I. Introduction/Overview [4:30]

Welcome to the MediaFLO Operations Center tour. My name is [ ] and I'll be your guide for this tour, which should last about 40 minutes.

A. Before we start, a few reminders:

1. You're welcome to take one of the MediaFLO USA brochures. They have information and diagrams to supplement the content of our tour.

2. Please set your cell phones to silent or meeting mode.

B. A few minutes on what MediaFLO USA is

MediaFLO USA is a wholly owned subsidiary of Qualcomm that aggregates and delivers premium, TV-quality entertainment and information services to mobile phones over its dedicated, nationwide wireless network via the FLO TV service.

We are wholesalers, providing wireless carriers a full, end-to-end service. We have agreements in place with content providers; NBC, CBS, ESPN, FOX Comedy Central, Nickeloden and MTV Networks to package and distribute their programming. We've built in the capacity to accommodate advertising. We encode the programs, ads, and guides in this building, and we have agreements with two of the top US wireless carriers; Verizon Wireless and AT&T/Cingular to transmit the programming over the air to their subscribers. The subscribers are using phones with a special chipset that can receive and decode the MediaFLO signal, allowing them to unleash the power of TV on their cell phones.

We describe ourselves as a wholesaler because we offer all of these services to wireless carriers, who in turn offer them at retail to their customers. Currently you can get the FLO TV service via Verizon's VCast Mobile TV for $15 a month. In addition, we have an agreement with AT&T/Cingular that will offer the FLO TV service to their subscribers at the end of this year.

C. What you'll see on this tour

This building is a kind of a funnel in which we ingest, store and transmit content – pass-through, sporting events, advertisements, channel guides and so forth. Our first stop will be right here where you see the workflow posters. Then we will go into visit:

1. The Live Events Room

where our engineers watch the ball games, concerts and other real-time events, and make sure that the broadcast goes out smoothly;

2. The Post-Production/QC/Ingest Room

where we review non-realtime content and schedule it into the broadcast feed;

3. The Broadcast (or Operations) Center

where several different teams monitor the status of the signal, the broadcasts and the MediaFLO network;

4. The Central Equipment Room

the data center where we have the racks of equipment to receive, encode and store the content that you'll ultimately see on your phone; and

Does anybody have any questions so far?

II. Main Hall [7:00]

MediaFLO USA is the glue that binds an entire wireless value chain, from content providers to subscribers as you will see from these posters. The posters depict the main steps and technologies involved in getting programs from our content providers, such as the show "24" which is broadcast via Fox Mobile, all the way to your mobile device. You'll see that several posters feature a section called "Workflow," so let me explain each of these posters, starting with the one on the far left.

A. MediaFLO flowchart

1. Content/Downlink

The first step is the Content/Downlink step. Content comes to us in this building from the source via high-speed fiber connection or via satellite.

We have enough capacity in the MediaFLO network to deliver a total of 20 network services, which you can think of as channels on a television. We also have the ability to originate up to 8 of those network services for our own use or to assist content providers.

So, in Content/Downlink, providers send us not only the content, but also the data we need for the channel guide.

2. Programming

The next step is programming. Like any broadcast facility, we schedule the content by content provider.

Keep in mind, though, that while you may be watching a Comedy Central show on your phone, it's not necessarily the same show running on the Comedy Central cable channel at that moment. This is because MediaFLO content is all "made for mobile." Comedy Central and others provide unique packages of their content, and we optimize the broadcast time of those packages for our network. We've obtained special rights for broadcasting this content to wireless devices.

3. Review

Depending on the source, we handle the content differently.

a) Pass-through content.

Most of the MediaFLO content you'll see on your phone is pass-through content: We ingest it in the Central Equipment Room and send it on to the network for viewing.

b) Live content such as sporting events and concerts.

Because live events are unpredictable, we monitor the feed carefully before sending it out. We'll see that operation in a moment in our Live Events Room.

c) Non-realtime content like spots, originated content and ads for insertion into programming.

We also receive non-realtime content—some by satellite, some on physical media such as DVD. We review it in our Post-Production/Ingest Room—which I'll also show you in a moment—and store it on video servers in the Central Equipment Room for later broadcast.

4. Ad Insertion

The next step is ad insertion. Mobile content is a bonanza for advertisers trying to increase their reach, and MediaFLO makes it easy for them to reach the mobile audience.

Most content that is made for mobile comes with ad triggers, so we can insert ads in real time and during the content feed.

5. Operations Center

Next, the Operations Center is where our support and operations teams monitor the broadcast and services 24-by-7. They can examine and troubleshoot at all points along the network, from the point at which the signal leaves this building to how the programming looks on the handset.

6. Core Technology

We describe the next step as "Core Technology;" it's what goes on in our Central Equipment Room or data center. A lot of the secret sauce in MediaFLO surrounds our method of encoding the content to use as few bits as possible to deliver the audio and video. We also wrap the feed in an Over-The-Air interface for efficient delivery to the handset. This requires a lot of computing and storage and throughput, and the muscle for all of that is our core technology.

7. Uplink to Satellite

Now that the content is scheduled, with ads inserted and the feed encoded, we send the signal via fiber to satellite antennas here at Qualcomm. From there, the signal is uplinked to a high-powered KU-band satellite—an Intelsat Galaxy 28, formerly known as IA-8. The satellite's coverage is complementary to the area in which we could operate with our FCC licenses throughout the United States and Puerto Rico.

8. Broadcast Transmitters

From the satellite the signal returns to Earth, where it's picked up by existing television transmitter sites. MediaFLO is a US operator broadcasting on UHF channel 55 from sites like mountaintops, tall buildings and tall towers all across our service area. So we co-locate our transmitters with existing broadcasters to take advantage of infrastructure like access, roads and power lines. We radiate with approx. 50,000 (LIRP) watts of broadcasting power from each site. This broadcast is much more powerful than cellular base stations, so we can cover a large metropolitan area with just a few transmitters—say, 1 to 7. This is much less infrastructure than a cellular network requires.

9. Mobile Devices

Finally, the signal arrives at the phones. The phones contain special Qualcomm chipsets developed by QCT (Qualcomm CDMA Technologies) to pick up, decode and process the Channel 55 signal and display it on the phone. You can think of the chips as a miniature set-top box inside your phone.

So that's the path the content follows, from the content provider all the way down to your phone. Next we'll go to the [whatever is next] Room, so if anybody has any questions, this is a good time for them.

III. Live Events Room [5:30]

A. Overview

This is our Live Events Room. Here we receive occasional feeds from various venues – sporting events, concerts – via satellite or fiber, and we monitor the events before we broadcast them.

From a broadcaster's perspective, when you do live events, things can get pretty crazy and unpredictable. Concerts get canceled or delayed, games get rained out, the team changes pitchers, the feed may drop...so you need to keep a close eye on the event and feed in real time because these are not full-time, persistent feeds like pass-throughs. It's not as easy as simply ingesting a pass-through feed and storing it.

The engineers in this room monitor the event as it's occurring. Any live event we broadcast over the MediaFLO network is first staffed and monitored by an engineer in this room. In here they have more flexibility with the content than with pass-through content because they need to record and store the event properly, allowing for bumps along the way.

B. Master control positions

So, you'll see that we have a total of five master control positions here. An Operations Engineer sits at each workstation and monitors the feed for an individual event. Each position corresponds to a different service, or channel, on the MediaFLO network. We can put one game or event on each of these positions, up to four. We use the fifth position as protector-guard position in case one of the positions or channels should fail; if the equipment at, say, position 2 failed, the engineer would get up, go to position 5 and resume monitoring his live event there.

C. Glass cockpit – monitor wall

The monitor wall, or glass cockpit, is entirely software-controlled: we can change names and labels, we can move monitors from one position to another with simple software configuration.

Notice that in some of the monitors we're seeing the feed at different points:

a) Here is the raw, clean, live source feed from the venue.

b) This one is the line output from this room to the broadcast center, which is a switched feed that allows me to insert spots or commercials before I send it to the broadcast center.

c) This one shows the uplink to the satellite.

d) And that one shows the return feeds coming back off the air, as it looks on the phone.

The monitors in that position, for example, are showing the same broadcast, with the few-second delay between points in the feed.

Let's say, then, that we're getting a live feed from a baseball game. The engineers in this room are dialed into a conference bridge, or IFB, with the broadcast staff at the ballpark, everybody is hearing the same instructions about the broadcast. The announcer says, "We'll be right back after these messages," which is known as a "natural out," and they cut to a wide shot of the ballpark, or give us some kind of cue that it's time for us to insert our ads. The engineers insert the ads to the switched feed going from this room to the broadcast center, then rejoin the raw feed from the ballpark at the end of the commercial break.

Since we're able to monitor these various points in the feed, we have a scheme for showing the status of the feed and locating problems when they arise. You'll see that each screen has a blue border, which is a status marker for audio and video.

a) A blue border means that both audio and video are good.

b) A yellow border indicates that the video is good but the audio is missing.

c) A red border around a green screen is bad news. It means that there is neither video nor audio.

D. Zero-day Delay

Finally, we have the ability to do zero-day delay, which are live events that we record for broadcast later that day. These are digital video recorders writing to hard drives, not tape, and they let us time-shift live broadcasts, something you can't yet do on the device.

So, we can record a game at 1:00 p.m. today – middle of the workday – and broadcast it over one of our reserved, dedicated channels tonight at 7:00 p.m. when subscribers have time to watch it. We can even send a reminder to your phone when the broadcast starts.

Now we'll go to our Ingest/Post-Production Room. Any questions so far?

IV. Ingest/QA/QC/Post-Production [2 :45]

A. Ingest Workstations

This is our Ingest/QA/QC/Post-Production area. As we bring in (or "ingest") non-realtime content, like advertisements or spot, we run quality assurance and quality control on it. Most of that content is on tape or in a digital file that we receive via fiber or satellite. We have an engineer who watches it to make sure that the video and audio are good enough for broadcast. We also time it so that our Traffic team can schedule it for broadcast. Then we store it on a server in the Central Equipment Room.

These are our ingest workstations. Our engineers work in a conventional broadcast environment, using digital Betacam and Betacam SP machines, DV machines and DVD players. We ingest here through our Omnibus automation system and store on Omnion play-to-air servers in the Central Equipment Room.

With these parallel workstations we can store two sets of content or two commercials at once and make them available to our Traffic team.

B. Edit Bays

In these Edit Bays we build internal media and cross-channel branding and promotion. For instance, we might place a spot in the middle of an NBC News broadcast announcing a baseball game later in the day: "Don't miss the Padres vs. Cubs game tonight at 7:00 on Channel 10." Since MediaFLO is aggregating content from so many providers, we can promote and advertise other pieces of content within MediaFLO, even when it's not in the same channel. Of course, we have to create these promotions ourselves, and we use these edit bays to do it.

In traditional television, promotion is *in-channel*; in MediaFLO we can promote *cross-channel*. This is especially useful for promoting premium content. For instance, while watching Comedy Central you might see a promotion for a rock concert tonight at 10:00 EST on MTV, $1.99 pay-per-view. Without these promotions, viewers wouldn't find out about the content unless they saw it while surfing the channel guide.

These edit bays are fully equipped Apple Final Cut Pro systems.

Now we'll go to the Operations Center. Does anybody have questions?

V. Opertations Center [8:45]

A. We staff five positions in the Center.

1. Supervisor

2. Broadcast Operations

They look at audio and video levels, and make sure that the program guide data is correct as it's being received on the handsets.

3. Network Operations

This team monitors network connectivity. They keep an eye on the transmitter sites to ensure they are on the air. They also monitor our servers here on site, to make sure that the networks are properly handling all of the transactions.

4. Technical Support

Our tech support team receives inbound calls from and makes outbound calls to wireless carriers to troubleshoot any problems or questions with the broadcast.

5. Engineer-in-Charge

The engineers-in-charge may or may not sit in here, because they have a shop right behind the wall. We have two-way radio communication with them and can summon them easily for escalations.

6. IT Operations (coming)

We'll also be adding an IT Operations team here in the Center to support our carrier relationships. They will monitor transactions from the carrier, and make sure that we're sending out license keys to the subscribers. They'll track subscriptions and authorization on the device.

B. Workstations

All of the workstation positions in this center are set up identically with everything needed for any position. Each workstation has:

1. KVM (keyboard, video, mouse) switching for connecting to and controlling any device in the back room through these monitors;

2. A wave form monitor vector scope, audio monitor and display system to examine any source or any return up on the wall; and

3. A docking station and monitor for their staff laptops with access to the Web, e-mail, Microsoft Office, etc.

Any questions so far?

C. Monitor wall

The monitor wall is the part of the center that really catches the eye. There are 22 separate monitor panels on the wall. Each one is a 50-inch HDTV, 1900x1200 pixel resolution, that is actually projected from behind the wall onto the screen. All of these displays are software-controlled and completely configurable. They are LCD-projection systems with primary and backup units.

I'll explain some of the monitors to you.

1. Timeline – Automation Schedule

This graph depicts the times of day at which each show is aired.

2. RF signal

This is the RF signal coming back from the satellite, as shown on a spectrum analyzer. It shows us the health of the signal as it comes back from the satellite, and whether there's any interference.

3. Earth station

We monitor our uplink from satellite dishes to the satellite in this display.

4. West Coast feed, East Coast feed

MediaFLO has the capacity to deliver 20 channels (called "services"). Each channel comprises audio and video. At the moment, Verizon is offering [x] of those services in their basic package. This monitor wall is split with an East and West Coast feed. East Coast is on the right and West Coast is on the left.

5. Upper monitor (in column of three)

This monitors the source as we receive it via satellite or fiber. Here, the source comes in at 720 x 480 resolution, 8 megabits per second. This is good resolution, but if we pushed all of our channels out at that resolution, we wouldn't have enough capacity for 20 channels, so the core technology implemented in our Central Equipment Room encodes and compresses the feed first.

6. Middle monitor

So this monitor shows us the image after encoding but before uplink to satellite. We scale it down to 320 x 240 resolution so that we can fit about 20 channels into our band.

7. Bottom monitor

This shows the image as it arrives at the transmitter sites from the satellite. Notice the delay among the monitors: There's about 15 seconds of latency from the moment our signal starts until the moment it lands on the phone, and most of it—about 12.5 seconds—is taken up by the encoding process.

8. Pass around the handsets

Speaking of the phone, I have some handsets here so that you can see what MediaFLO looks like on the device. You're watching Media FLO's broadcast on these phones as subscribers in our service areas are able to do right now. [Give them a couple of minutes to ogle.]

Any questions so far?

9. Omnivore monitor

I'm going into a bit more technical detail for you now.

Currently, MediaFLO packs 20 channels into a 6-megahertz band of spectrum. In time we may add more channels as technology improves, but for now we've settled on 20. In any given second we can push 6 megabits, or 6 million bits of data, into that band. We've set limits such that each service takes at most 500 kilobits per second, but the average bit rate, after we've encoded and compressed the feed, is 250-350 kilobits per second.

Have a look at Omnivore, our service bit rate monitor. The bars illustrate the bit rate of each service at any given second, so we can see how much capacity each service is using. The lower, yellow region is audio, and the blue is video—you can see how much more capacity is required by video than by audio.

Now, if you look at what's playing on NBC NEWS2GO right now, you'll see just a commentator with a constant background, so the blue video bar is relatively steady and the bit rate is low. But if you look at the basketball game on ESPN, where the entire picture is changing almost constantly, the blue video bar is fluctuating and the bit rate is high.

Omnivore also displays the superframe at bottom, which displays everything in our 6-megahertz band at any given time. So we can see everything we're sending up to the satellite and out to devices.

10. Statmon Display

Finally, this Statmon display is a national roll-up showing the status of the hundreds of transmitters across our coverage area. It's superimposed on the National Weather Radar display and shows all of the transmitter sites at which we're co-located.

These transmitters are usually 50,000 watts of power, which is typical for broadcast. We can drill in on each transmitter tower for stats like operating power, coolant temperature, air temperature, humidity, bit rates and the strength of the signal as its received from the satellite. It will also tell us if a component breaks down inside our transmitter.

Next we'll have a look in the Equipment Room, so does anybody have any questions about the Operations Center?

VI. Central Equipment Room [4:30]

Here in the Central Equipment Room we have built a data center to receive, store, encode and transmit the content we've been talking about today.

A. We've put a lot of contingency planning into this.

1. We have 107 equipment racks, with primary and backup units for all MediaFLO functions.

2. The center has 10 CRACs (Computer Room Air Conditioning) units. We can run on as few as four of them, so even if we lost half of our air conditioning capacity, we could still keep the Equipment Room cool. The compressors for the CRACs are outside the building.

3. We've laid out the Equipment Room with what's known as cold-row-hot-row. The front row is cold and the air comes out of the floor and through the racks. The hot air goes out the back and is sucked up into the ceiling, then out to the air conditioner.

4. Every rack has two power systems, known as A-B power. If you look in the back of each rack you'll see red wires for primary and blue for backup.

5. We also have battery backup, with one million watts of battery backup on system A and another million watts of battery backup on System B.

6. On top of that we have a 1.25-million-watt generator outside the building, with a 2.5-day supply of fuel.

B. All racks follow a standardized wiring scheme.

All wires are numbered and all racks are labeled so we can tell where each cable goes to and from. The cables follow a color-coding scheme also, corresponding to the several networks that run through the Operation Center:

1. Orange – satellite feed

2. Yellow – serial digital interface, like a tape machine

3. White – Qualnet network

4. Yellow – creative network

5. Blue - Production network

C. Ad storage servers

This set of racks is where we store ads, commercials and spots that we drop into the feed.

D. Satellite receivers

These racks contain receivers dedicated to each service (Nick, Comedy, MTV, Weather, etc.). The signal comes right off of the satellite antenna, gets decoded in this device, then the output from this device gets routed into the MediaFLO encoder.

E. Broadcast core

In these racks is our broadcast core, where we move all of our signals around at 270Mbps. Even if the core router were to fail, we can bypass it using failover devices.

F. QA/QC positions

We have devices all over the center for displaying on-air signals so that we can tell if a signal should drop.

G. MediaFLO core

These racks contain the MediaFLO core, where the encoding and compression take place. We scale the picture from 720 x 480 down to 320 x 240, then compress it and encode it. These are dual Quad processor systems, so eight CPUs, for processing about 5 million lines of code per second to perform the work of compressing the signal from as high as 8 megabits per second down to the 250-350 kilobits per second that I mentioned in the Operations Center.

H. IT core

These racks contain the business systems and servers we use for billing. We maintain databases of on-air transactions so that we know how much to bill the carriers, and so that they, in turn, know how much to bill their subscribers.

We also issue license keys between the carrier and MediaFLO. So, once you've subscribed, we send your license key to Verizon, who makes a call to your phone to download the key so that you can watch the content on your phone.

I. Redundant systems

Back here we're building out another set of redundant systems—what we call "double-double"—so that when we need to do software upgrades, we can switch to these systems and upgrade the main ones without losing service.

J. Fire protection

Here you can see the dual fire-protection systems we're running in the center.

1. The FM 200 system would dump inert gas into the room and smother the fire. The room would be fogged up and the equipment would shut down.

2. Then, if the FM 200 didn't extinguish the fire, the backup system would kick in. By default, the overhead sprinkler system is filled with compressed air, but in the backup system, smoke detectors would cause the sprinkler system to be loaded with water.

VII. East Corridor—Outside of Building, Content Production

A. Fan coil units for CRACs

B. Satellite pad [currently under construction]

C. Content Production Area

Here in the Content Production Area we select content for clipcast and datacast, both of which are decoded on the handset. To the subscriber they look just like a video channel, but with much lower bandwidth requirements. It's picture or text data going out over the network on channels reserved for MediaFLO.

Clipcast is a store-and-forward application. We would download the clipcast to your phone in the middle of night and store it there for replay at a convenient time. It shows up like a regular channel in your program guide. This requires a subscription.

Datacast is a persistent IP stream.

Appendix

VIII. Introduction

A. Where did MediaFLO come from???

Wireless carriers are always looking for new ways of boosting ARPU and differentiating their offerings from those of other carriers, and video on the phone has been evolving gradually over several years. Broadcasters and advertisers have looked to the cell phone as a "fourth screen" (after cinema, television and computer). Device manufacturers want innovative offerings with which to induce customers to upgrade. And consumers are always multitasking and seeking new ways to be efficient.

But there have been technical and business hurdles to overcome, such as bandwidth, battery life, cost of deployment, storage, subscriber licensing, billing, and quality of playback on the phone. MediaFLO has emerged as the premier solution for pulling together everybody along the value chain and unleashing the power of TV on mobile phones.

B. How is MediaFLO different?

Has anybody here watched programming or clips on the phone? There are currently available services, but the biggest problem is that they have to move on the same busy network as your voice and data calls, so most video is limited to short clips that you can download on demand. Another big problem is that these networks are designed for one-to-one communication – known as unicasting – so they don't have the bandwidth to transmit rich, full-length content to millions, or even thousands, of users.

MediaFLO is different in that it moves on a dedicated, one-to-many, multicasting network. MediaFLO USA is building out a network of towers and transmitters around the USA that operate in the 700 MHz range on what TV broadcasters know as Channel 55. Special chips in the phone act like a set-top box to receive and decode the MediaFLO signal. This means that wireless carriers can offer a rich, mobile TV experience to a huge base of subscribers without burdening their existing networks. And, subscribers can watch TV on their phones without worrying about its effect on their voice and data calls.

I. Executive Briefing Center

In this room, MUI executives meet with MUI partners and representatives of companies all along the value chain I've described. We use the screens in here for airing promotional clips and slides. These windows are made of electric glass and can be switched between transparency and non-transparency to allow visitors a preview of the operations center.

II. Main Hall

A. Several pieces of the workflow come from QCOM

Conceptual Development

1. Foresight to acquire spectrum

    a) UHF Channel 55 – 5MHz band in the 700MHz range

    b) some markets are currently cleared and all should be cleared by Feb 2009

2. Encoding software

    a) compresses signal to optimize use of bandwidth and squeeze multiple services into it

3. Decoding hardware

    a) chips in phone (OTA receiver and MPEG4 decoder along with the phones CPU) act as a digital set-top box

    b) together with CPU chip, allow phone to receive and decode MediaFLO's UHF channel 55 signal

B. Physical plant

1. MUI currently occupies two buildings

    a) This one facility, Building E is 60,000 sft – on second floor houses executives, legal, finance, product management, marketing, hr, programming and advertising. The first floor houses production, operations, mgmt, etc.; it's a big platform for pulling together, storing, scheduling and pushing MediaFLO content onto the air

    b) The other building D contains 50,000 sft – field, IT, supply chain and site operations teams rolling out and supporting our transmitter sites across the country

2. Constructing a satellite co-locate Sat teleport behind Bldg. E

    a) Currently downlinking and uplinking through satellite antennas on other QCOM campuses in Sorrento Valley

3. Also building a disaster-recovery site in another city TBD

III. Live Events Room

A. Behind the glass cockpit [30:20]

1. Small equipment room: Servers, routers, fiber connections just for live events. We built it so that we weren't constantly running back and forth to the main equipment room.

IV. Operations Center

A. Multiple Networks in the center

We have three networks running in this center:

1. Broadcast Network

This network is closed, it doesn't touch the outside world, so it's insulated from viruses, hackers, etc. The broadcast network runs the core broadcast center in the back room.

2. Creative Network

This is a network with the Post-Production/Ingest Room we saw a few minutes ago. It's tied to the Broadcast Network through a gateway that keeps media separated from broadcast network core.

3. Qualnet

This is the network that we all use as Qualcomm employees for our laptops. It's tied to the Internet, but it has no access to or from Broadcast and Creative Networks.

4. Communications Network

We also have the communication network we use for telephones, intercoms and pagers to talk with people out in the field. We have backup systems and conference bridges as well. We don't rely on QCOM Corporate switches or infrastructure for our communication.

B. Hands on the handset

1. In the operations center we run a low-power transmitter because we won't be live on channel 55 in San Diego until mid-late 2007.