



**IBM Systems Lab Services
and Training**



IBM MMT FAQ

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These MMT FAQ are divided into the following sections:

- MMT 1.0 Q&A
- MMT 1.5 Q&A
- MMT Cart Additional Q&A
- MMT Metrics

MMT 1.0 Q&A

Q1: What is MMT?

MMT has two meanings. The first meaning is IBM® Mobile Measurement Technology. It refers to the MMT cart used to make tens of thousands of temperature and humidity measurements in data centers at multiple elevations, but it also refers to the associated technology which includes additional measurements and the MMT data center thermal and energy efficiency analysis methodology.

Q2: What is the benefit to the customer of the MMT offering?

The MMT survey and analysis helps clients visualize and understand the thermal profile of their existing data center and IT power and cooling systems. Thermal trouble spots and energy inefficiencies are diagnosed and remedies are recommended, resulting in energy and dollar savings for the client. Additional details are provided further down.

Q3: What is the MMT cart?

The MMT cart is designed to take temperature measurements on each floor tile of a data center. It is assembled in layers with each layer having 9 thermocouples in a 3x3 array and one relative humidity sensor. The layers are at one foot intervals with the first layer at 0.5 ft off the floor. The cart is typically used with 8 layers extending from 0.5 ft to 7.5 ft from the floor, but is easily used with 7 or 9 layers, and can be used with 10 layers. The cart's width fits on a 24" or 600 mm floor tile. The cart depth is only slightly greater than a floor tile, primarily because of the notebook computer tray.

Q4: How is the MMT cart used in a data center?

The cart is pushed from floor tile to floor tile. When on a new tile, a button is pushed, and the readings are taken.

Q5: How is the cart data correlated with a position in the data center?

The notebook computer on the cart operates in live mode, displaying a map of the data center. The user indicates the starting tile and from there the software keeps track of the cart location using information from digital encoders on the rear two wheels of the cart. For example, if one wheel indicates motion and the other doesn't, the software knows the cart is turning and displays the new cart location. If the map indicates an incorrect cart location, for example after a long move, the user easily corrects the location.

Q6: What other MMT cart information is available?

Refer to the section below titled "MMT CART ADDITIONAL Q&A"

Q7: Besides the cart measurements, what other information is collected in an MMT data center survey?

The other measurements are all the air conditioning unit (ACU) return and discharge (or supply) temperatures, all the ACU airflow volumes, and all the perforated tile airflow volumes. The IT power readings are also collected and the data center equipment layout is surveyed with the IT equipment inlets noted.

Q8: How is the map of the data center obtained?

The map displayed by the notebook computer on the cart is generated from the data center equipment layout survey. Information provided by the client is generally used as the starting point for the layout survey, but the customer information is not sufficient by itself.

Q9: What if the data center has a slab floor instead of a raised floor?

A 2 ft x 2 ft grid would still be used, made possible by the map displayed on the notebook computer.

Q10: What is done with the data collected?

The temperature and humidity data is transformed into 3D maps of the data center. The data is analyzed using a set of metrics defined below. IT equipment inlet temperatures are identified and analyzed resulting in temperature histograms and hotspot charts. The ACU and IT power data is combined to determine the utilization of each ACU. The perforated tile and ACU flow measurements are combined to determine what percentage of the airflow is targeted to IT equipment. The perforated tile flow measurements are also plotted on a data center map. All of these results are combined and used to recommend actionable steps to remedy hotspots and inefficiencies and to aid future data center planning.

Q11: What type of recommendations are made based on the MMT 1.0 data center survey?

Energy savings recommendations focus on two areas: turning off ACU's and raising the chiller and ACU temperature set-points. These are based on the analysis described above. For example, without the detailed MMT inlet temperature analysis, raising the data center temperatures would be done blindly. Similarly, the combination of the ACU utilization analysis and hotspot analysis are used to determine which ACU's should be turned off. Addressing data center thermal issues is based on the same analysis.

Q12: Are there prerequisites to turning off ACU's and raising the data center temperatures?

Definitely. Before these steps are taken, the identified hotspots must be addressed and the raised floor sealing must be improved. The hotspots are analyzed and specific recommendations are made to address them.

Q13: How much energy can be saved by following the MMT recommendations?

The MMT recommendations have identified potential energy savings opportunities equivalent on average to 12% of the IT power or 23% of cooling power for data centers ranging from 4,000 to 85,000 square feet. Actual client results may vary.

Q14: Has the savings from an MMT engagement been validated?

Yes. IBM and a utility company combined to monitor the energy used by a data center as the MMT recommendations were implemented. The work was done in a data center of one of the utility's customers. The final conclusions are nearing completion.

Q15: What sort of payback or ROI is achieved from an MMT survey?

The MMT payback is potentially in the 6 month to 1 year range yielding a potential ROI of up to 100% after one year. Actual client results may vary

Q16: Are there other services that a client might want to purchase with the MMT? Why?

The MMT offering has yielded very positive results when combined with the Lab Services "Data Center Thermal Analysis and Optimization" offering. The MMT results are used to validate a baseline data center thermal simulation, then additional simulations are run to study the effect of various changes to the data center. These what-if scenarios can, for example, involve a suspended ceiling return, IT equipment repositioning or addition, cooling equipment repositioning or addition, use of partitions, use of rack mounted heat exchangers, and/or use of other supplemental cooling equipment.

Q17: How are the MMT results delivered?

The MMT results are delivered as presentation slides in a softcopy format. The results are presented during a teleconference, or on-line meeting or in a face-to-face meeting if included in the agreement.

Q18: Where is the MMT offering available?

IBM Lab Services teams cover the world. Personnel are located in the United States, Ireland, Japan, China and India. U.S. personnel are located in the West, Midwest and East regions and are deployed throughout the U.S. as needed.

Q19: Are there data centers for which the MMT is not an appropriate service?

Yes. This occurs when most of the racks in the data center draw airflow directly from under the raised floor so that the MMT cart cannot measure the rack inlet temperatures. If the data center has a combination of racks, some drawing airflow from above the floor and some from below the floor, and if there is a significant area and number of racks drawing air from above the floor, then deployment of the MMT cart is appropriate. If not, then we would offer a "Data Center Thermal Baseline Assessment" or "Data Center Thermal Analysis and Optimization" offering.

MMT 1.5 Q&A

Q1: What is the second meaning of MMT?

The second meaning is Measurement and Management Technology. It includes everything described for MMT 1.0 but it also extends the MMT technology to include real time sensors and on-line 7x24 results.

Q2: How would MMT 1.5 be summarized?

MMT 1.5 is a dynamic measurement-management system consisting of a network of real-time sensors installed at strategic locations throughout the data center. This solution is coupled to a software system to generate real-time energy efficiency reports, metrics and advanced visualization. Sensor positioning and modeling results are both built on an MMT 1.0 data center survey. The real-time data collected provides the vital information needed to effectively monitor and manage energy efficiency of the data center.

Q3: What types of sensors are included?

MMT 1.5 includes rack inlet temperature sensors, ACU return and discharge temperature sensors, ACU flow sensors (based on pressure), room humidity sensors and under floor pressure sensors.

Q4: What sensor technology is used?

Several sensor technologies can be used. The most generally used solution involves a wired grid and sensors using the "one-wire" protocol. The wired grid is deployed throughout the data center using ethernet-type cables. Junctions are installed at regular intervals. Sensors can be attached to the junctions as needed.

Q5: What are the advantages of the wired grid?

The advantages of the wired grid are inexpensive temperature sensors and reliability of the sensor network.

Q6: Does the wired solution lack flexibility when racks are moved, added or removed from the data center?

No, flexibility is provided by the grid covering the entire data center and by the junction connections at regular intervals.

Q7: How is the sensor data collected?

The sensors are connected to sensor hubs which have ethernet ports. The hubs are connected to a customer's computer referred to as the MMT Feeder. It feeds data on to the internet to the MMT Web Server which is located in IBM.

Q8: Are there security issues with the MMT Feeder connected to the internet?

There can be. To simplify the solution of the security issues, the MMT Feeder can be setup to only push data to the MMT Web Server and not respond to incoming requests.

Q9: How do customers see the MMT 1.5 results?

The MMT Client runs on the MMT Server. Customers log into the MMT Client to see their data center results. Access to their data is password protected.

Q10: What sorts of results are available on the MMT Client?

On the MMT Client customers see real time temperature maps at all levels, sensor readings, ACU utilization results, and ACU zones. They also receive alarm messages and can generate reports.

Q11: How are the temperature maps generated from sparse temperature sensors?

The temperature sensor readings are combined with the complete MMT 1.0 survey temperature map to update the map based on the current data.

Q12: What benefits does the customer receive from the MMT 1.5 data?

Real time 7x24 data allows the customer to maintain ongoing energy savings and to quickly address temperature hotspots and ACU and energy efficiency issues.

Q13: Where is the MMT 1.5 offering available?

It is currently available in the United States.

MMT CART ADDITIONAL Q&A

Q1: Are more details available about the cart temperature measurement capability?

Type K 40 gage thermocouples are mounted on 8" centers. The 3x3 thermocouple grid on one floor tile is joined to the grid on another tile by the same 8" spacing. The small thermocouple size minimizes the time the cart must spend on each floor tile. The dwell time from when the cart button is pushed to when data taking begins has been reduced to 3 seconds using the 40 gage thermocouples.

Q2: Do overhead cables or other obstructions cause problems?

No. Cart layers can be added or removed in the middle of a survey

Q3: How is the MMT hardware shipped to the customer's site?

The MMT hardware is shipped from IBM Yorktown, NY. The disassembled MMT cart fits in 3 shipping containers - 2 medium, 1 large. The airflow hood, meter and associated hardware are shipped in 2 suitcases - 1 small, 1 large. All 5 pieces can fit on one pallet. (This answer applies to U.S. shipping.)

Q4: Are MMT carts available for purchase or lease outside IBM?

No.

MMT METRICS

Q1: What are the MMT metrics?

The standard MMT metrics are the following 7 points.

Inlet Hotspots

- Identifies IT equipment with the hottest inlet temperatures; a rack has multiple inlet temperatures.

Horizontal Hotspots

- Uses the average rack inlet temperatures to compare the temperature distribution throughout the data center.
- Identifies under-cooled and over-provisioned areas.

Vertical Hotspots

- Uses the temperature difference between a rack top and bottom inlet temperatures.
- Identifies areas affected by recirculation of warm air from rack exhausts to server inlets.

Targeted Air Flow

- Percentage of air from ACU's directed through perforated tiles near rack inlets.

Plenum Temperature

- The flow-weighted average discharge temperature of the active ACU's is improved by turning off selected ACU's.

ACU Utilization

- The ratio of the heat removed by an ACU over the nominal ACU heat removal capacity.
- Identifies which ACU's can be turned off with the least impact.

ACU Flow

- Identifies ACU's providing low flow, typically caused by significant blockages impeding the discharge



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