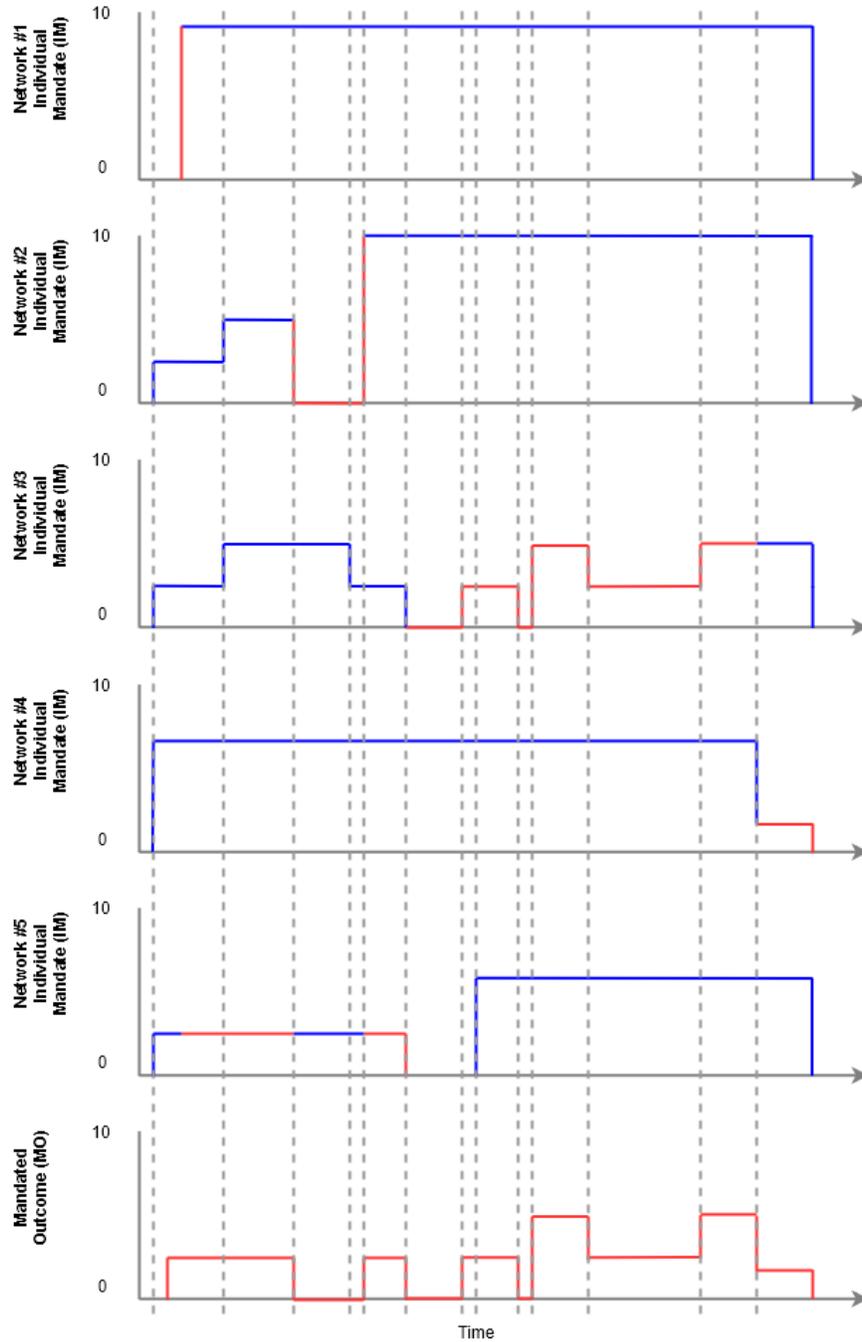
Q22: Can DARPA provide a scoring example consistent with the SC2 Phase 2 Scoring Procedures?

A22:

A Network's contribution is the sum of its IMs

Q21: Per the SC2 Phase 2 Scoring Procedures, what denotes the start of the earliest Measurement Period (MP) in a match?

A21: The earliest time that demarks the start of a Measurement Period is the official scenario start time provided by Colosseum in the match metadata.

Q20: Is a successfully delivered packet scored during the Measurement Period (MP) in which it originated, or the MP in which it was delivered?

A20: The originating MP.

Q19: For PE2, what is the minimum scenario bandwidth a CIRN must support?

A19: 5 MHz.

Q18: For PE2, what is the minimum expected value for *max_latency_s* per the SC2 Phase 2 Scoring Procedures, Section 3.2 Individual Mandates?

A18: 100ms.

Q17: For PE2, must a mandated outcome which specifies a ~~*max_packet_latency_s*~~ *max_latency_s* performance threshold (PT) also specify a *min_throughput_bps* PT?

A17: Yes.

Q16: For PE2, must all packets in a flow with a mandated outcome which specifies only a ~~*max_file_latency_s*~~ file_transfer_deadline_s performance threshold (PT) be delivered to achieve the Individual Mandate (IM)?

A16: Yes.

Q15: Will DARPA release a script or other executable scoring "program" which computes a match's score per the SC2 Phase 2 Scoring Procedures?

A15: No.

Q14: For PE2, what is the required number of nodes in a CIRN?

A14: 10.

Q13: Is the field *hold_time* in MandatedOutcomes.json equivalent to the Steady State Period (SSP) in the SC2 Phase 2 Scoring Procedures?

A13: Yes

Q12: Are protected incumbents' messages subject to collaboration channel degradation?

A12: Yes.

Q11: Can we rely on the flow ids in the mandated outcome JSON file matching the destination port number of the packets for PE2?

A11: Yes.

Q10: Is a CIRN permitted to transmit messages over the collaboration network identifying itself as an incumbent or a different team?

A10: No.

Q9: For PE2, will any scored matches disable the collaboration network?

A9: No.

Q8: For PE2, what characteristics (e.g., latency and throughput) will the collaboration network emulate?

A8: The collaboration network will emulate three sets of network characteristics:

Category	Throughput	Latency	Description
Wireline	No impairments	No impairments	Mimics wireline connectivity between gateway nodes
SATCOM	≤ 1Mbps	>500ms, <1000ms	Mimic gateway connectivity via a Satellite Communications (SATCOM) link
HF	≤ 10 kbps	< 5 secs	Mimics gateway connectivity via a long-haul HF (high frequency) link.

Q7: Are competitors wholly responsible for selecting all USRP settings, such as amplifier gain?

A7: Yes, each team's CIRN software is responsible for configuring all USRP settings. For convenience, a list of recommended USRP settings has been provided by the USRP hardware manufacturer (National Instruments) and is available at the following location:

https://sc2colosseum.freshdesk.com/support/solutions/articles/22000220403-optimizing-srn-usrp-performance

Q6: Per Section 3.2.1 of the SC2 Rules Document, what throughput performance must my CIRN achieve in order to qualify to participate in PE2?

A6: In order for a submitted CIRN design to qualify to participate in PE2, the 10-node CIRN must achieve the following specified aggregate data rates and latencies, using a 10MHz bandwidth, under the specified conditions:

SNR	Aggregate data rate achieved	Per packet latency achieved
5 dB	5 Mb/s	1.00 sec
10 dB	10 Mb/s	0.75 sec
15 dB	~~16 Mb/s~~ 15 Mb/s	0.50 sec
20 dB	~~23 Mb/s~~ 20 Mb/s	0.37 sec

This criteria will be tested in the following configuration:

- Each SNR condition will last 2 minutes
- The aggregate data rate must be consistently achieved over any consecutive 60 second period within the allotted 2 minutes per SNR
- The RF conditions will present the same approximate SNR between all nodes of the network
- UDP traffic given to each node will be sufficient to meet the required objective
- Every node in the network will be given the same offered load of data to transmit
- SNR given assumes a 10MHz bandwidth

Submissions which transmit outside the 10MHz of bandwidth (per the criteria outlaid in the PE2 Scoring Procedures Document) may be deemed ineligible.

Q5: During PE2, what is the maximum available frequency bandwidth a CIRN may transmit over without incurring a penalty for transmitting on a disallowed frequency?

A5: 40 MHz.

Q4: For PE2, what center frequency range will SRNs use?

A4: 900 MHz - 1100 MHz.

Q3: Will our CIRN be told how long a match will last?

A3: No. Information about match duration will not be provided to CIRNs.

Q2: May teams add or change members as the competition evolves through the phases?

A2: Yes, with the following restrictions:

1) A team may remove members at any point in the competition at the sole discretion of the team.

2) A team may add wholly new members at any point at the sole discretion of the team. Wholly new members are those that have not previously participated on any SC2 team.

3) A team may only add new team members who previously participated on another SC2 team under one of the following conditions:

- The new team member participated as a member of another team in a previous phase of SC2, and has not participated in the current phase.

- The new team member participated as a member of another team in a previous phase, and is changing teams during the allowed grace period, January 1 – March 31 of the next phase.

- The new team member participated as a member of another team which has formally disbanded or otherwise withdrawn from the competition.

4) Teams may not add team members who currently or previously participated as part of the SC2 DARPA team.

5) All team membership changes must be registered with DARPA SC2 Team via email to sc2@darpa.mil.

6) The registered team lead is the only person authorized to make membership changes.

Q1: During the competition, can we (humans) provide control input to our nodes?

A1: No. CIRNs must be fully autonomous.